

METHODS AND APPARATUSES FOR LTM WITH EARLY TA ACQUISITION

TECHNICAL FIELD

[0001] The present disclosure relates to wireless communications, and more specifically to methods and apparatuses for a lower layer-Triggered Mobility (LTM) procedure with early timing advance (TA) acquisition. LTM may also be named as a L1/L2 lower layer-Triggered Mobility or the like.

BACKGROUND

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

SUMMARY

[0003] An article "a" before an element is unrestricted and understood to refer to "at least one" of those elements or "one or more" of those elements. The terms "a," "at least one," "one or more," and "at least one of one or more" may be interchangeable. As used herein, including in the claims, "or" as used in a list of items (e.g. a list of items prefaced by a phrase such as "at least one of" or "one or more of" or "one or both of") indicates an inclusive list such that, for example, a list of at least one of A, B, or C means A or B or C or AB or AC or BC or ABC (i.e., A and B and C). Also, as used herein, the phrase "based on" shall not be construed as a reference to a closed set of conditions. For example, an example step that is described as "based on condition A" may be based on both a condition A and a condition B without

departing from the scope of the present disclosure. In other words, as used herein, the phrase "based on" shall be construed in the same manner as the phrase "based at least in part on. Further, as used herein, including in the claims, a "set" may include one or more elements.

[0004] Some implementations of the present disclosure provide a user equipment (UE). The UE includes at least one memory; and at least one processor coupled to the at least one memory and configured to cause the UE to: receive, from a source cell of a first base station (BS), lower layer-triggered mobility (LTM) configuration information related to a candidate cell of a second BS, wherein the first BS is same as or different from the second BS; receive, from the source cell, an LTM cell switch command for triggering a cell switch procedure, wherein the LTM cell switch command includes at least one of: identifier (ID) information of the candidate cell; or an early timing advance (TA) value for the candidate cell; and perform the cell switch procedure towards the candidate cell upon receiving the LTM cell switch command and start a supervisor timer.

[0005] In some implementations of the UE described herein, the cell switch procedure is: a primary cell of a master cell group (PCell) switch procedure; or a primary secondary cell group cell (PSCell) switch procedure.

[0006] In some implementations of the UE described herein, if the cell switch procedure is the PCell switch procedure, the processor is configured to cause the UE to: connect to a cell of a third BS via re-establishment procedure upon an expiry of the supervisor timer; transmit, to the cell of the third BS, information indicating that a report for an LTM cell switch failure is available; receive a request for the report from the third BS; and transmit the report to the third BS.

[0007] In some implementations of the UE described herein, the report includes at least one of the following: the early TA value for the candidate cell; information indicating whether the cell switch procedure is a random access channel (RACH)-less based LTM cell switch or a RACH based LTM cell switch; information indicating whether the cell switch procedure is a RACH-less based LTM cell switch failure with configured grant (CG); information indicating whether the cell switch procedure is a RACH-less based LTM cell switch failure without CG; information indicating whether the LTM cell switch failure occurs;

a layer-1 (L1) measurement result for the source cell when the LTM cell switch failure occurs; or a L1 measurement result for the candidate cell when the LTM cell switch failure occurs.

[0008] In some implementations of the UE described herein, the early TA value for the candidate cell is obtained by the source cell via an early TA acquisition, and received by the UE from the source cell; the early TA value for the candidate cell is set as a fixed value; or the early TA value for the candidate cell is set as identical with a TA value of the source cell.

[0009] In some implementations of the UE described herein, the processor is configured to cause the UE to transmit, to the third BS, a total number of LTM executions towards the same candidate cell if subsequent LTM is supported.

[0010] In some implementations of the UE described herein, the total number includes: only a total number of successful completion of the cell switch procedure; or both a total number of the LTM cell switch failure and the total number of successful completion of the cell switch procedure.

[0011] In some implementations of the UE described herein, if the cell switch procedure is a PSCell switch procedure, the processor is configured to cause the UE to: transmit a secondary cell group (SCG) failure information message to a master node (MN) serving the UE upon an expiry of the supervisor timer.

[0012] In some implementations of the UE described herein, the SCG failure information message includes at least one of the following: information indicating an LTM cell switch failure; a layer-1 (L1) measurement result for the source cell when the LTM cell switch failure occurs; a L1 measurement result for the candidate cell when the LTM cell switch failure occurs; information indicating a RACH-less based LTM cell switch failure; information indicating a RACH-less based LTM cell switch failure with configured grant (CG); information indicating a RACH-less based LTM cell switch failure without CG; information indicating a RACH based LTM cell switch failure; or information indicating an expiry of the supervisor timer.

[0013] In some implementations of the UE described herein, at least one of the L1 measurement result for the source cell or a L1 measurement result for the candidate cell is encapsulated in a container of a radio resource control (RRC) message.

[0014] Some implementations of the present disclosure provide a processor for wireless communication, comprising at least one controller coupled with at least one memory and configured to cause the processor to: receive, from a source cell of a first base station (BS), lower layer-triggered mobility (LTM) configuration information related to a candidate cell of a second BS, wherein the first BS is same as or different from the second BS; receive, from the source cell, an LTM cell switch command for triggering a cell switch procedure, wherein the LTM cell switch command includes at least one of: identifier (ID) information of the candidate cell; or an early timing advance (TA) value for the candidate cell; and perform the cell switch procedure towards the candidate cell upon receiving the LTM cell switch command and start a supervisor timer.

[0015] Some implementations of the present disclosure provide a method performed by a user equipment (UE). The method includes: receiving, from a source cell of a first base station (BS), lower layer-triggered mobility (LTM) configuration information related to a candidate cell of a second BS, wherein the first BS is same as or different from the second BS; receiving, from the source cell, an LTM cell switch command for triggering a cell switch procedure, wherein the LTM cell switch command includes at least one of: identifier (ID) information of the candidate cell; or an early timing advance (TA) value for the candidate cell; and performing the cell switch procedure towards the candidate cell upon receiving the LTM cell switch command and starting a supervisor timer.

[0016] Some implementations of the present disclosure provide a base station (BS). The BS includes at least one memory; and at least one processor coupled to the at least one memory and configured to cause the BS to: receive a radio resource control (RRC) reestablishment request from a user equipment (UE) after a failure of a lower layer-triggered mobility (LTM) cell switch procedure occurs; and transmit an RRC reestablishment message to the UE.

[0017] In some implementations of the BS described herein, the LTM cell switch procedure is: a primary cell of a master cell group (PCell) switch procedure; or a primary secondary cell group cell (PSCell) switch procedure.

[0018] In some implementations of the BS described herein, the processor is configured to cause the BS to: receive, from the UE, information indicating that a report for an LTM cell

switch failure is available; transmit a request for the report to the UE; and receive the report from the UE.

[0019] In some implementations of the BS described herein, the processor is configured to cause the BS to transfer the report to a source BS of the source cell.

[0020] In some implementations of the BS described herein, the report includes at least one of the following: the early TA value for the candidate cell; information indicating whether the cell switch procedure is a random access channel (RACH)-less based LTM cell switch or a RACH based LTM cell switch; information indicating whether the cell switch procedure is a RACH-less based LTM cell switch failure with configured grant (CG); information indicating whether the cell switch procedure is a RACH-less based LTM cell switch failure without CG; information indicating whether the LTM cell switch failure occurs; a layer-1 (L1) measurement result for the source cell when the LTM cell switch failure occurs; or a L1 measurement result for the candidate cell when the LTM cell switch failure occurs.

[0021] In some implementations of the BS described herein, the processor is configured to cause the BS to receive, from the UE, a total number of LTM executions towards the same candidate cell if subsequent LTM is supported.

[0022] In some implementations of the BS described herein, the total number includes: only a total number of successful completion of the cell switch procedure; or both a total number of the LTM cell switch failure and the total number of successful completion of the cell switch procedure.

[0023] Some implementations of the present disclosure provide a processor for wireless communication, comprising at least one controller coupled with at least one memory and configured to cause the processor to: receive a radio resource control (RRC) reestablishment request from a user equipment (UE) after a failure of a lower layer-triggered mobility (LTM) cell switch procedure occurs; and transmit an RRC reestablishment message to the UE.

[0024] Some implementations of the present disclosure provide a method performed by a base station (BS). The method includes: receiving a radio resource control (RRC) reestablishment request from a user equipment (UE) after a failure of a lower layer-triggered mobility (LTM) cell switch procedure occurs; and transmitting an RRC reestablishment message to the UE.

[0025] Some implementations of the present disclosure provide a source base station (BS). The source BS includes at least one memory; and at least one processor coupled to the at least one memory and configured to cause the source BS to: transmit, to a user equipment (UE), lower layer-triggered mobility (LTM) configuration information related to a candidate cell of the UE; and transmit, to the UE, an LTM cell switch command for triggering a cell switch procedure from a source cell of the source BS towards the candidate cell, wherein the LTM cell switch command includes at least one of: identifier (ID) information of the candidate cell; or an early timing advance (TA) value for the candidate cell.

[0026] In some implementations of the source BS described herein, the processor is configured to cause the source BS to receive a report for an LTM cell switch failure from a third BS, wherein the report is transmitted by the UE to the third BS.

[0027] In some implementations of the source BS described herein, the report includes at least one of the following: the early TA value for the candidate cell; information indicating whether the cell switch procedure is a random access channel (RACH)-less based LTM cell switch or a RACH based LTM cell switch; information indicating whether the cell switch procedure is a RACH-less based LTM cell switch failure with configured grant (CG); information indicating whether the cell switch procedure is a RACH-less based LTM cell switch failure without CG; information indicating whether the LTM cell switch failure occurs; a layer-1 (L1) measurement result for the source cell when the LTM cell switch failure occurs; or a L1 measurement result for the candidate cell when the LTM cell switch failure occurs.

[0028] In some implementations of the source BS described herein, the processor is configured to cause the source BS to receive a secondary cell group (SCG) failure information message from the UE upon an expiry of a supervisor timer.

[0029] In some implementations of the source BS described herein, the SCG failure information message includes at least one of the following: information indicating an LTM cell switch failure; a layer-1 (L1) measurement result for the source cell when the LTM cell switch failure occurs; a L1 measurement result for the candidate cell when the LTM cell switch failure occurs; information indicating a RACH-less based LTM cell switch failure; information indicating a RACH-less based LTM cell switch failure with configured grant (CG); information indicating a RACH-less based LTM cell switch failure without CG;

information indicating a RACH based LTM cell switch failure; or information indicating an expiry of the supervisor timer.

[0030] In some implementations of the source BS described herein, at least one of the L1 measurement result for the source cell or a L1 measurement result for the candidate cell is encapsulated in a container of a radio resource control (RRC) message.

[0031] Some implementations of the present disclosure provide a processor for wireless communication, comprising at least one controller coupled with at least one memory and configured to cause the processor to: transmit, to a user equipment (UE), lower layer-triggered mobility (LTM) configuration information related to a candidate cell of the UE; and transmit, to the UE, an LTM cell switch command for triggering a cell switch procedure from a source cell of the source BS towards the candidate cell, wherein the LTM cell switch command includes at least one of: identifier (ID) information of the candidate cell; or an early timing advance (TA) value for the candidate cell.

[0032] Some implementations of the present disclosure provide a method performed by a source base station (BS). The method includes: transmitting, to a user equipment (UE), lower layer-triggered mobility (LTM) configuration information related to a candidate cell of the UE; and transmitting, to the UE, an LTM cell switch command for triggering a cell switch procedure from a source cell of the source BS towards the candidate cell, wherein the LTM cell switch command includes at least one of: identifier (ID) information of the candidate cell; or an early timing advance (TA) value for the candidate cell.

[0033] Some implementations of the present disclosure provide a distributed unit (DU) of a base station (BS). The DU includes at least one memory; and at least one processor coupled to the at least one memory and configured to cause the DU to: transmit, to a user equipment (UE), a physical downlink control channel (PDCCH) order for triggering an early timing advance (TA) acquisition related to a candidate cell, wherein the candidate cell is associated with a cell switch procedure; determine whether a failure of the early TA acquisition occurs; and transmit information indicating the failure of the early TA acquisition to a centralized unit (CU) of the BS if determining that the failure of the early TA acquisition occurs.

[0034] In some implementations of the DU described herein, the cell switch procedure is: a primary cell of a master cell group (PCell) switch procedure; or a primary secondary cell group cell (PSCell) switch procedure.

[0035] In some implementations of the DU described herein, the processor is configured to cause the DU to transmit at least one of the following to the CU of the BS: identifier (ID) information of the UE; or a timer length of a timing advance timer (TAT) associated with the early TA acquisition.

[0036] In some implementations of the DU described herein, in response to the occurrence of the failure, the processor is configured to cause the DU to: trigger an early TA re-acquisition related to the candidate cell; or retransmit, to the UE, the PDCCH order for triggering the early TA acquisition related to the candidate cell.

[0037] In some implementations of the DU described herein, the processor is configured to cause the DU to transmit at least one of the following to a CU of the BS: information indicating whether an early TA re-acquisition due to the occurrence of the failure is triggered; a total number of performing early TA acquisition for the candidate cell before the DU receiving the early TA value for the candidate cell; or a total number of transmitting PDCCH orders for triggering the early TA acquisition related to the candidate cell before the DU receiving the early TA value for the candidate cell.

[0038] Some implementations of the present disclosure provide a processor for wireless communication, comprising at least one controller coupled with at least one memory and configured to cause the processor to: transmit, to a user equipment (UE), a physical downlink control channel (PDCCH) order for triggering an early timing advance (TA) acquisition related to a candidate cell, wherein the candidate cell is associated with a cell switch procedure; determine whether a failure of the early TA acquisition occurs; and transmit information indicating the failure of the early TA acquisition to a centralized unit (CU) of the BS if determining that the failure of the early TA acquisition occurs.

[0039] Some implementations of the present disclosure provide a method performed by a distributed unit (DU) of a base station (BS). The method includes: transmitting, to a user equipment (UE), a physical downlink control channel (PDCCH) order for triggering an early timing advance (TA) acquisition related to a candidate cell, wherein the candidate cell is

associated with a cell switch procedure; determining whether a failure of the early TA acquisition occurs; and transmitting information indicating the failure of the early TA acquisition to a centralized unit (CU) of the BS if determining that the failure of the early TA acquisition occurs.

[0040] Some implementations of the present disclosure provide a first distributed unit (DU) of a first base station (BS). The first DU includes at least one memory; and at least one processor coupled to the at least one memory and configured to cause the first DU to: transmit a physical downlink control channel (PDCCH) order for triggering an early timing advance (TA) acquisition related to a candidate cell, wherein the candidate cell is associated with a cell switch procedure of a user equipment (UE); receive an early TA value for the candidate cell from a candidate DU of a second BS related to the candidate cell, wherein the first BS is same as or different from the second BS; store the early TA value for the candidate cell; and determine whether the early TA value for the candidate cell is valid.

[0041] In some implementations of the first DU described herein, the processor is configured to cause the first DU to determine whether the early TA value for the candidate cell is valid based on a timer or a threshold for a reference signal received power (RSRP), and wherein the processor is configured to cause the first DU to: if the timer expires, determine that the early TA value for the candidate cell is invalid; or if the RSRP change is greater than the threshold, determine that the early TA value for the candidate cell is invalid.

[0042] In some implementations of the first DU described herein, if the early TA value for the candidate cell is invalid, the processor is configured to cause the first DU to retransmit, to the UE, the PDCCH order for triggering the early TA acquisition related to the candidate cell.

[0043] In some implementations of the first DU described herein, the processor is configured to cause the first DU to transmit, to the UE, an LTM cell switch command for triggering the cell switch procedure towards the candidate cell, and wherein the LTM cell switch command includes at least one of: identifier (ID) information of the candidate cell; or the early TA value for the candidate cell.

[0044] In some implementations of the first DU described herein, the processor is configured to cause the first DU to: log time of transmitting the LTM cell switch command;

and transmit the time of transmitting the LTM cell switch command to the candidate DU related to the candidate cell.

[0045] In some implementations of the first DU described herein, the processor is configured to cause the first DU to transmit one of the following to a CU of the first BS or the second BS: time elapsed between reception of a firstly received early TA value for the candidate cell and time of triggering the cell switch procedure towards the candidate cell; or time elapsed between reception of a latest received early TA value for the candidate cell and the time of triggering the cell switch procedure towards the candidate cell.

[0046] In some implementations of the first DU described herein, the processor is configured to cause the first DU to transmit at least one of the following to a CU of the first BS or the second BS: information indicating whether an early TA re-acquisition related to the candidate cell is triggered, wherein the early TA re-acquisition is due to a determination of invalidity of a received early TA value for the candidate cell; a total number of performing early TA re-acquisition for the candidate cell due to the determination of the invalidity of an early TA value for the candidate cell; a timer length of a time alignment timer (TAT) used to determine whether the received early TA value for the candidate cell is valid; or a threshold related to a reference signal received power (RSRP) change used to determine whether the received early TA value for the candidate cell is valid.

[0047] Some implementations of the present disclosure provide a processor for wireless communication, comprising at least one controller coupled with at least one memory and configured to cause the processor to: transmit a physical downlink control channel (PDCCH) order for triggering an early timing advance (TA) acquisition related to a candidate cell, wherein the candidate cell is associated with a cell switch procedure of a user equipment (UE); receive an early TA value for the candidate cell from a candidate DU of a second BS related to the candidate cell, wherein the first BS is same as or different from the second BS; store the early TA value for the candidate cell; and determine whether the early TA value for the candidate cell is valid.

[0048] Some implementations of the present disclosure provide a method performed by a first distributed unit (DU) of a first base station (BS). The method includes: transmitting a physical downlink control channel (PDCCH) order for triggering an early timing advance

(TA) acquisition related to a candidate cell, wherein the candidate cell is associated with a cell switch procedure of a user equipment (UE); receiving an early TA value for the candidate cell from a candidate DU of a second BS related to the candidate cell, wherein the first BS is same as or different from the second BS; storing the early TA value for the candidate cell; and determining whether the early TA value for the candidate cell is valid.

[0049] Some implementations of the present disclosure provide a first centralized unit (CU) of a base station (BS). The first CU includes at least one memory; and at least one processor coupled to the at least one memory and configured to cause the first CU to: transmit lower layer-triggered mobility (LTM) candidate cell configuration associated with a candidate cell to a user equipment (UE); and transmit a random access channel (RACH) resource for an early timing advance (TA) acquisition to a source distributed unit (DU) managed by the first CU, wherein the candidate cell is associated with a cell switch procedure from a source cell of the UE towards the candidate cell.

[0050] In some implementations of the first CU described herein, the processor is configured to cause the first CU to receive information indicating a failure of the early TA acquisition related to the candidate cell from a DU of the BS managed by the first CU.

[0051] In some implementations of the first CU described herein, the cell switch procedure is: a primary cell of a master cell group (PCell) switch procedure; or a primary secondary cell group cell (PSCell) switch procedure.

[0052] In some implementations of the first CU described herein, the processor is configured to cause the first CU to receive at least one of the following from the source DU: identifier (ID) information of the UE; or a timer length of a timing advance timer (TAT) associated with the early TA acquisition.

[0053] In some implementations of the first CU described herein, if the candidate cell is related to a target DU of the BS, the processor is configured to cause the first CU to transfer at least one of the following to the target DU: the information indicating the failure; the ID information of the UE; or the timer length of the TAT associated with the early TA acquisition.

[0054] In some implementations of the first CU described herein, if the candidate cell is related to a second CU, the processor is configured to cause the first CU to transfer at least

one of the following to the second CU: the information indicating the failure; the ID information of the UE; or the timer length of the TAT associated with the early TA acquisition.

[0055] In some implementations of the first CU described herein, the processor is configured to cause the first CU to receive, from the source DU, first information including at least one of the following: information indicating whether an early TA re-acquisition due to the occurrence of the failure is triggered; a total number of performing early TA acquisition procedures for the candidate cell before the source DU receiving the early TA value for the candidate cell; or a total number of transmitting PDCCH orders for triggering the early TA acquisition related to the candidate cell before the source DU receiving the early TA value for the candidate cell.

[0056] In some implementations of the first CU described herein, the processor is configured to cause the first CU to receive, from the source DU, second information including one of the following: time elapsed between reception of a firstly received early TA value for the candidate cell and time of triggering the cell switch procedure towards the candidate cell; or time elapsed between reception of a latest received early TA value for the candidate cell and the time of triggering the cell switch procedure towards the candidate cell.

[0057] In some implementations of the first CU described herein, the processor is configured to cause the first CU to receive, from the source DU, third information including at least one of the following: information indicating whether an early TA re-acquisition related to the candidate cell is triggered, wherein the early TA re-acquisition is due to a determination of invalidity of a received early TA value for the candidate cell; a total number of performing early TA re-acquisition for the candidate cell due to the determination of the invalidity of an early TA value for the candidate cell; a timer length of a time alignment timer (TAT) used to determine whether the received early TA value for the candidate cell is valid; or a threshold related to a reference signal received power (RSRP) change used to determine whether the received early TA value for the candidate cell is valid.

[0058] In some implementations of the first CU described herein, if the candidate cell is related to a third CU, the processor is configured to cause the first CU to transmit at least one

of the following to the third CU: the first information; the second information; or the third information.

[0059] In some implementations of the first CU described herein, a timer length of a TAT used to determine whether the TA value for the candidate cell is valid is generated by the source DU, and wherein if the UE fails to complete the cell switch procedure from the source cell towards the candidate cell, the processor is configured to cause the first CU to transmit, to the source DU, information indicating that the cell switch procedure towards the candidate cell is failed.

[0060] Some implementations of the present disclosure provide a processor for wireless communication, comprising at least one controller coupled with at least one memory and configured to cause the processor to: transmit lower layer-triggered mobility (LTM) candidate cell configuration associated with a candidate cell to a user equipment (UE); and transmit a random access channel (RACH) resource for an early timing advance (TA) acquisition to a source distributed unit (DU) managed by the first CU, wherein the candidate cell is associated with a cell switch procedure from a source cell of the UE towards the candidate cell.

[0061] Some implementations of the present disclosure provide a method performed by a first centralized unit (CU) of a base station (BS). The method includes: transmitting lower layer-triggered mobility (LTM) candidate cell configuration associated with a candidate cell to a user equipment (UE); and transmitting a random access channel (RACH) resource for an early timing advance (TA) acquisition to a source distributed unit (DU) managed by the first CU, wherein the candidate cell is associated with a cell switch procedure from a source cell of the UE towards the candidate cell.

[0062] Some implementations of the present disclosure provide a target centralized unit (CU) of a first base station (BS). The target CU includes at least one memory; and at least one processor coupled to the at least one memory and configured to cause the target CU to receive, from a source CU of a second BS, information indicating a failure of an early timing advance (TA) acquisition related to a candidate cell or invalidity of an early timing advance (TA) value of the candidate cell, wherein the candidate cell is associated with a cell switch procedure from a source cell of a user equipment (UE) towards the candidate cell, and

wherein the source cell is related to the source CU, and the candidate cell is related to the target CU.

[0063] In some implementations of the target CU described herein, the cell switch procedure is: a primary cell of a master cell group (PCell) switch procedure; or a primary secondary cell group cell (PSCell) switch procedure.

[0064] In some implementations of the target CU described herein, the processor is configured to cause the target CU to receive at least one of the following from the source CU: identifier (ID) information of the UE; or a timer length of a timing advance timer (TAT) associated with the early TA acquisition.

[0065] In some implementations of the target CU described herein, the processor is configured to cause the target CU to transmit at least one of the following to a target DU managed by the target CU related to the candidate cell: the information indicating the occurrence of the failure; the ID information of the UE; or the timer length of the TAT associated with the early TA acquisition.

[0066] In some implementations of the target CU described herein, the processor is configured to cause the target CU to receive, from the source CU, first information including at least one of the following: information indicating whether an early TA re-acquisition due to the occurrence of the failure is triggered; a total number of performing early TA acquisition for the candidate cell before a source DU receiving the early TA value for the candidate cell; or a total number of transmitting PDCCH orders for triggering the early TA acquisition related to the candidate cell before the source DU receiving the early TA value for the candidate cell.

[0067] In some implementations of the target CU described herein, the processor is configured to cause the target CU to receive, from the source CU, second information including one of the following: time elapsed between reception of a firstly received early TA value for the candidate cell and time of triggering the cell switch procedure towards the candidate cell; or time elapsed between reception of a latest received early TA value for the candidate cell and the time of triggering the cell switch procedure towards the candidate cell.

[0068] In some implementations of the target CU described herein, the processor is configured to cause the target CU to receive, from the source CU, third information including

at least one of the following: information indicating whether an early TA re-acquisition related to the candidate cell is triggered, wherein the early TA re-acquisition is due to a determination of invalidity of a received early TA value for the candidate cell; a total number of performing early TA re-acquisition for the candidate cell due to the determination of the invalidity of an early TA value for the candidate cell; a timer length of a time alignment timer (TAT) used to determine whether the received early TA value for the candidate cell is valid; or a threshold related to a reference signal received power (RSRP) change used to determine whether the received early TA value for the candidate cell is valid.

[0069] In some implementations of the target CU described herein, the processor is configured to cause the target CU to transmit at least one of the following to a target DU managed by the target CU related to the candidate cell: the first information; the second information; or the third information.

[0070] Some implementations of the present disclosure provide a processor for wireless communication, comprising at least one controller coupled with at least one memory and configured to cause the processor to receive, from a source CU of a BS, information indicating a failure of an early timing advance (TA) acquisition related to a candidate cell or invalidity of an early timing advance (TA) value of the candidate cell, wherein the candidate cell is associated with a cell switch procedure from a source cell of a user equipment (UE) towards the candidate cell, and wherein the source cell is related to the source CU, and the candidate cell is related to the target CU.

[0071] Some implementations of the present disclosure provide a method performed by a target centralized unit (CU) of a first base station (BS). The method includes receiving, from a source CU of a second BS, information indicating a failure of an early timing advance (TA) acquisition related to a candidate cell or invalidity of an early timing advance (TA) value of the candidate cell, wherein the candidate cell is associated with a cell switch procedure from a source cell of a user equipment (UE) towards the candidate cell, and wherein the source cell is related to the source CU, and the candidate cell is related to the target CU.

BRIEF DESCRIPTION OF THE DRAWINGS

[0072] Figure 1 illustrates an example of a wireless communications system in accordance with aspects of the present disclosure.

[0073] Figure 2 illustrates an example of a user equipment (UE) 200 in accordance with aspects of the present disclosure.

[0074] Figure 3 illustrates an example of a processor 300 in accordance with aspects of the present disclosure.

[0075] Figure 4 illustrates an example of a network equipment (NE) 400 in accordance with aspects of the present disclosure.

[0076] Figure 5A illustrates a schematic diagram of an intra-CU intra-DU mobility scenario in accordance with aspects of the present disclosure.

[0077] Figure 5B illustrates a schematic diagram of an intra-CU inter-DU mobility scenario in accordance with aspects of the present disclosure.

[0078] Figure 5C illustrates a schematic diagram of an inter-CU mobility scenario in accordance with aspects of the present disclosure.

[0079] Figures 6-8 illustrate flowcharts of a method related to an LTM cell switch procedure in accordance with aspects of the present disclosure.

[0080] Figure 9 illustrates a schematic diagram of an MCG LTM procedure in accordance with aspects of the present disclosure.

[0081] Figure 10 illustrates a schematic diagram of an SCG LTM procedure in accordance with aspects of the present disclosure.

[0082] Figures 11-13 illustrate flowcharts of a method related to an LTM cell switch procedure in accordance with aspects of the present disclosure.

[0083] Figure 14 illustrates a schematic diagram of an LTM cell switch procedure in accordance with aspects of the present disclosure.

[0084] Figure 15 illustrates a schematic diagram of an LTM cell switch procedure in accordance with aspects of the present disclosure.

DETAILED DESCRIPTION

[0085] In general, when a UE moves from one cell to another cell, at some point a serving cell change needs to be performed. In the legacy, the serving cell change is done by explicit RRC reconfiguration signalling (e.g. a handover (HO) command) to trigger the synchronization of a target cell based on L3 measurements report. It leads to longer latency, larger overhead, and longer interruption time than beam level mobility. Therefore, in 3GPP, LTM was approved to change a serving cell via L1/L2 signalling, in order to reduce the latency, overhead and interruption time.

[0086] LTM is a procedure in which a BS receives L1 measurement report(s) from a UE, and on their basis the BS changes UE's serving cell by a cell switch command signaled via a MAC CE. The cell switch command indicates an LTM candidate cell configuration that the BS previously prepared and provided to the UE through RRC signalling. Then the UE switches to the target cell according to the cell switch command. The LTM procedure can be used to reduce the mobility latency.

[0087] In some cases, subsequent LTM may be supported. Subsequent LTM means subsequent LTM cell switch procedures between candidate cells where a UE does not need to be reconfigured by the network in between.

[0088] A supervision timer can be used to detect a failure of an LTM execution or an LTM cell switch procedure, wherein an LTM procedure fails if the LTM supervision timer expires, upon which a UE initiates an RRC connection re-establishment procedure. For example, legacy T304 timer is used as the supervision timer to supervision the LTM cell switch procedure.

[0089] "LTM candidate cell" refers to a candidate cell configured to a UE for LTM. There may be multiple LTM candidate cells prepared for the UE, where the LTM candidate cells may belong to the same or different candidate DUs.

[0090] "LTM candidate cell configuration" refers to a configuration associated with an LTM candidate cell. An LTM candidate cell configuration can be a complete LTM candidate cell configuration or a delta (difference) configuration with respect to an LTM reference configuration. Each LTM candidate cell configuration may be identified by an index, called as LTM candidate cell configuration index, LTM candidate configuration index, or other

names. In one example, the LTM candidate cell configuration index is LTM-CandidateId, which is used to identity an LTM candidate cell configuration.

[0091] "LTM Reference Configuration" refers to a configuration provided by the network to the UE that is common to all the configured LTM candidate cells. It is used by the UE to generate a complete LTM candidate cell configuration (i.e., by applying an LTM candidate cell configuration on top of an LTM reference configuration).

[0092] "Complete LTM Candidate Cell Configuration" refers to a configuration that contains all the necessary fields needed to perform an LTM cell switch procedure. This configuration can be an LTM candidate cell configuration itself or be generated by applying an LTM candidate cell configuration on top of an LTM reference configuration.

[0093] MCG LTM is a PCell switch procedure that the network triggers via a medium access control (MAC) control element (CE) based on L1 measurements. SCG LTM is a PSCell switch procedure that the network triggers via a medium access control (MAC) control element (CE) based on L1 measurements. The potential applicable scenarios of LTM include "intra-CU intra-DU LTM," "intra-CU inter-DU LTM," and "inter-CU LTM" as shown in Figures 5A-5C as described below.

- (1) Intra-CU intra-DU mobility: a UE moves between different cells within a DU.
- (2) Intra-CU inter-DU mobility: a UE moves between different cells belonging to different DUs but within a CU.
- (3) Inter-CU mobility: a UE moves between different cells belonging to different DUs different CUs.

[0094] Mobility Robustness Optimization (MRO) is to detect connection failures that occur due to Too Early or Too Late Handovers, or Handover to Wrong Cell. The general procedure is that after an RLF or handover (HO) failure happen, a UE may access a new cell by re-establishment or connection setup. Once the UE enters the connected state, the UE transmits an RLF report and a RACH report to the serving cell. The serving cell will transmit Failure Indication including the RLF report to the last serving cell. Finally, the information is used to optimize the mobility. One of the functions of MRO is to detect connection failures that occur due to Too Early or Too Late Handovers, or Handover to Wrong Cell.

[0095] Currently, for analysis of connection failures, a UE may make an RLF Report available to the network. The UE stores the latest RLF Report, including both LTE and NR RLF report until the RLF report is fetched by the network or for 48 hours after the connection failure is detected. For example, the UE only indicates the RLF report availability and only provides the RLF report to the network if the current RPLMN is a PLMN that was present in the UE's EPLMN List or was the RPLMN at the time the connection failure was detected. In case an RLF happens in an E-UTRA cell, the UE makes the LTE RLF Report available to NG-RAN nodes and eNB(s), and in case RLF happens in an NR cell the UE makes the NR RLF Report available to gNB(s). If the LTE RLF Report is reported to a NG-RAN node, and the last serving node is an E-UTRAN node, the NG-RAN node may transfer it to the E-UTRAN node by triggering the Uplink RAN configuration transfer procedure over NG and the E-UTRAN node can take this into account as defined in 3GPP TS 36.300 [2].

[0096] In 3GPP Rel-17, Successful Handover Report (SHR) is introduced for MRO of a PCell change procedure. In particular, the MRO function in NR needs to be enhanced to provide a more robust mobility via reporting failure events observed during successful handovers. A solution to this problem is to configure the UE to compile a report associated with a successful handover comprising a set of measurements collected during the handover phase, i.e. measurement at the handover trigger, measurement at the end of handover execution or measurement after handover execution. The UE could be configured with triggering conditions to compile a SHR, hence the report would be triggered only if the conditions are met. This limits UE reporting to relevant cases, such as underlying issues detected by RLM, or BFD detected upon a successful handover event.

[0097] Successful PCell change related information may be included in a SHR. The availability of a SHR may be indicated by the Handover Complete message (e.g. an RRC Reconfiguration Complete message) transmitted from a UE to target NG-RAN node over RRC. The target NG-RAN node may fetch information of a successful handover report via UE Information Request/Response mechanism. In addition, the target NG-RAN node could then forward the SHR to the source NR-RAN node to indicate failures experienced during a successful handover event.

[0098] Upon reception of a SHR, the receiving node is able to analyze whether its mobility configuration needs adjustment. Such adjustments may result in changes of mobility

configurations, such as changes of RLM configurations or changes of mobility thresholds between the source and the target. In addition, target NG-RAN node, in the executed handover, may further optimize the dedicated RACH resources based on the measurements reported upon successful handovers.

[0099] One objective for mobility enhancements in 3GPP Rel-18 is to specify an LTM procedure (i.e. a PCell or PSCell switch procedure triggered by the network via MAC CE based on L1 measurement). To improve mobility robustness, following issues regarding an MRO mechanism for an LTM procedure need to be considered, including, e.g. what is an MRO mechanism for an MCG/SCG LTM failure for an Intra-CU or Inter-CU mobility scenario, what is an MRO mechanism for a failure detection of an early TA acquisition for an Intra-CU or Inter-CU mobility scenario, and/or what is an MRO mechanism for determination of invalidity of an early TA value for an Intra-CU or Inter-CU mobility scenario. Currently, details regarding such MRO mechanism have not been discussed yet. Embodiments of the present disclosure aim to resolve the abovementioned issues.

[0100] Specifically, some embodiments of the present application study an MRO mechanism for an MCG LTM failure in which LTM is supported for an Intra-CU or Inter-CU mobility scenario. If an MCG LTM failure happens, a UE is expected to report assistant information for a network optimization purpose.

[0101] Some embodiments of the present application study an MRO mechanism for an SCG LTM failure for an Intra-CU or Inter-CU mobility scenario, in which once an SCG LTM failure happens, an SCG failure information message may be triggered. For example, assistant information related to the SCG LTM failure may be included in an SCG failure information message for a network optimization purpose.

[0102] Some embodiments of the present application study an MRO mechanism for a failure detection of an early TA acquisition for an Intra-CU or Inter-CU mobility scenario, in which a source DU is responsible for a failure detection of an early TA acquisition; a RACH resource for the early TA acquisition may be configured by a target DU; and a source DU is expected to report some assistant information for a network optimization purpose.

[0103] Some embodiments of the present disclosure study an MRO mechanism for determination of invalidity of an early TA value for an Intra-CU or Inter-CU mobility

scenario, in which a source DU is in charge of checking the validity of an early TA value related to a candidate cell. If the source DU determines that the early TA value is invalid, the source DU may transmit a PDCCH order for an early TA re-acquisition.

[0104] More details of the embodiments of the present disclosure will be illustrated in the following text in combination with the appended drawings.

[0105] Figure 1 illustrates an example of a wireless communications system 100 in accordance with aspects of the present disclosure. The wireless communications system 100 may include one or more NE 102, one or more UE 104, and a core network (CN) 106. The wireless communications system 100 may support various radio access technologies. In some implementations, the wireless communications system 100 may be a 4G network, such as an LTE network or an LTE-Advanced (LTE-A) network. In some other implementations, the wireless communications system 100 may be a NR network, such as a 5G network, a 5G-Advanced (5G-A) network, or a 5G ultrawideband (5G-UWB) network. In other implementations, the wireless communications system 100 may be a combination of a 4G network and a 5G network, or other suitable radio access technology including Institute of Electrical and Electronics Engineers (IEEE) 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20. The wireless communications system 100 may support radio access technologies beyond 5G, for example, 6G. Additionally, the wireless communications system 100 may support technologies, such as time division multiple access (TDMA), frequency division multiple access (FDMA), or code division multiple access (CDMA), etc.

[0106] The one or more NE 102 may be dispersed throughout a geographic region to form the wireless communications system 100. One or more of the NE 102 described herein may be or include or may be referred to as a network node, a base station, a network element, a network function, a network entity, a radio access network (RAN), a NodeB, an eNodeB (eNB), a next-generation NodeB (gNB), or other suitable terminology. An NE 102 and a UE 104 may communicate via a communication link, which may be a wireless or wired connection. For example, an NE 102 and a UE 104 may perform wireless communication (e.g. receive signaling, transmit signaling) over a Uu interface.

[0107] An NE 102 may provide a geographic coverage area for which the NE 102 may support services for one or more UEs 104 within the geographic coverage area. For example,

an NE 102 and a UE 104 may support wireless communication of signals related to services (e.g. voice, video, packet data, messaging, broadcast, etc.) according to one or multiple radio access technologies. In some implementations, an NE 102 may be moveable, for example, a satellite associated with a non-terrestrial network (NTN). In some implementations, different geographic coverage areas 112 associated with the same or different radio access technologies may overlap, but the different geographic coverage areas may be associated with different NE 102.

[0108] The one or more UE 104 may be dispersed throughout a geographic region of the wireless communications system 100. A UE 104 may include or may be referred to as a remote unit, a mobile device, a wireless device, a remote device, a subscriber device, a transmitter device, a receiver device, or some other suitable terminology. In some implementations, the UE 104 may be referred to as a unit, a station, a terminal, or a client, among other examples. Additionally, or alternatively, the UE 104 may be referred to as an Internet-of-Things (IoT) device, an Internet-of-Everything (IoE) device, or machine-type communication (MTC) device, among other examples.

[0109] A UE 104 may be able to support wireless communication directly with other UEs 104 over a communication link. For example, a UE 104 may support wireless communication directly with another UE 104 over a device-to-device (D2D) communication link. In some implementations, such as vehicle-to-vehicle (V2V) deployments, vehicle-to-everything (V2X) deployments, or cellular-V2X deployments, the communication link 114 may be referred to as a sidelink. For example, a UE 104 may support wireless communication directly with another UE 104 over a PC5 interface.

[0110] An NE 102 may support communications with the CN 106, or with another NE 102, or both. For example, an NE 102 may interface with other NE 102 or the CN 106 through one or more backhaul links (e.g. S1, N2, N2, or network interface). In some implementations, the NE 102 may communicate with each other directly. In some other implementations, the NE 102 may communicate with each other or indirectly (e.g. via the CN 106). In some implementations, one or more NE 102 may include subcomponents, such as an access network entity, which may be an example of an access node controller (ANC). An ANC may communicate with the one or more UEs 104 through one or more other access network

transmission entities, which may be referred to as a radio heads, smart radio heads, or transmission-reception points (TRPs).

[0111] The CN 106 may support user authentication, access authorization, tracking, connectivity, and other access, routing, or mobility functions. The CN 106 may be an evolved packet core (EPC), or a 5G core (5GC), which may include a control plane entity that manages access and mobility (e.g. a mobility management entity (MME), an access and mobility management functions (AMF)) and a user plane entity that routes packets or interconnects to external networks (e.g. a serving gateway (S-GW), a Packet Data Network (PDN) gateway (P-GW), or a user plane function (UPF)). In some implementations, the control plane entity may manage non-access stratum (NAS) functions, such as mobility, authentication, and bearer management (e.g. data bearers, signal bearers, etc.) for the one or more UEs 104 served by the one or more NE 102 associated with the CN 106.

[0112] The CN 106 may communicate with a packet data network over one or more backhaul links (e.g. via an S1, N2, N2, or another network interface). The packet data network may include an application server. In some implementations, one or more UEs 104 may communicate with the application server. A UE 104 may establish a session (e.g. a protocol data unit (PDU) session, or the like) with the CN 106 via an NE 102. The CN 106 may route traffic (e.g. control information, data, and the like) between the UE 104 and the application server using the established session (e.g. the established PDU session). The PDU session may be an example of a logical connection between the UE 104 and the CN 106 (e.g. one or more network functions of the CN 106).

[0113] In the wireless communications system 100, the NEs 102 and the UEs 104 may use resources of the wireless communications system 100 (e.g. time resources (e.g. symbols, slots, subframes, frames, or the like) or frequency resources (e.g. subcarriers, carriers)) to perform various operations (e.g. wireless communications). In some implementations, the NEs 102 and the UEs 104 may support different resource structures. For example, the NEs 102 and the UEs 104 may support different frame structures. In some implementations, such as in 4G, the NEs 102 and the UEs 104 may support a single frame structure. In some other implementations, such as in 5G and among other suitable radio access technologies, the NEs 102 and the UEs 104 may support various frame structures (i.e., multiple frame structures).

The NEs 102 and the UEs 104 may support various frame structures based on one or more numerologies.

[0114] One or more numerologies may be supported in the wireless communications system 100, and a numerology may include a subcarrier spacing and a cyclic prefix. A first numerology (e.g. $\mu=0$) may be associated with a first subcarrier spacing (e.g. 15 kHz) and a normal cyclic prefix. In some implementations, the first numerology (e.g. $\mu=0$) associated with the first subcarrier spacing (e.g. 15 kHz) may utilize one slot per subframe. A second numerology (e.g. $\mu=1$) may be associated with a second subcarrier spacing (e.g. 30 kHz) and a normal cyclic prefix. A third numerology (e.g. $\mu=2$) may be associated with a third subcarrier spacing (e.g. 60 kHz) and a normal cyclic prefix or an extended cyclic prefix. A fourth numerology (e.g. $\mu=3$) may be associated with a fourth subcarrier spacing (e.g. 120 kHz) and a normal cyclic prefix. A fifth numerology (e.g. $\mu=4$) may be associated with a fifth subcarrier spacing (e.g. 240 kHz) and a normal cyclic prefix.

[0115] A time interval of a resource (e.g. a communication resource) may be organized according to frames (also referred to as radio frames). Each frame may have a duration, for example, a 10 millisecond (ms) duration. In some implementations, each frame may include multiple subframes. For example, each frame may include 10 subframes, and each subframe may have a duration, for example, a 1 ms duration. In some implementations, each frame may have the same duration. In some implementations, each subframe of a frame may have the same duration.

[0116] Additionally or alternatively, a time interval of a resource (e.g. a communication resource) may be organized according to slots. For example, a subframe may include a number (e.g. quantity) of slots. The number of slots in each subframe may also depend on the one or more numerologies supported in the wireless communications system 100. For instance, the first, second, third, fourth, and fifth numerologies (i.e., $\mu=0$, $\mu=1$, $\mu=2$, $\mu=3$, $\mu=4$) associated with respective subcarrier spacings of 15 kHz, 30 kHz, 60 kHz, 120 kHz, and 240 kHz may utilize a single slot per subframe, two slots per subframe, four slots per subframe, eight slots per subframe, and 16 slots per subframe, respectively. Each slot may include a number (e.g. quantity) of symbols (e.g. OFDM symbols). In some implementations, the number (e.g. quantity) of slots for a subframe may depend on a numerology. For a normal cyclic prefix, a slot may include 14 symbols. For an extended cyclic prefix (e.g. applicable

for 60 kHz subcarrier spacing), a slot may include 12 symbols. The relationship between the number of symbols per slot, the number of slots per subframe, and the number of slots per frame for a normal cyclic prefix and an extended cyclic prefix may depend on a numerology. It should be understood that reference to a first numerology (e.g. $\mu=0$) associated with a first subcarrier spacing (e.g. 15 kHz) may be used interchangeably between subframes and slots.

[0117] In the wireless communications system 100, an electromagnetic (EM) spectrum may be split, based on frequency or wavelength, into various classes, frequency bands, frequency channels, etc. By way of example, the wireless communications system 100 may support one or multiple operating frequency bands, such as frequency range designations FR1 (410 MHz – 7.125 GHz), FR2 (24.25 GHz – 52.6 GHz), FR3 (7.125 GHz – 24.25 GHz), FR4 (52.6 GHz – 114.25 GHz), FR4a or FR4-1 (52.6 GHz – 71 GHz), and FR5 (114.25 GHz – 300 GHz). In some implementations, the NEs 102 and the UEs 104 may perform wireless communications over one or more of the operating frequency bands. In some implementations, FR1 may be used by the NEs 102 and the UEs 104, among other equipment or devices for cellular communications traffic (e.g. control information, data). In some implementations, FR2 may be used by the NEs 102 and the UEs 104, among other equipment or devices for short-range, high data rate capabilities.

[0118] FR1 may be associated with one or multiple numerologies (e.g. at least three numerologies). For example, FR1 may be associated with a first numerology (e.g. $\mu=0$), which includes 15 kHz subcarrier spacing; a second numerology (e.g. $\mu=1$), which includes 30 kHz subcarrier spacing; and a third numerology (e.g. $\mu=2$), which includes 60 kHz subcarrier spacing. FR2 may be associated with one or multiple numerologies (e.g. at least 2 numerologies). For example, FR2 may be associated with a third numerology (e.g. $\mu=2$), which includes 60 kHz subcarrier spacing; and a fourth numerology (e.g. $\mu=3$), which includes 120 kHz subcarrier spacing.

[0119] Figure 2 illustrates an example of a UE 200 in accordance with aspects of the present disclosure. The UE 200 may include a processor 202, a memory 204, a controller 206, and a transceiver 208. The processor 202, the memory 204, the controller 206, or the transceiver 208, or various combinations thereof or various components thereof may be examples of means for performing various aspects of the present disclosure as described

herein. These components may be coupled (e.g. operatively, communicatively, functionally, electronically, electrically) via one or more interfaces.

[0120] The processor 202, the memory 204, the controller 206, or the transceiver 208, or various combinations or components thereof may be implemented in hardware (e.g. circuitry). The hardware may include a processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), or other programmable logic device, or any combination thereof configured as or otherwise supporting a means for performing the functions described in the present disclosure.

[0121] The processor 202 may include an intelligent hardware device (e.g. a general-purpose processor, a DSP, a CPU, an ASIC, an FPGA, or any combination thereof). In some implementations, the processor 202 may be configured to operate the memory 204. In some other implementations, the memory 204 may be integrated into the processor 202. The processor 202 may be configured to execute computer-readable instructions stored in the memory 204 to cause the UE 200 to perform various functions of the present disclosure.

[0122] The memory 204 may include volatile or non-volatile memory. The memory 204 may store computer-readable, computer-executable code including instructions when executed by the processor 202 cause the UE 200 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such the memory 204 or another type of memory. Computer-readable media includes both non-transitory computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A non-transitory storage medium may be any available medium that may be accessed by a general-purpose or special-purpose computer.

[0123] In some implementations, the processor 202 and the memory 204 coupled with the processor 202 may be configured to cause the UE 200 to perform one or more of the functions described herein (e.g. executing, by the processor 202, instructions stored in the memory 204). For example, the processor 202 may support wireless communication at the UE 200 in accordance with examples as disclosed herein. In response to an occurrence of a failure associated with an LTM PCell switch procedure from a source cell to a target cell of the UE 200, the UE 200 may be configured to support: a means for receiving, from a source

cell of a first BS, LTM configuration information related to a candidate cell of a second BS, wherein the first BS is same as or different from the second BS; a means for receiving, from the source cell, an LTM cell switch command for triggering a cell switch procedure, wherein the LTM cell switch command includes at least one of identifier (ID) information of the candidate cell or an early timing advance (TA) value for the candidate cell; and a means for performing the cell switch procedure towards the candidate cell upon receiving the LTM cell switch command and starting a supervisor timer.

[0124] The controller 206 may manage input and output signals for the UE 200. The controller 206 may also manage peripherals not integrated into the UE 200. In some implementations, the controller 206 may utilize an operating system such as iOS®, ANDROID®, WINDOWS®, or other operating systems. In some implementations, the controller 206 may be implemented as part of the processor 202.

[0125] In some implementations, the UE 200 may include at least one transceiver 208. In some other implementations, the UE 200 may have more than one transceiver 208. The transceiver 208 may represent a wireless transceiver. The transceiver 208 may include one or more receiver chains 210, one or more transmitter chains 212, or a combination thereof. The means for receiving abovementioned in the processor 202 or the means for transmitting in the processor 202 may be implemented via at least one transceiver 208.

[0126] A receiver chain 210 may be configured to receive signals (e.g. control information, data, packets) over a wireless medium. For example, the receiver chain 210 may include one or more antennas for receive the signal over the air or wireless medium. The receiver chain 210 may include at least one amplifier (e.g. a low-noise amplifier (LNA)) configured to amplify the received signal. The receiver chain 210 may include at least one demodulator configured to demodulate the receive signal and obtain the transmitted data by reversing the modulation technique applied during transmission of the signal. The receiver chain 210 may include at least one decoder for decoding the processing the demodulated signal to receive the transmitted data.

[0127] A transmitter chain 212 may be configured to generate and transmit signals (e.g. control information, data, packets). The transmitter chain 212 may include at least one modulator for modulating data onto a carrier signal, preparing the signal for transmission

over a wireless medium. The at least one modulator may be configured to support one or more techniques such as amplitude modulation (AM), frequency modulation (FM), or digital modulation schemes like phase-shift keying (PSK) or quadrature amplitude modulation (QAM). The transmitter chain 212 may also include at least one power amplifier configured to amplify the modulated signal to an appropriate power level suitable for transmission over the wireless medium. The transmitter chain 212 may also include one or more antennas for transmitting the amplified signal into the air or wireless medium.

[0128] Figure 3 illustrates an example of a processor 300 in accordance with aspects of the present disclosure. The processor 300 may be an example of a processor configured to perform various operations in accordance with examples as described herein. The processor 300 may include a controller 302 configured to perform various operations in accordance with examples as described herein. The processor 300 may optionally include at least one memory 304, which may be, for example, an L1/L2/L3 cache. Additionally, or alternatively, the processor 300 may optionally include one or more arithmetic-logic units (ALUs) 306. One or more of these components may be in electronic communication or otherwise coupled (e.g. operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g. buses).

[0129] The processor 300 may be a processor chipset and include a protocol stack (e.g. a software stack) executed by the processor chipset to perform various operations (e.g. receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) in accordance with examples as described herein. The processor chipset may include one or more cores, one or more caches (e.g. memory local to or included in the processor chipset (e.g. the processor 300) or other memory (e.g. random access memory (RAM), read-only memory (ROM), dynamic RAM (DRAM), synchronous dynamic RAM (SDRAM), static RAM (SRAM), ferroelectric RAM (FeRAM), magnetic RAM (MRAM), resistive RAM (RRAM), flash memory, phase change memory (PCM), and others).

[0130] The controller 302 may be configured to manage and coordinate various operations (e.g. signaling, receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) of the processor 300 to cause the processor 300 to support various operations in accordance with examples as

described herein. For example, the controller 302 may operate as a control unit of the processor 300, generating control signals that manage the operation of various components of the processor 300. These control signals include enabling or disabling functional units, selecting data paths, initiating memory access, and coordinating timing of operations.

[0131] The controller 302 may be configured to fetch (e.g. obtain, retrieve, receive) instructions from the memory 304 and determine subsequent instruction(s) to be executed to cause the processor 300 to support various operations in accordance with examples as described herein. The controller 302 may be configured to track memory address of instructions associated with the memory 304. The controller 302 may be configured to decode instructions to determine the operation to be performed and the operands involved. For example, the controller 302 may be configured to interpret the instruction and determine control signals to be output to other components of the processor 300 to cause the processor 300 to support various operations in accordance with examples as described herein. Additionally, or alternatively, the controller 302 may be configured to manage flow of data within the processor 300. The controller 302 may be configured to control transfer of data between registers, arithmetic logic units (ALUs), and other functional units of the processor 300.

[0132] The memory 304 may include one or more caches (e.g. memory local to or included in the processor 300 or other memory, such RAM, ROM, DRAM, SDRAM, SRAM, MRAM, flash memory, etc. In some implementations, the memory 304 may reside within or on a processor chipset (e.g. local to the processor 300). In some other implementations, the memory 304 may reside external to the processor chipset (e.g. remote to the processor 300).

[0133] The memory 304 may store computer-readable, computer-executable code including instructions that, when executed by the processor 300, cause the processor 300 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. The controller 302 and/or the processor 300 may be configured to execute computer-readable instructions stored in the memory 304 to cause the processor 300 to perform various functions. For example, the processor 300 and/or the controller 302 may be coupled with or to the memory 304, the processor 300, the controller 302, and the memory 304 may be configured to perform various functions described herein. In some examples, the processor 300 may

include multiple processors and the memory 304 may include multiple memories. One or more of the multiple processors may be coupled with one or more of the multiple memories, which may, individually or collectively, be configured to perform various functions herein.

[0134] The one or more ALUs 306 may be configured to support various operations in accordance with examples as described herein. In some implementations, the one or more ALUs 306 may reside within or on a processor chipset (e.g. the processor 300). In some other implementations, the one or more ALUs 306 may reside external to the processor chipset (e.g. the processor 300). One or more ALUs 306 may perform one or more computations such as addition, subtraction, multiplication, and division on data. For example, one or more ALUs 306 may receive input operands and an operation code, which determines an operation to be executed. One or more ALUs 306 be configured with a variety of logical and arithmetic circuits, including adders, subtractors, shifters, and logic gates, to process and manipulate the data according to the operation. Additionally, or alternatively, the one or more ALUs 306 may support logical operations such as AND, OR, exclusive-OR (XOR), not-OR (NOR), and not-AND (NAND), enabling the one or more ALUs 306 to handle conditional operations, comparisons, and bitwise operations.

[0135] The processor 300 may support wireless communication in accordance with examples as disclosed herein.

[0136] In some implementations, the processor 300 may be configured to support means for performing operations as described with respect to Figure 6. For example, the processor 300 may be configured to or operable to support: a means for receiving, from a source cell of a first BS, LTM configuration information related to a candidate cell of a second BS, wherein the first BS is same as or different from the second BS; a means for receiving, from the source cell, an LTM cell switch command for triggering a cell switch procedure, wherein the LTM cell switch command includes at least one of: ID information of the candidate cell; or an early TA value for the candidate cell; and a means for performing the cell switch procedure towards the candidate cell upon receiving the LTM cell switch command and starting a supervisor timer.

[0137] In some implementations, the processor 300 may be configured to support means for performing operations as described with respect to Figure 7. For example, the processor

300 may be configured to or operable to support: a means for receiving an RRC reestablishment request from a UE after a failure of an LTM cell switch procedure occurs; and a means for transmitting an RRC reestablishment message to the UE.

[0138] In some implementations, the processor 300 may be configured to support means for performing operations as described with respect to Figure 8. For example, the processor 300 may be configured to or operable to support: a means for transmitting, to a UE, LTM configuration information related to a candidate cell of the UE; and a means for transmitting, to the UE, an LTM cell switch command for triggering a cell switch procedure from a source cell of the source BS towards the candidate cell, wherein the LTM cell switch command includes at least one of: ID information of the candidate cell; or an early TA value for the candidate cell.

[0139] In some implementations, the processor 300 may be configured to support means for performing operations as described with respect to Figure 11. For example, the processor 300 may be configured to or operable to support: a means for transmitting, to a UE, a PDCCH order for triggering an early TA acquisition related to a candidate cell, wherein the candidate cell is associated with a cell switch procedure; a means for determining whether a failure of the early TA acquisition occurs; and a means for transmitting information indicating the failure of the early TA acquisition to a CU of the BS if determining that the failure of the early TA acquisition occurs.

[0140] In some implementations, the processor 300 may be configured to support means for performing operations as described with respect to Figure 12. For example, the processor 300 may be configured to or operable to support: a means for transmitting a PDCCH order for triggering an early TA acquisition related to a candidate cell, wherein the candidate cell is associated with a cell switch procedure of a UE; a means for receiving an early TA value for the candidate cell from a candidate DU of a second BS related to the candidate cell, wherein the first BS is same as or different from the second BS; a means for storing the early TA value for the candidate cell; and a means for determining whether the early TA value for the candidate cell is valid.

[0141] In some implementations, the processor 300 may be configured to support means for performing operations as described with respect to Figure 13. For example, the processor

300 may be configured to or operable to support: a means for transmitting LTM candidate cell configuration associated with a candidate cell to a UE; and a means for transmitting a RACH resource for an early TA acquisition to a source DU managed by the first CU, wherein the candidate cell is associated with a cell switch procedure from a source cell of the UE towards the candidate cell.

[0142] In some additional implementations, the processor 300 may be configured to support means for performing operations as disclosed herein. The processor 300 may be configured to or operable to support a means for receiving, from a source CU of a BS, information indicating a failure of an early TA acquisition related to a candidate cell or invalidity of an early TA value of the candidate cell, wherein the candidate cell is associated with a cell switch procedure from a source cell of a UE towards the candidate cell, and wherein the source cell is related to the source CU, and the candidate cell is related to the target CU.

[0143] It should be appreciated by persons skilled in the art that the components in exemplary processor 300 may be changed, for example, some of the components in exemplary processor 300 may be omitted or modified or new component(s) may be added to exemplary processor 300, without departing from the spirit and scope of the disclosure. For example, in some embodiments, the processor 300 may not include the ALUs 306.

[0144] Figure 4 illustrates an example of a NE 400 in accordance with aspects of the present disclosure. The NE 400 may include a processor 402, a memory 404, a controller 406, and a transceiver 408. The processor 402, the memory 404, the controller 406, or the transceiver 408, or various combinations thereof or various components thereof may be examples of means for performing various aspects of the present disclosure as described herein. These components may be coupled (e.g. operatively, communicatively, functionally, electronically, electrically) via one or more interfaces.

[0145] The processor 402, the memory 404, the controller 406, or the transceiver 408, or various combinations or components thereof may be implemented in hardware (e.g. circuitry). The hardware may include a processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), or other programmable logic device, or any combination

thereof configured as or otherwise supporting a means for performing the functions described in the present disclosure.

[0146] The processor 402 may include an intelligent hardware device (e.g. a general-purpose processor, a DSP, a CPU, an ASIC, an FPGA, or any combination thereof). In some implementations, the processor 402 may be configured to operate the memory 404. In some other implementations, the memory 404 may be integrated into the processor 402. The processor 402 may be configured to execute computer-readable instructions stored in the memory 404 to cause the NE 400 to perform various functions of the present disclosure.

[0147] The memory 404 may include volatile or non-volatile memory. The memory 404 may store computer-readable, computer-executable code including instructions when executed by the processor 402 cause the NE 400 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such the memory 404 or another type of memory. Computer-readable media includes both non-transitory computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A non-transitory storage medium may be any available medium that may be accessed by a general-purpose or special-purpose computer.

[0148] In some implementations, the processor 402 and the memory 404 coupled with the processor 402 may be configured to cause the NE 400 to perform one or more of the functions described herein (e.g. executing, by the processor 402, instructions stored in the memory 404). For example, the processor 402 may support wireless communication at the NE 400 in accordance with examples as disclosed herein. For example, the NE 400 may be configured to support means for performing the operations as described with respect to Figure 6 or operations of a candidate target SN as described below.

[0149] In some implementations, the NE 400 may be a BS. The NE 400 may be configured to support: a means for receiving an RRC reestablishment request from a UE after a failure of an LTM cell switch procedure occurs; and a means for transmitting an RRC reestablishment message to the UE.

[0150] In some implementations, the NE 400 may be a source BS and configured to support: a means for transmitting, to a UE, LTM configuration information related to a

candidate cell of the UE; and a means for transmitting, to the UE, an LTM cell switch command for triggering a cell switch procedure from a source cell of the source BS towards the candidate cell, wherein the LTM cell switch command includes at least one of: ID information of the candidate cell; or an early TA value for the candidate cell.

[0151] In some implementations, the NE 400 may be a source DU of a BS and configured to support: a means for transmitting, to a UE, a PDCCH order for triggering an early TA acquisition related to a candidate cell, wherein the candidate cell is associated with a cell switch procedure; a means for determining whether a failure of the early TA acquisition occurs; and a means for transmitting information indicating the failure of the early TA acquisition to the first CU of the first BS if determining that the failure of the early TA acquisition occurs.

[0152] In some implementations, the NE 400 may be a source DU of a BS and configured to support: a means for transmitting a PDCCH order for triggering an early TA acquisition related to a candidate cell, wherein the candidate cell is associated with a cell switch procedure of a UE; a means for receiving an early TA value for the candidate cell from a candidate DU of a second BS related to the candidate cell, wherein the first BS is same as or different from the second BS; a means for storing the early TA value for the candidate cell; and a means for determining whether the early TA value for the candidate cell is valid.

[0153] In some implementations, the NE 400 may be a source DU of a BS and configured to support: a means for transmitting LTM candidate cell configuration associated with a candidate cell to a UE; and a means for transmitting a RACH resource for an early TA acquisition to a source DU managed by the first CU, wherein the candidate cell is associated with a cell switch procedure from a source cell of the UE towards the candidate cell.

[0154] In some additional implementations, the NE 400 may be a target CU of a BS and configured to support a means for receiving, from a source CU of the BS, information indicating a failure of an early TA acquisition related to a candidate cell or invalidity of an early TA value of the candidate cell, wherein the candidate cell is associated with a cell switch procedure from a source cell of a UE towards the candidate cell, and wherein the source cell is related to the source CU, and the candidate cell is related to the target CU.

[0155] The controller 406 may manage input and output signals for the NE 400. The controller 406 may also manage peripherals not integrated into the NE 400. In some implementations, the controller 406 may utilize an operating system such as iOS®, ANDROID®, WINDOWS®, or other operating systems. In some implementations, the controller 406 may be implemented as part of the processor 402.

[0156] In some implementations, the NE 400 may include at least one transceiver 408. In some other implementations, the NE 400 may have more than one transceiver 408. The transceiver 408 may represent a wireless transceiver. The transceiver 408 may include one or more receiver chains 410, one or more transmitter chains 412, or a combination thereof. The means for receiving or the means for transmitting abovementioned in the processor 402 may be implemented via at least one transceiver 408.

[0157] A receiver chain 410 may be configured to receive signals (e.g. control information, data, packets) over a wireless medium. For example, the receiver chain 410 may include one or more antennas for receive the signal over the air or wireless medium. The receiver chain 410 may include at least one amplifier (e.g. a low-noise amplifier (LNA)) configured to amplify the received signal. The receiver chain 410 may include at least one demodulator configured to demodulate the receive signal and obtain the transmitted data by reversing the modulation technique applied during transmission of the signal. The receiver chain 410 may include at least one decoder for decoding the processing the demodulated signal to receive the transmitted data.

[0158] A transmitter chain 412 may be configured to generate and transmit signals (e.g. control information, data, packets). The transmitter chain 412 may include at least one modulator for modulating data onto a carrier signal, preparing the signal for transmission over a wireless medium. The at least one modulator may be configured to support one or more techniques such as amplitude modulation (AM), frequency modulation (FM), or digital modulation schemes like phase-shift keying (PSK) or quadrature amplitude modulation (QAM). The transmitter chain 412 may also include at least one power amplifier configured to amplify the modulated signal to an appropriate power level suitable for transmission over the wireless medium. The transmitter chain 412 may also include one or more antennas for transmitting the amplified signal into the air or wireless medium.

[0159] It should be appreciated by persons skilled in the art that the components in exemplary NE 400 may be changed, for example, some of the components in exemplary NE 400 may be omitted or modified or new component(s) may be added to exemplary NE 400, without departing from the spirit and scope of the disclosure. For example, in some embodiments, the NE 400 may not include the controller 406.

[0160] Figure 5A illustrates a schematic diagram of an intra-CU intra-DU mobility scenario in accordance with aspects of the present disclosure. The wireless communication system in Figure 5A includes a DU, a UE (e.g. UE 101A), and some access nodes (e.g. access node 102A and access node 103A). The access node 102A and access node 103A are controlled by the DU, and provides services for UEs within cell #1 and cell #2 respectively. Even though there are only one UE and two access nodes in Figure 5A, persons skilled in the art will recognize that any number of UEs and access nodes may be included in the wireless communication system.

[0161] In Figure 5A, UE 101A is moving from cell #1 to cell #2, and may perform a handover procedure from cell #1 to access to cell #2, which is a handover procedure performed between different cells within a DU. This scenario may be referred to as intra-CU intra-DU mobility. In short, this scenario may be called as intra-DU mobility.

[0162] Figure 5B illustrates a schematic diagram of an intra-CU inter-DU mobility scenario in accordance with aspects of the present disclosure. The wireless communication system in Figure 5B includes a CU, a UE (e.g. UE 101B), and some DUs (e.g. DU #1 and DU #2). DU #1 and DU #2 are controlled by the CU, and provides services for UEs within cell #A and cell #B respectively. Even though there are only one UE and two DUs in Figure 5B, persons skilled in the art will recognize that any number of UEs and DUs may be included in the wireless communication system.

[0163] In Figure 5B, UE 101B is moving from cell #A to cell #B, and may perform a handover procedure from cell #A to access to cell #B, which is a handover procedure performed between different cells belonging to different DUs but within the same CU. This scenario may be referred to as intra-CU inter-DU mobility. In short, this scenario may be called as inter-DU mobility.

[0164] Figure 5C illustrates a schematic diagram of an inter-CU mobility scenario in accordance with aspects of the present disclosure. The wireless communication system in Figure 5C includes some CUs (e.g. CU #1 and CU #2), a UE (e.g. UE 101C), and some DUs (e.g. DU #A and DU #B). DU #A is controlled by CU #1 and provides services for UEs within cell #X. DU #B is controlled by CU #2 and provides services for UEs within cell #Y. Even though there are only one UE, two DUs, and two CUs in Figure 5C, persons skilled in the art will recognize that any number of UEs, DUs, and CUs may be included in the wireless communication system.

[0165] In Figure 5C, UE 101C is moving from cell #X to cell #Y, and may perform a handover procedure from cell #X to access to cell #Y, which is a handover procedure performed between different cells belonging to different DUs within different CUs. This scenario may be referred to as inter-CU mobility.

[0166] Figure 6 illustrates a flowchart of a method related to an LTM cell switch procedure in accordance with aspects of the present disclosure. The operations of the method may be implemented by a UE as described herein. In some implementations, the UE may execute a set of instructions to control the function elements of the UE to perform the described functions. In some implementations, aspects of operations 602, 604, and 606 may be performed by UE 200, UE 101A, UE 101B, UE 101C, UE 901, or UE 1001 as described with reference to any of Figures 2, 5A-5C, 9, and 10. Each of operations 602, 604, and 606 may be performed in accordance with examples as described herein.

[0167] At operation 602, the method may include receiving, from a source cell of a BS (denoted as "BS #1"), LTM configuration information related to a candidate cell of another BS (denoted as "BS #2"). BS #1 may be the same as or different BS #2. For example, if BS #1 is the same as BS #2, it is an intra-BS case, i.e. an Intra-CU mobility scenario. If BS #1 is different from BS #2, it is an inter-BS case, i.e. an Inter-CU mobility scenario.

[0168] At operation 604, the method may include receiving, from the source cell, an LTM cell switch command for triggering a cell switch procedure. The LTM cell switch command includes at least one of: (1) ID information of the candidate cell; or (2) an early TA value for the candidate cell.

[0169] At operation 606, the method may include performing the cell switch procedure towards the candidate cell upon receiving the LTM cell switch command and starting a supervisor timer ((may also be named as an LTM timer or the like).

[0170] In some implementations, the cell switch procedure is a PCell switch procedure, i.e. an MCG LTM procedure. In some other implementations, the cell switch procedure is a PSCell switch procedure, i.e. an SCG LTM procedure.

[0171] In an implementation, if the cell switch procedure is the PCell switch procedure, i.e. an MCG LTM procedure, the UE may connect to a cell of an additional BS (denoted as "BS #3") via a re-establishment procedure upon an expiry of the supervisor timer (i.e. an LTM timer). Then, the UE may transmit, to the cell of BS #3, information indicating that a report for an LTM cell switch failure (denoted as "report #1") is available. The UE may receive a request for report #1 from BS #3 and then transmit report #1 to BS #3.

[0172] In some implementations of the method described herein, report #1 (i.e. the report for the LTM cell switch failure) includes at least one of the following:

- (1) The early TA value for the candidate cell. In some embodiments, the early TA value for the candidate cell is obtained by the source cell via an early TA acquisition, and received by the UE from the source cell. In some other embodiments, the early TA value for the candidate cell is set as a fixed value. In some additional embodiments, the early TA value for the candidate cell is set as identical with a TA value of the source cell.
- (2) Information indicating whether the cell switch procedure is a random access channel (RACH)-less based LTM cell switch or a RACH based LTM cell switch.
- (3) Information indicating whether the cell switch procedure is a RACH-less based LTM cell switch failure with configured grant (CG).
- (4) Information indicating whether the cell switch procedure is a RACH-less based LTM cell switch failure without CG.
- (5) Information indicating whether the LTM cell switch failure occurs.
- (6) A L1 measurement result for the source cell when the LTM cell switch failure occurs, which may be encapsulated in a container of an RRC message.

- (7) A L1 measurement result for the candidate cell when the LTM cell switch failure occurs, which may be encapsulated in a container of an RRC message.

[0173] In some implementations of the method described herein, the UE may transmit, to BS #3, a total number of LTM executions towards the same candidate cell if subsequent LTM is supported. In an implementation, the total number includes only a total number of successful completion of the cell switch procedure (i.e. how many times the cell switch procedure has been successfully completed). In another implementation, the total number includes both a total number of the LTM cell switch failure (i.e. how many times the LTM cell switch failure occurs) and a total number of successful completion of the cell switch procedure. Specific examples are described in the embodiments of Figure 9 as follows.

[0174] In some implementations of the method described herein, if the cell switch procedure is a PSCell switch procedure, i.e. an SCG LTM procedure, the UE may transmit an SCG failure information message to a MN serving the UE upon an expiry of the supervisor timer (i.e. an LTM timer). For instance, the SCG failure information message (denoted as "message #1") may include at least one of the following:

- (1) information indicating an LTM cell switch failure;
- (2) a L1 measurement result for the source cell when the LTM cell switch failure occurs, which may be encapsulated in a container of an RRC message;
- (3) a L1 measurement result for the candidate cell when the LTM cell switch failure occurs, which may be encapsulated in a container of an RRC message;
- (4) information indicating a RACH-less based LTM cell switch failure;
- (5) information indicating a RACH-less based LTM cell switch failure with CG;
- (6) information indicating a RACH-less based LTM cell switch failure without CG;
- (7) information indicating a RACH based LTM cell switch failure; or
- (8) information indicating an expiry of the supervisor timer. Specific examples are described in the embodiments of Figure 10 as follows.

[0175] It should be noted that the method described in Figure 6 describes possible implementations, and that the operations and the steps may be rearranged or otherwise

eliminated or modified and that other implementations are possible, without departing from the spirit and scope of the disclosure.

[0176] Figure 7 illustrates a flowchart of a method related to an LTM cell switch procedure in accordance with aspects of the present disclosure. The operations of the method may be implemented by a network node as described herein. In some implementations, the network node may be a BS (e.g. BS #3 as described in the embodiments of Figure 6), and may execute a set of instructions to control the function elements of the BS to perform the described functions. In some implementations, aspects of operations 702 and 704 may be performed by NE 400 or BS 906 as described with reference to Figure 4 or Figure 9. Each of operations 702 and 704 may be performed in accordance with examples as described herein. Specific examples are described in the embodiments of Figure 9 as follows.

[0177] At operation 702, the method may include receiving an RRC reestablishment request from a UE after a failure of an LTM cell switch procedure occurs. At operation 704, the method may include transmitting an RRC reestablishment message to the UE.

[0178] In some implementations, the LTM cell switch procedure is a PCell switch procedure, i.e. an MCG LTM procedure. In some other implementations, the cell switch procedure is a PSCell switch procedure, i.e. an SCG LTM procedure.

[0179] In some implementations of the method described herein, the BS (e.g. BS #3) may receive, from the UE, information indicating that a report for an LTM cell switch failure (e.g. report #1 as described in the embodiments of Figure 6) is available. Then, the BS may transmit a request for the report to the UE and receive the report from the UE. In some implementations, the BS may transfer the report to a source BS (e.g. BS #1 as described in the embodiments of Figure 6) of the source cell. The report may include similar elements to those of report #1 as described in the embodiments of Figure 6.

[0180] In some implementations of the method described herein, the BS may receive, from the UE, a total number of LTM executions towards the same candidate cell if subsequent LTM is supported. In an implementation, the total number includes only a total number of successful completion of the cell switch procedure. In an implementation, the total number includes both a total number of the LTM cell switch failure and the total number of successful completion of the cell switch procedure.

[0181] It should be noted that the method described in Figure 7 describes possible implementations, and that the operations and the steps may be rearranged or otherwise eliminated or modified and that other implementations are possible, without departing from the spirit and scope of the disclosure.

[0182] Figure 8 illustrates a flowchart of a method related to an LTM cell switch procedure in accordance with aspects of the present disclosure. The operations of the method may be implemented by a network node as described herein. In some implementations, the network node may be a source BS (e.g. BS #1 as described in the embodiments of Figure 6), and may execute a set of instructions to control the function elements of the source BS to perform the described functions. In some implementations, aspects of operations 802 and 804 may be performed by NE 400, BS 905, or BS 1005 as described with reference to any of Figures 4, 9, or 10. Each of operations 802 and 804 may be performed in accordance with examples as described herein.

[0183] At operation 802, the method may include transmitting, to a UE, LTM configuration information related to a candidate cell of the UE. At operation 804, the method may include transmitting, to the UE, an LTM cell switch command for triggering a cell switch procedure from a source cell of the source BS towards the candidate cell. The LTM cell switch command may include at least one of: (1) ID information of the candidate cell; or (2) an early TA value for the candidate cell.

[0184] In some implementations of the method described herein, the source BS may receive a report for an LTM cell switch failure from another BS, wherein the report is transmitted by the UE to this another BS. The report may include similar elements to those of report #1 as described in the embodiments of Figure 6.

[0185] In some implementations of the method described herein, the source BS may receive an SCG failure information message from the UE upon an expiry of a supervisor timer (i.e. an LTM timer). The SCG failure information message may include similar elements to those of message #1 as described in the embodiments of Figure 6.

[0186] It should be noted that the method described in Figure 8 describes possible implementations, and that the operations and the steps may be rearranged or otherwise

eliminated or modified and that other implementations are possible, without departing from the spirit and scope of the disclosure.

[0187] Figure 9 illustrates a schematic diagram of an MCG LTM procedure in accordance with aspects of the present disclosure. Details described in all other embodiments of the present disclosure are applicable for the embodiments shown in Figure 9.

[0188] As shown in Figure 9, BS 905 is in CU-DU architecture, and includes CU 904, source DU 902, and candidate DU 903. In the embodiments of Figure 9, a cell switching operation performed by UE 901 may refer to an Intra-CU mobility scenario in which a source cell and a target cell in the same CU (e.g. CU 904) or refer to an Inter-CU mobility scenario in which a source cell and a target cell are located at different CUs (e.g. CU 904 and another CU not shown in Figure 9). For instance, the flowchart 900 as shown in Figure 9 only shows a cell switching operation in an intra-CU mobility scenario for the exemplary purpose where source DU 902 and candidate DU 903 are managed by the same CU 904 (e.g. BS #1 is the same as from BS #2 as described in the embodiments of Figure 6). The flowchart 900 also can be applied to an Inter-CU mobility scenario where source DU 902 and candidate DU 903 are managed by different CUs (e.g. BS #1 is different from BS #2 as described in the embodiments of Figure 6).

[0189] In the exemplary flowchart 900 as shown in Figure 9, in operation 911, UE 901 may access the serving BS (e.g. BS 905) and send a measurement report to the serving BS. The serving BS may include a CU (e.g. gNB-CU) and one or more DUs (e.g. gNB-DUs). A serving cell is associated with a CU and a DU. There is an F1 interface between the DU and the CU. For example, in the embodiments of Figure 9 related to an MCG LTM procedure, BS 905 is an MCG BS (e.g. MCG gNB). BS 905 includes CU 904, source DU 902, and candidate DU 903. BS 905 may include one or more other candidate DUs (not shown in Figure 9). In some implementations, UE 901 may send the measurement report to CU 904 via source DU 902.

[0190] In operation 912, source CU 904 of serving BS 905 may determine to initiate a L1/L2 based inter-cell mobility configuration procedure, i.e., making a L1/L2 based inter-cell mobility configuration decision.

[0191] In operation 913, in an Intra-CU LTM case (i.e., Intra-CU mobility scenario), the source CU (e.g. source CU 904) may send a request message, e.g. UE CONTEXT SETUP REQUEST, including the ID information of candidate cell(s) to the candidate (target) DU (e.g. candidate DU 903) of the same BS. The request for a RACH resource for an early TA acquisition may also be included in the request message transmitted to the candidate (target) DU. A candidate cell may also be named as a candidate (target) cell. As shown in Figure 9, CU 904 may send a request message, which contains ID information of the candidate cell(s), to candidate DU 903 via an F1 interface.

[0192] Alternatively, in an Inter-CU LTM case (i.e., Inter-CU mobility scenario), the source CU (e.g. source CU 904 of BS 905) (e.g. BS #1) may send a request message e.g. a Handover (HO) request, including the ID information of candidate cell(s) to a candidate (target) CU (not shown in Figure 9) (e.g. BS #2). The request for a RACH resource for an early TA acquisition may also be included in the request message transmitted to the candidate (target) CU. Then, the candidate (target) CU may send a request message, e.g. UE CONTEXT SETUP REQUEST, including the ID information of candidate cell(s) to a candidate (target) DU. The request for a RACH resource for an early TA acquisition may also be included in the request message transmitted to the candidate (target) DU.

[0193] In operation 914, in an Intra-CU LTM case, if the candidate (target) DU (e.g. candidate DU 903) decides to accept the request of LTM configuration related to a candidate cell, it responds to the CU (e.g. source CU 904) including the RRC configuration for the accepted candidate (target) cell, e.g. via UE CONTEXT SETUP RESPONSE. As shown in Figure 9, if candidate DU 903 decides to accept the request of LTM configuration related to candidate cell(s), candidate DU 903 may transmit a response message, which includes the RRC configuration(s) for the accepted candidate (target) cell(s), to CU 904 via an F1 interface. The F1 interface response may include at least one of the following:

- (1) RACH resources for an early TA acquisition,
- (2) an indication indicating an early TA value of the candidate cell determined by the candidate (target) DU,
- (3) an indication indicating that an early TA value of the candidate cell is equal to a fixed value (e.g. 0), or

- (4) an indication indicating that an early TA value of the candidate cell is equal to a TA value of the source cell.

[0194] Alternatively, in an Inter-CU LTM case, if the candidate (target) DU (e.g. a DU of BS #2) decides to accept the request of LTM configuration related to a candidate cell, it responds to a target CU (e.g. a CU of BS #2) including the RRC configuration for the accepted candidate (target) cell via an F1 interface. The F1 interface response may include at least one of the following:

- (1) RACH resource for early TA acquisition,
- (2) an indication indicating an early TA value of the candidate cell determined by the candidate (target) DU,
- (3) an indication indicating that an early TA value of the candidate cell is equal to a fixed value (e.g. 0), or
- (4) an indication indicating that an early TA value of the candidate cell is equal to a TA value of the source cell.

[0195] Then, the candidate (target) CU may transmit the response, e.g. a handover request acknowledge, to the source CU (e.g. source CU 904) via an Xn interface. The Xn interface response may include similar elements to those of the F1 interface response received from the candidate (target) DU.

[0196] In operation 915, source CU 904 of BS 905 will transmit the configuration(s) to source DU 902 of BS 905. In some implementations, CU 904 may transmit the configuration(s), e.g. RACH resource(s) for early TA acquisition, to source DU 902.

[0197] In some implementations, CU 904 may generate an RRC reconfiguration message based on the configuration(s) from the candidate cell(s) and transmit the RRC reconfiguration message to UE 901 via source DU 902. For instance, the RRC reconfiguration message includes candidate cell configuration(s) for LTM and/or RACH resource(s) for early TA acquisition.

[0198] In operation 916, UE 901 may receive the RRC reconfiguration message associated with one or more candidate cells for LTM configuration from source DU 902.

[0199] In operation 917, UE 901 may receive a PDCCH order for triggering TA acquisition to a particular candidate cell, e.g. a candidate cell associated with candidate DU 903, from source DU 902.

[0200] In operation 918, UE 901 may transmit the preamble for early TA acquisition to candidate DU 903 upon the reception of the PDCCH order. In some implementations, if candidate DU 903 can calculate an early TA value for the particular candidate cell based on the received preamble, candidate DU 903 may transmit the preamble and corresponding RACH occasion, a beam indication, an ID of UE 901, RA-RNTI, ID information of the candidate cell ID (i.e., target cell ID), TCI State index for the candidate cell or similar information, and/or the calculated TA value to source DU 902 via CU 904. In some implementations, candidate DU 903 may store the calculated TA value.

[0201] Regarding the Inter-CU mobility scenario, in operation 918, the target CU (not shown in Figure 9) (e.g. a CU of BS #2) which manages the candidate (target) DU may transmit at least one of the early TA value of the candidate cell and the corresponding preamble, a RACH occasion, a UE ID, or a target cell ID to source CU 904 via an F1 interface. Then, the source CU 904 may transmit the received information to source DU 902.

[0202] In operation 919, source DU 902 will receive an early TA value of the candidate cell from source CU 904. In some implementations, source DU 902 is responsible for checking the validity of the early TA value of the candidate cell. For example, source DU 902 starts a timer upon the reception of the early TA value from candidate DU 903 via the target CU and the source CU (which are the same CU in an intra-CU mobility scenario and different CUs in an inter-CU mobility scenario). Once the timer expires, source DU 902 may transmit a PDCCH order for an early TA re-acquisition. Therefore, if source DU 902 determines that the early TA value is invalid, source DU 902 may transmit a PDCCH order for an early TA re-acquisition.

[0203] In operation 920, source DU 902 may transmit an LTM cell switch command for the candidate cell to UE 901 for triggering cell switching related to the candidate cell.

[0204] In operation 921, upon reception of the LTM cell switch command, UE 901 may start a supervisor timer (i.e. an LTM timer) and performs LTM cell switching towards the candidate cell indicated in the LTM cell switch command. UE 901 may consider that an LTM

cell switch failure (which may also be named as "an LTM failure" or "an MCG LTM failure" or the like) occurs upon an expiry of the supervisor timer. UE 901 shall initiate an RRC re-establishment procedure upon an occurrence of the LTM cell switch failure.

[0205] In operation 922, after the LTM cell switch failure occurs, UE 901 may re-connect to a new cell of another BS, i.e. BS 906 in Figure 9 (e.g. BS #3 as described in the embodiments of Figure 6), via an RRC re-establishment or establishment procedure. UE 901 may transmit an indication indicating that an LTM failure report (e.g. report #1 as described in the embodiments of Figure 6) is available to the serving cell of BS 906.

[0206] In operation 923, the serving cell of BS 906 transmits a UE information request message to UE 901 in which UE 901 is requested to transmit the LTM failure report.

[0207] In operation 924, UE 901 transmits the LTM failure report related to the LTM cell switch failure to the serving cell which can be included in a UE information response message. In some implementations, the LTM failure report includes at least one of the following:

- (1) An early TA value for the candidate cell, which may be obtained by the source cell via an early TA acquisition, and received by the UE from the source cell; or may be set as a fixed value (e.g. 0); or may be set as identical with a TA value of the source cell.
- (2) Information indicating whether the cell switch procedure is a RACH-less based LTM cell switch or a RACH based LTM cell switch.
- (3) Information indicating whether the cell switch procedure is a RACH-less based LTM cell switch failure with CG.
- (4) Information indicating whether the cell switch procedure is a RACH-less based LTM cell switch failure without CG.
- (5) Information indicating whether the LTM cell switch failure occurs.
- (6) A L1 measurement result for the source cell when the LTM cell switch failure occurs, which may be encapsulated in a container of an RRC message.
- (7) A L1 measurement result for the candidate cell when the LTM cell switch failure occurs, which may be encapsulated in a container of an RRC message.

[0208] In operation 925 (optional), if subsequent LTM cell switch procedures between candidate cells where UE 901 does not need to be reconfigured by the network in between are preformed, UE 901 may report a total number of LTM executions towards the same candidate cell if subsequent LTM is supported to the serving BS (e.g. BS #3).

[0209] In an implementation, the total number includes only a total number of successful completion of the cell switch procedure (i.e. how many times the cell switch procedure has been successfully completed). In another implementation, the total number includes both a total number of the LTM cell switch failure (i.e. how many times the LTM cell switch failure occurs) and a total number of successful completion of the cell switch procedure.

[0210] Figure 10 illustrates a schematic diagram of an SCG LTM procedure in accordance with aspects of the present disclosure. Details described in all other embodiments of the present disclosure are applicable for the embodiments shown in Figure 10.

[0211] As shown in Figure 10, BS 1005 is in CU-DU architecture, and includes CU 1004, source DU 1002, and candidate DU 1003. In the embodiments of Figure 10, a cell switching operation performed by UE 1001 may refer to an Intra-CU mobility scenario in which a source cell and a target cell in the same CU or refer to an Inter-CU mobility scenario in which a source cell and a target cell are located at different CUs. For instance, the flowchart 1000 as shown in Figure 10 only shows a cell switching operation in an intra-CU mobility scenario for the exemplary purpose where source DU 1002 and candidate DU 1003 are managed by the same CU 1004 (e.g. BS #1 is the same as BS #2 as described in the embodiments of Figure 6). The flowchart 1000 also can be applied to an Inter-CU mobility scenario where source DU 1002 and candidate DU 1003 are managed by different CUs (e.g. BS #1 is different from BS #2 as described in the embodiments of Figure 6).

[0212] In the exemplary flowchart 1000 as shown in Figure 10, in operation 1011, UE 1001 may access the serving BS (e.g. BS 1005) and send a measurement report to the serving BS. The serving BS may include a CU (e.g. gNB-CU) and one or more DUs (e.g. gNB-DUs). A serving cell is associated with a CU and a DU. There is an F1 interface between the DU and the CU. For example, in the embodiments of Figure 10 related to an SCG LTM procedure, BS 1005 is an SCG BS (e.g. SCG gNB). BS 1005 includes CU 1004, source DU 1002, and candidate DU 1003. BS 1005 may include one or more other candidate DUs (not shown in

Figure 10). In some implementations, UE 1001 may send the measurement report to CU 1004 via source DU 1002.

[0213] In operation 1012, source CU 1004 of SCG BS 1005 may determine to initiate a L1/L2 based inter-cell mobility configuration procedure, i.e., making a L1/L2 based inter-cell mobility configuration decision.

[0214] In operation 1013, in an Intra-CU LTM case (i.e., Intra-CU mobility scenario), the source CU (e.g. source CU 1004) may send a request message, e.g. UE CONTEXT SETUP REQUEST, including the ID information of candidate cell(s) to the candidate (target) DU (e.g. candidate DU 1003) of the same BS. The request for a RACH resource for an early TA acquisition may also be included in the request message transmitted to the candidate (target) DU. A candidate cell may also be named as a candidate (target) cell. As shown in Figure 10, CU 1004 may send a request message, which contains ID information of the candidate cell(s), to candidate DU 1003 via an F1 interface.

[0215] Alternatively, in an Inter-CU LTM case (i.e., Inter-CU mobility scenario), the source CU (e.g. source CU 1004 of BS 1005) (e.g. BS #1) may send a request message e.g. a Handover (HO) request, including the ID information of candidate cell(s) to a candidate (target) CU (not shown in Figure 10) (e.g. BS #2). The request for a RACH resource for an early TA acquisition may also be included in the request message transmitted to the candidate (target) CU. Then, the candidate (target) CU may send a request message, e.g. UE CONTEXT SETUP REQUEST, including the ID information of candidate cell(s) to a candidate (target) DU. The request for a RACH resource for an early TA acquisition may also be included in the request message transmitted to the candidate (target) DU.

[0216] In operation 1014, in an Intra-CU LTM case, if the candidate (target) DU (e.g. candidate DU 1003) decides to accept the request of LTM configuration related to a candidate cell, it responds to the CU (e.g. source CU 1004) including the RRC configuration for the accepted candidate (target) cell, e.g. via UE CONTEXT SETUP RESPONSE. As shown in Figure 10, if candidate DU 1003 decides to accept the request of LTM configuration related to candidate cell(s), candidate DU 1003 may transmit a response message, which includes the RRC configuration(s) for the accepted candidate (target) cell(s), to CU 1004 via an F1 interface. The F1 interface response may include at least one of the following:

- (1) RACH resources for an early TA acquisition,
- (2) an indication indicating an early TA value of the candidate cell determined by the candidate (target) DU,
- (3) an indication indicating that an early TA value of the candidate cell is equal to a fixed value (e.g. 0), or
- (4) an indication indicating that an early TA value of the candidate cell is equal to a TA value of the source cell.

[0217] Alternatively, in an Inter-CU LTM case, if the candidate (target) DU (e.g. a DU of BS #2) decides to accept the request of LTM configuration related to a candidate cell, it responds to a target CU (e.g. a CU of BS #2) including the RRC configuration for the accepted candidate (target) cell via an F1 interface. The F1 interface response may include at least one of the following:

- (1) RACH resource for early TA acquisition,
- (2) an indication indicating an early TA value of the candidate cell determined by the candidate (target) DU,
- (3) an indication indicating that an early TA value of the candidate cell is equal to a fixed value (e.g. 0), or
- (4) an indication indicating that an early TA value of the candidate cell is equal to a TA value of the source cell.

[0218] Then, the candidate (target) CU may transmit the response, e.g. a handover request acknowledge, to the source CU (e.g. source CU 1004) via an Xn interface. The Xn interface response may include similar elements to those of the F1 interface response received from the candidate (target) DU.

[0219] In operation 1015, source CU 1004 of BS 1005 will transmit the configuration(s) to source DU 1002 of BS 1005. In some implementations, CU 1004 may transmit the configuration(s), e.g. RACH resource(s) for early TA acquisition, to source DU 1002.

[0220] In some implementations, CU 1004 may generate an RRC reconfiguration message based on the configuration(s) from the candidate cell(s) and transmit the RRC

reconfiguration message to UE 1001 via source DU 1002. For instance, the RRC reconfiguration message includes candidate cell configuration(s) for LTM and/or RACH resource(s) for early TA acquisition.

[0221] In operation 1016, UE 1001 may receive the RRC reconfiguration message associated with one or more candidate cells for LTM configuration from source DU 1002.

[0222] In operation 1017, UE 1001 may receive a PDCCH order for triggering TA acquisition to a particular candidate cell, e.g. a candidate cell associated with candidate DU 1003, from source DU 1002.

[0223] In operation 1018, UE 1001 may transmit the preamble for early TA acquisition to candidate DU 1003 upon the reception of the PDCCH order. In some implementations, if candidate DU 1003 can calculate an early TA value for the particular candidate cell based on the received preamble, candidate DU 1003 may transmit the preamble and corresponding RACH occasion, a beam indication, an ID of UE 1001, RA-RNTI, ID information of the candidate cell ID (i.e., target cell ID), TCI State index for the candidate cell or similar information, and/or the calculated TA value to source DU 1002 via CU 1004. In some implementations, candidate DU 1003 may store the calculated TA value.

[0224] Regarding the Inter-CU mobility scenario, in operation 1018, the target CU (not shown in Figure 10) (e.g. a CU of BS #2) which manages the candidate (target) DU may transmit at least one of the early TA value of the candidate cell and the corresponding preamble, a RACH occasion, a UE ID, or a target cell ID to source CU 1004 via an F1 interface. Then, the source CU 1004 may transmit the received information to source DU 1002.

[0225] In operation 1019, source DU 1002 will receive an early TA value of the candidate cell from source CU 1004. In some implementations, source DU 1002 is responsible for checking the validity of the early TA value of the candidate cell. For example, source DU 1002 starts a timer upon the reception of the early TA value from candidate DU 1003 via the target CU and the source CU (which are the same CU in an intra-CU mobility scenario and different CUs in an inter-CU mobility scenario). Once the timer expires, source DU 1002 may transmit a PDCCH order for an early TA re-acquisition. Therefore, if source DU 1002

determines that the early TA value is invalid, source DU 1002 may transmit a PDCCH order for an early TA re-acquisition.

[0226] In operation 1020, source DU 1002 may transmit an LTM cell switch command for the candidate cell to UE 1001 for triggering cell switching related to the candidate cell.

[0227] In operation 1021, upon reception of the LTM cell switch command, UE 1001 may start an LTM timer (i.e. a supervisor timer) and performs LTM cell switching towards the candidate cell indicated in the LTM cell switch command. UE 1001 may consider that an LTM cell switch failure (which may also be named as "an LTM failure" or "an SCG LTM failure" or the like) occurs upon an expiry of the LTM timer. UE 1001 shall initiate an SCG failure information procedure upon the occurrence of the LTM cell switch failure. For example, UE 1001 may transmit an SCG failure information message (e.g. message #1 as described in the embodiments of Figure 6) to an MCG BS (not shown in Figure 10) (i.e. MCG gNB) which is serving UE 1001. In some embodiments, the following information may be included in the SCG failure information message:

- (1) information indicating an LTM cell switch failure;
- (2) a L1 measurement result for the source cell when the LTM cell switch failure occurs, which may be encapsulated in a container of an RRC message;
- (3) a L1 measurement result for the candidate cell when the LTM cell switch failure occurs, which may be encapsulated in a container of an RRC message; or
- (4) A failure type of the LTM cell switch failure, e.g. including: a RACH-less based LTM cell switch failure, a RACH-less based LTM cell switch failure with CG, a RACH-less based LTM cell switch failure without CG, a RACH based LTM cell switch failure; or an expiry of the supervisor timer.

[0228] Figure 11 illustrates a flowchart of a method related to an LTM cell switch procedure in accordance with aspects of the present disclosure. The operations of the method may be implemented by a network node as described herein. In some implementations, the network node may be a source DU of a BS, and may execute a set of instructions to control the function elements of the source DU to perform the described functions. In some implementations, aspects of operations 1102, 1104, and 1106 may be performed by NE 400

or source DU 1402 as described with reference to Figure 4 or Figure 14. Each of operations 1102, 1104, and 1106 may be performed in accordance with examples as described herein. Specific examples are described in the embodiments of Figure 14 as follows.

[0229] At operation 1102, the method may include transmitting, to a UE, a PDCCH order for triggering an early TA acquisition related to a candidate cell. The candidate cell is associated with a cell switch procedure. For example, the cell switch procedure may be a PCell switch procedure or a PSCell switch procedure.

[0230] At operation 1104, the method may include determining whether a failure of the early TA acquisition occurs. At operation 1106, the method may include transmitting information indicating the failure of the early TA acquisition to a CU of the BS (e.g. CU 1404 as described with reference to Figure 14) if determining that the failure of the early TA acquisition occurs.

[0231] In some implementations of the method described herein, the source DU may transmit at least one of the following to the CU: ID information of the UE; or a timer length of a TAT associated with the early TA acquisition.

[0232] In response to the occurrence of the failure of the early TA acquisition, the source DU may trigger an early TA re-acquisition related to the candidate cell in some implementations, or the DU may retransmit, to the UE, the PDCCH order for triggering the early TA acquisition related to the candidate cell in some other implementations.

[0233] In some implementations of the method described herein, the source DU may transmit at least one of the following to a CU of the BS:

- (1) information indicating whether an early TA re-acquisition due to the occurrence of the failure is triggered;
- (2) a total number of performing early TA acquisition for the candidate cell before the DU receiving the early TA value for the candidate cell; or
- (3) a total number of transmitting PDCCH orders for triggering the early TA acquisition related to the candidate cell before the DU receiving the early TA value for the candidate cell.

[0234] It should be noted that the method described in Figure 8 describes possible implementations, and that the operations and the steps may be rearranged or otherwise eliminated or modified and that other implementations are possible, without departing from the spirit and scope of the disclosure.

[0235] Figure 12 illustrates a flowchart of a method related to an LTM cell switch procedure in accordance with aspects of the present disclosure. The operations of the method may be implemented by a network node as described herein. In some implementations, the network node may be a source DU of a BS, and may execute a set of instructions to control the function elements of the source DU to perform the described functions. In some implementations, aspects of operations 1202, 1204, 1206, and 1208 may be performed by NE 400 or source DU 1502 as described with reference to Figure 4 or Figure 15. Each of operations 1202 to 1208 may be performed in accordance with examples as described herein. Specific examples are described in the embodiments of Figure 15 as follows.

[0236] At operation 1202, the method may include transmitting, by a source DU of a BS (denoted as "BS #a"), a PDCCH order for triggering an early TA acquisition related to a candidate cell. The candidate cell is associated with a cell switch procedure of a UE. For example, the cell switch procedure may be a PCell switch procedure or a PSCell switch procedure.

[0237] At operation 1204, the method may include receiving an early TA value for the candidate cell from a candidate DU of another BS (denoted as "BS #b") related to the candidate cell. BS #a may be the same as or different from BS #b. For example, if BS #a is the same as BS #b, it is an intra-BS case, e.g. an Intra-CU mobility scenario. If BS #a is different from BS #b, it is an inter-BS case, e.g. an Inter-CU mobility scenario.

[0238] At operation 1206, the method may include storing the early TA value for the candidate cell. At operation 1208, the method may include determining whether the early TA value for the candidate cell is valid.

[0239] In some implementations of the method described herein, the source DU may determine whether the early TA value for the candidate cell is valid based on a timer or a threshold for an RSRP change. For instance, if the timer expires, the DU may determine that the early TA value for the candidate cell is invalid. If the RSRP change is greater than the

threshold, the DU may determine that the early TA value for the candidate cell is invalid. For instance, if the early TA value for the candidate cell is invalid, the DU may retransmit, to the UE, the PDCCH order for triggering the early TA acquisition related to the candidate cell.

[0240] In some implementations of the method described herein, the source DU may transmit, to the UE, an LTM cell switch command for triggering the cell switch procedure towards the candidate cell. The LTM cell switch command includes at least one of: ID information of the candidate cell; or the early TA value for the candidate cell.

[0241] In some implementations of the method described herein, the source DU may log time of transmitting the LTM cell switch command, and transmit the time of transmitting the LTM cell switch command to the candidate DU related to the candidate cell.

[0242] In some implementations of the method described herein, the source DU may transmit one of the following to a CU (e.g. in an intra-BS or inter-BS case):

- (1) time elapsed between reception of a firstly received early TA value for the candidate cell and time of triggering the cell switch procedure towards the candidate cell; or
- (2) time elapsed between reception of a latest received early TA value for the candidate cell and the time of triggering the cell switch procedure towards the candidate cell.

[0243] In some implementations of the method described herein, the source DU may transmit at least one of the following to a CU (e.g. in an intra-BS or inter-BS case):

- (1) information indicating whether an early TA re-acquisition related to the candidate cell is triggered, wherein the early TA re-acquisition is due to a determination of invalidity of a received early TA value for the candidate cell;
- (2) a total number of performing early TA re-acquisition for the candidate cell due to the determination of the invalidity of an early TA value for the candidate cell;
- (3) a timer length of a TAT used to determine whether the received early TA value for the candidate cell is valid; or
- (4) a threshold related to a RSRP change used to determine whether the received early TA value for the candidate cell is valid.

[0244] It should be noted that the method described in Figure 12 describes possible implementations, and that the operations and the steps may be rearranged or otherwise eliminated or modified and that other implementations are possible, without departing from the spirit and scope of the disclosure.

[0245] Figure 13 illustrates a flowchart of a method related to an LTM cell switch procedure in accordance with aspects of the present disclosure. The operations of the method may be implemented by a network node as described herein. In some implementations, the network node may be a source CU of a BS, and may execute a set of instructions to control the function elements of the source CU to perform the described functions. In some implementations, aspects of operations 1302 and 1304 may be performed by NE 400 as described with reference to Figure 4. Each of operations 1302 and 1304 may be performed in accordance with examples as described herein.

[0246] At operation 1302, the method may include transmitting LTM candidate cell configuration associated with a candidate cell by a CU (denoted as CU #a) of a BS to a UE.

[0247] At operation 1304, the method may include transmitting a RACH resource for an early TA acquisition to a source DU managed by CU #a. The candidate cell is associated with a cell switch procedure from a source cell of the UE towards the candidate cell. For example, the cell switch procedure may be a PCell switch procedure or a PSCell switch procedure.

[0248] In some implementations of the method described herein, CU #a may receive information indicating a failure of the early TA acquisition related to the candidate cell from a DU of the BS managed by CU #a.

[0249] In some implementations of the method described herein, CU #a may receive at least one of the following from the source DU: ID information of the UE; or a timer length of a TAT associated with the early TA acquisition.

[0250] In some implementations, if the candidate cell is related to a target DU of the BS (e.g. in an intra-BS case), CU #a may transfer at least one of the following to the target DU:

- (1) the information indicating the failure;
- (2) the ID information of the UE; or

(3) the timer length of the TAT associated with the early TA acquisition.

[0251] In some other implementations, if the candidate cell is related to another CU (denoted as CU #b) (e.g. in an inter-BS case), CU #a may transfer at least one of the following to CU #b:

- (1) the information indicating the failure;
- (2) the ID information of the UE; or
- (3) the timer length of the TAT associated with the early TA acquisition.

[0252] In some implementations of the method described herein, CU #a may receive, from the source DU at least one of the following information (denoted as information #1):

- (1) information indicating whether an early TA re-acquisition due to the occurrence of the failure is triggered;
- (2) a total number of performing early TA acquisition procedures for the candidate cell before the source DU receiving the early TA value for the candidate cell; or
- (3) a total number of transmitting PDCCH orders for triggering the early TA acquisition related to the candidate cell before the source DU receiving the early TA value for the candidate cell.

[0253] In some implementations of the method described herein, CU #a may receive, from the source DU at least one of the following information (denoted as information #2):

- (1) time elapsed between reception of a firstly received early TA value for the candidate cell and time of triggering the cell switch procedure towards the candidate cell; or
- (2) time elapsed between reception of a latest received early TA value for the candidate cell and the time of triggering the cell switch procedure towards the candidate cell.

[0254] In some implementations of the method described herein, CU #a may receive, from the source DU at least one of the following information (denoted as information #3):

- (1) information indicating whether an early TA re-acquisition related to the candidate cell is triggered, wherein the early TA re-acquisition is due to a determination of invalidity of a received early TA value for the candidate cell;

- (2) a total number of performing early TA re-acquisition for the candidate cell due to the determination of the invalidity of an early TA value for the candidate cell;
- (3) a timer length of a TAT used to determine whether the received early TA value for the candidate cell is valid; or
- (4) a threshold related to a RSRP change used to determine whether the received early TA value for the candidate cell is valid.

[0255] In some implementations, if the candidate cell is related to another CU (e.g. a target CU which manages a target DU) (e.g., CU #b), CU #a may transmit at least one of information #1, information #2, or information #3 to the another CU.

[0256] In some implementations of the method described herein, a timer length of a TAT used to determine whether the TA value for the candidate cell is valid is generated by the source DU. If the UE fails to complete the cell switch procedure from the source cell towards the candidate cell, CU #a may transmit, to the source DU, information indicating that the cell switch procedure towards the candidate cell is failed. Specific examples are described in the embodiments of Figures 14 and 15 as follows.

[0257] It should be noted that the method described in Figure 13 describes possible implementations, and that the operations and the steps may be rearranged or otherwise eliminated or modified and that other implementations are possible, without departing from the spirit and scope of the disclosure.

[0258] In accordance with some other aspects of the present disclosure, operations of a method related to an LTM cell switch procedure may be implemented by a target CU of a BS as described herein. In some implementations, the target CU may execute a set of instructions to control the function elements of the target CU to perform the described functions. In some implementations, the method may include receiving, by a target CU of a BS from a source CU of another BS (e.g. by CU #b from CU #a as described in the embodiments of Figure 13), information indicating a failure of an early TA acquisition related to a candidate cell or invalidity of an early TA value of the candidate cell. The candidate cell is associated with a cell switch procedure from a source cell of a UE towards the candidate cell. The source cell is related to the source CU (e.g. CU #a). The candidate cell is related to the target CU (e.g. CU #b).

[0259] In some implementations, the cell switch procedure may be a PCell switch procedure or a PSCell switch procedure.

[0260] In some implementations of the method described herein, the target CU may receive at least one of the following from the source CU: ID information of the UE; or a timer length of a TAT associated with the early TA acquisition.

[0261] In some implementations of the method described herein, the target CU may transmit at least one of the following to a target DU managed by the target CU related to the candidate cell: (1) the information indicating the occurrence of the failure; (2) the ID information of the UE; or (3) the timer length of the TAT associated with the early TA acquisition.

[0262] In some implementations of the method described herein, the target CU may receive at least one of information #1, information #2, or information #3 as described in the embodiments of Figure 13 from the source CU.

[0263] In some implementations of the method described herein, the target CU may transmit at least one of information #1, information #2, or information #3 as described in the embodiments of Figure 13 to a target DU managed by the target CU related to the candidate cell.

[0264] Figure 14 illustrates a schematic diagram of an LTM cell switch procedure in accordance with aspects of the present disclosure. Details described in all other embodiments of the present disclosure are applicable for the embodiments shown in Figure 14.

[0265] As shown in Figure 14, BS 1405 is in CU-DU architecture, and includes CU 1404, source DU 1402, and candidate DU 1403. In the embodiments of Figure 14, a cell switching operation performed by UE 1401 may refer to an Intra-CU mobility scenario in which a source cell and a target cell in the same CU or refer to an Inter-CU mobility scenario in which a source cell and a target cell are located at different CUs. For instance, the flowchart 1400 as shown in Figure 14 only shows a cell switching operation in an intra-CU mobility scenario for the exemplary purpose where source DU 1402 and candidate DU 1403 are managed by the same CU 1404. The flowchart 1400 also can be applied to an Inter-CU mobility scenario where source DU 1402 and candidate DU 1403 are managed by different CUs.

[0266] In the exemplary flowchart 1400 as shown in Figure 14, in operation 1411, UE 1401 may access the serving BS (e.g. gNB) and send a measurement report to the serving BS, for example, BS 1405. The serving BS may include a CU (e.g. gNB-CU) and one or more DUs (e.g. gNB-DUs). A serving cell is associated with a CU and a DU. There is an F1 interface between the DU and the CU. For example, as shown in Figure 14, BS 1405 includes CU 1404, source DU 1402, and candidate DU 1403. BS 1405 may include one or more other candidate DUs (not shown in Figure 14). In some implementations, UE 1401 may send the measurement report to CU 1404 via source DU 1402.

[0267] In operation 1412, source CU 1404 of serving BS 1405 may determine to initiate a L1/L2 based inter-cell mobility configuration procedure, i.e., making a L1/L2 based inter-cell mobility configuration decision.

[0268] In operation 1413, in an Intra-CU LTM case (i.e., Intra-CU mobility scenario), the source CU (e.g. source CU 1404) may send a request message, e.g. UE CONTEXT SETUP REQUEST, including the ID information of candidate cell(s) to the candidate (target) DU (e.g. candidate DU 1403) of the same BS. The request for a RACH resource for an early TA acquisition may also be included in the request message transmitted to the candidate (target) DU. A candidate cell may also be named as a candidate (target) cell. As shown in Figure 14, CU 1404 may send a request message, which contains ID information of the candidate cell(s), to candidate DU 1403 via an F1 interface.

[0269] Alternatively, in an Inter-CU LTM case (i.e., Inter-CU mobility scenario), the source CU (e.g. source CU 1404 of BS 1405) may send a request message e.g. a Handover (HO) request, including the ID information of candidate cell(s) to a candidate (target) CU (not shown in Figure 14). The request for a RACH resource for an early TA acquisition may also be included in the request message transmitted to the candidate (target) CU. Then, the candidate (target) CU may send a request message, e.g. UE CONTEXT SETUP REQUEST, including the ID information of candidate cell(s) to a candidate (target) DU. The request for a RACH resource for an early TA acquisition may also be included in the request message transmitted to the candidate (target) DU.

[0270] In operation 1414, in an Intra-CU LTM case, if the candidate (target) DU (e.g. candidate DU 1403) decides to accept the request of LTM configuration related to a candidate

cell, it responds to the CU (e.g. source CU 1404) including the RRC configuration for the accepted candidate (target) cell, e.g. via UE CONTEXT SETUP RESPONSE. As shown in Figure 14, if candidate DU 1403 decides to accept the request of LTM configuration related to candidate cell(s), candidate DU 1403 may transmit a response message, which includes the RRC configuration(s) for the accepted candidate (target) cell(s), to CU 1404 via an F1 interface. The F1 interface response may include at least one of the following:

- (1) RACH resources for an early TA acquisition,
- (2) an indication indicating an early TA value of the candidate cell determined by the candidate (target) DU,
- (3) an indication indicating that an early TA value of the candidate cell is equal to a fixed value (e.g. 0), or
- (4) an indication indicating that an early TA value of the candidate cell is equal to a TA value of the source cell.

[0271] Alternatively, in an Inter-CU LTM case, if the candidate (target) DU (e.g. a DU of BS #2) decides to accept the request of LTM configuration related to a candidate cell, it responds to a target CU including the RRC configuration for the accepted candidate (target) cell via an F1 interface. The F1 interface response may include at least one of the following:

- (1) RACH resource for early TA acquisition,
- (2) an indication indicating an early TA value of the candidate cell determined by the candidate (target) DU,
- (3) an indication indicating that an early TA value of the candidate cell is equal to a fixed value (e.g. 0), or
- (4) an indication indicating that an early TA value of the candidate cell is equal to a TA value of the source cell.

[0272] Then, the candidate (target) CU may transmit the response, e.g. a handover request acknowledge, to the source CU (e.g. source CU 1404) via an Xn interface. The Xn interface response may include similar elements to those of the F1 interface response received from the candidate (target) DU.

[0273] In operation 1415, source CU 1404 of BS 1405 will transmit the configuration(s) to source DU 1402 of BS 1405. In some implementations, CU 1404 may transmit the configuration(s), e.g. RACH resource(s) for early TA acquisition, to source DU 1402.

[0274] In some implementations, CU 1404 may generate an RRC reconfiguration message based on the configuration(s) from the candidate cell(s) and transmit the RRC reconfiguration message to UE 1401 via source DU 1402. For instance, the RRC reconfiguration message includes candidate cell configuration(s) for LTM and/or RACH resource(s) for early TA acquisition.

[0275] In operation 1416, UE 1401 may receive the RRC reconfiguration message associated with one or more candidate cells for LTM configuration from source DU 1402.

[0276] In operation 1417, UE 1401 may receive a PDCCH order for triggering TA acquisition to a particular candidate cell, e.g. a candidate cell associated with candidate DU 1403, from source DU 1402.

[0277] In operation 1418, UE 1401 may transmit the preamble for early TA acquisition to candidate DU 1403 upon the reception of the PDCCH order.

[0278] In operation 1419, source DU 1402 may start a timer for early TA acquisition (e.g. a TAT) upon transmitting the PDCCH order. It is possible that the candidate DU cannot calculate an early TA value or does not receive the preamble. If source DU 1402 cannot receive an early TA value before the timer expires, source DU 1402 may re-transmit a PDCCH order for an early TA re-acquisition.

[0279] In some implementations, when source DU 1402 transmits a PDCCH order for triggering an early TA acquisition, source DU 1402 starts an early TA timer (e.g. TAT). Source DU 1402 stops the timer upon reception of the early TA value associated with the transmitted preamble. Once the timer expires, source DU 1402 considers that a failure of early TA acquisition occurs. If a failure of early TA acquisition occurs, source DU 1402 may trigger an early TA re-acquisition related to the candidate cell, or source DU 1402 may retransmit, to the UE, the PDCCH order for triggering the early TA acquisition related to the candidate cell.

[0280] In operation 1420, source DU 1402 may transmit the following information to source CU 1404. There may be following two options in different embodiments, i.e., Option #A or Option #B as below.

[0281] Option #A: once source DU 1402 determines that a failure of early TA acquisition occurs, source DU 1402 indicates the failure of early TA acquisition to source CU 1404. For example, CU 1404 may receive at least one of the following from source DU 1402: the failure of early TA acquisition; ID information of the UE; or a timer length of a TAT associated with the early TA acquisition. Then, CU 1404 may perform different operations in different cases.

- (1) In an Intra-CU LTM case, CU 1404 transfers the information indicating the failure of early TA acquisition received from source DU 1402 to candidate (target) DU 1403.
- (2) In an Inter-CU LTM case, CU 1404 (i.e. a source gNB/CU) transmits information indicating the failure of early TA acquisition to a target gNB/CU via Xn interface. For example, source CU 1404 (e.g. CU #a) transmits at least one of the following to the target gNB/CU (e.g. CU #b): the information indicating the failure; ID information of the UE; or a timer length of a TAT associated with the early TA acquisition.

[0282] Option #B: once source DU 1402 determines that a failure of early TA acquisition occurs, source DU 1402 may transmit at least one of the following (e.g. information #1 as described in the embodiments of Figure 13) to CU 1404:

- (1) information indicating whether an early TA re-acquisition due to the occurrence of the failure is triggered;
- (2) a total number of performing early TA acquisition for the candidate cell before the DU receiving the early TA value for the candidate cell, e.g., 1, 2, 3, and so on; or
- (3) a total number of transmitting PDCCH orders for triggering the early TA acquisition related to the candidate cell before the DU receiving the early TA value for the candidate cell, e.g., 1, 2, 3, and so on.

[0283] Figure 15 illustrates a schematic diagram of an LTM cell switch procedure in accordance with aspects of the present disclosure. Details described in all other embodiments of the present disclosure are applicable for the embodiments shown in Figure 15.

[0284] As shown in Figure 15, BS 1505 is in CU-DU architecture, and includes CU 1504, source DU 1502, and candidate DU 1503. In the embodiments of Figure 15, a cell switching operation performed by UE 1501 may refer to an Intra-CU mobility scenario in which a source cell and a target cell in the same CU or refer to an Inter-CU mobility scenario in which a source cell and a target cell are located at different CUs. For instance, the flowchart 1500 as shown in Figure 15 only shows a cell switching operation in an intra-CU mobility scenario for the exemplary purpose where source DU 1502 and candidate DU 1503 are managed by the same CU 1504 (e.g. BS #a is the same as BS #b as described in the embodiments of Figure 12). The flowchart 1500 also can be applied to an Inter-CU mobility scenario where source DU 1502 and candidate DU 1503 are managed by different CUs (e.g. BS #a is different from BS #b as described in the embodiments of Figure 12).

[0285] In the exemplary flowchart 1500 as shown in Figure 15, in operation 1511, UE 1501 may access the serving BS (e.g. BS 1505) and send a measurement report to the serving BS. The serving BS may include a CU (e.g. gNB-CU) and one or more DUs (e.g. gNB-DUs). A serving cell is associated with a CU and a DU. There is an F1 interface between the DU and the CU. For example, BS 1505 includes CU 1504, source DU 1502, and candidate DU 1503. BS 1505 may include one or more other candidate DUs (not shown in Figure 15). In some implementations, UE 1501 may send the measurement report to CU 1504 via source DU 1502.

[0286] In operation 1512, source CU 1504 of serving BS 1505 may determine to initiate a L1/L2 based inter-cell mobility configuration procedure, i.e., making a L1/L2 based inter-cell mobility configuration decision.

[0287] In operation 1513, in an Intra-CU LTM case (i.e., Intra-CU mobility scenario), the source CU (e.g. source CU 1504) may send a request message, e.g. UE CONTEXT SETUP REQUEST, including the ID information of candidate cell(s) to the candidate (target) DU (e.g. candidate DU 1503) of the same BS. The request for a RACH resource for an early TA acquisition may also be included in the request message transmitted to the candidate (target) DU. A candidate cell may also be named as a candidate (target) cell. As shown in Figure 15, CU 1504 may send a request message, which contains ID information of the candidate cell(s), to candidate DU 1503 via an F1 interface.

[0288] Alternatively, in an Inter-CU LTM case (i.e., Inter-CU mobility scenario), the source CU (e.g. source CU 1504 of BS 1505) (e.g. BS #a) may send a request message e.g. a Handover (HO) request, including the ID information of candidate cell(s) to a candidate (target) CU (not shown in Figure 15) (e.g. a CU of BS #b). The request for a RACH resource for an early TA acquisition may also be included in the request message transmitted to the candidate (target) CU. Then, the candidate (target) CU may send a request message, e.g. UE CONTEXT SETUP REQUEST, including the ID information of candidate cell(s) to a candidate (target) DU. The request for a RACH resource for an early TA acquisition may also be included in the request message transmitted to the candidate (target) DU.

[0289] In operation 1514, in an Intra-CU LTM case, if the candidate (target) DU (e.g. candidate DU 1503) decides to accept the request of LTM configuration related to a candidate cell, it responds to the CU (e.g. source CU 1504) including the RRC configuration for the accepted candidate (target) cell, e.g. via UE CONTEXT SETUP RESPONSE. As shown in Figure 15, if candidate DU 1503 decides to accept the request of LTM configuration related to candidate cell(s), candidate DU 1503 may transmit a response message, which includes the RRC configuration(s) for the accepted candidate (target) cell(s), to CU 1504 via an F1 interface. The F1 interface response may include at least one of the following:

- (1) RACH resources for an early TA acquisition,
- (2) an indication indicating an early TA value of the candidate cell determined by the candidate (target) DU,
- (3) an indication indicating that an early TA value of the candidate cell is equal to a fixed value (e.g. 0), or
- (4) an indication indicating that an early TA value of the candidate cell is equal to a TA value of the source cell.

[0290] Alternatively, in an Inter-CU LTM case, if the candidate (target) DU (e.g. a DU of BS #a) decides to accept the request of LTM configuration related to a candidate cell, it responds to a target CU (e.g. a CU of BS #b) including the RRC configuration for the accepted candidate (target) cell via an F1 interface. The F1 interface response may include at least one of the following:

- (1) RACH resource for early TA acquisition,
- (2) an indication indicating an early TA value of the candidate cell determined by the candidate (target) DU,
- (3) an indication indicating that an early TA value of the candidate cell is equal to a fixed value (e.g. 0), or
- (4) an indication indicating that an early TA value of the candidate cell is equal to a TA value of the source cell.

[0291] Then, the candidate (target) CU may transmit the response, e.g. a handover request acknowledge, to the source CU (e.g. source CU 1504) via an Xn interface. The Xn interface response may include similar elements to those of the F1 interface response received from the candidate (target) DU.

[0292] In operation 1515, source CU 1504 of BS 1505 will transmit the configuration(s) to source DU 1502 of BS 1505. In some implementations, CU 1504 may transmit the configuration(s), e.g. RACH resource(s) for early TA acquisition, to source DU 1502.

[0293] In some implementations, CU 1504 may generate an RRC reconfiguration message based on the configuration(s) from the candidate cell(s) and transmit the RRC reconfiguration message to UE 1501 via source DU 1502. For instance, the RRC reconfiguration message includes candidate cell configuration(s) for LTM and/or RACH resource(s) for early TA acquisition.

[0294] In operation 1516, UE 1501 may receive the RRC reconfiguration message associated with one or more candidate cells for LTM configuration from source DU 1502.

[0295] In operation 1517, UE 1501 may receive a PDCCH order for triggering TA acquisition to a particular candidate cell, e.g. a candidate cell associated with candidate DU 1503, from source DU 1502.

[0296] In operation 1518, UE 1501 may transmit the preamble for early TA acquisition to candidate DU 1503 upon the reception of the PDCCH order. In some implementations, if candidate DU 1503 can calculate an early TA value for the particular candidate cell based on the received preamble, candidate DU 1503 may transmit the preamble and corresponding

RACH occasion, a beam indication, an ID of UE 1501, RA-RNTI, ID information of the candidate cell ID (i.e., target cell ID), TCI State index for the candidate cell or similar information, and/or the calculated TA value to source DU 1502 via CU 1504. In some implementations, candidate DU 1503 may store the calculated TA value.

[0297] Regarding the Inter-CU mobility scenario, in operation 1518, the target CU (not shown in Figure 15) which manages the candidate DU may transmit at least one of the TA value and corresponding preamble, a RACH occasion, a UE ID, or a target cell ID to source CU 1504 via an F1 interface. Then, the source CU may transmit the received information to source DU 1502.

[0298] In operation 1519, source DU 1502 will receive an early TA value of the candidate cell from source CU 1504. In some implementations, source DU 1502 is responsible for checking the validity of the early TA value of the candidate cell. For example, source DU 1502 starts a timer upon the reception of the early TA value from candidate DU 1503 via the target CU and the source CU (which are the same CU in an intra-CU mobility scenario and are different CUs in an inter-CU mobility scenario). Once timer expires, source DU 1502 may transmit a PDCCH order for an early TA re-acquisition. Therefore, if source DU 1502 determines that the early TA value is invalid, source DU 1502 may transmit a PDCCH order for an early TA re-acquisition.

[0299] In operation 1520, source DU 1502 may transmit an LTM cell switch command for a candidate cell to UE 1501 for triggering cell switching related to the candidate cell to source CU 1504.

[0300] In operation 1521, upon reception of the LTM cell switch command, UE 1501 may perform an LTM cell switching towards the candidate cell indicated by the LTM cell switch command.

[0301] After operation 1521, there may be following options in different embodiments, i.e., Option #1 or Option #2 or Option #3 as below.

[0302] Option #1 (operation 1522A is performed)

[0303] In operation 1522A, if UE 1501 successfully completed the LTM cell switching towards the candidate cell, source DU 1502 may report the following information (e.g.

information #2 and information #3 as described in the embodiments of Figure 13) to source CU 1504. Regarding Inter-CU mobility scenario, after source CU 1504 receives the report from source DU, source CU 1504 may transmit the report to a target CU/gNB (e.g. BS #b).

- (1) time elapsed between reception of a firstly received early TA value for the candidate cell and time of triggering the cell switch procedure towards the candidate cell; or
- (2) time elapsed between reception of a latest received early TA value for the candidate cell and the time of triggering the cell switch procedure towards the candidate cell.
- (3) information indicating whether an early TA re-acquisition related to the candidate cell is triggered, wherein the early TA re-acquisition is due to a determination of invalidity of a received early TA value for the candidate cell;
- (4) a total number of performing early TA re-acquisition for the candidate cell due to the determination of the invalidity of an early TA value for the candidate cell;
- (5) a timer length of a TAT used to determine whether the received early TA value for the candidate cell is valid; or
- (6) a threshold related to a RSRP change used to determine whether the received early TA value for the candidate cell is valid.

[0304] Option #2 (operation 1522B is performed)

[0305] In operation 1522B, in the case that source DU 1502 itself provides a timer length of the TAT, if UE 1501 successfully perform the LTM cell switching, target DU 1503 indicates to source DU 1502 via source CU 1504 that the LTM cell switching is successful. If UE 1501 fails to complete the LTM cell switching, e.g. the LTM timer expiry, source DU 1502 is informed by source CU 1504 that the LTM cell switching is failed.

[0306] Option #3 (operation 1522C is performed)

[0307] In operation 1522C, in the case that target DU 1503 provides a timer length of the TAT, UE 1501 logs the time stamp of the reception of LTM cell switch command. If UE 1501 fails to perform LTM cell switching, UE 1501 reports the time stamp of the reception of LTM cell switch command to source DU 1502.

[0308] The description herein is provided to enable a person having ordinary skill in the art to make or use the disclosure. Various modifications to the disclosure will be apparent to a person having ordinary skill in the art, and the generic principles defined herein may be applied to other variations without departing from the scope of the disclosure. Thus, the disclosure is not limited to the examples and designs described herein but is to be accorded the broadest scope consistent with the principles and novel features disclosed herein.

What is claimed:

1. A user equipment (UE), comprising:
 - at least one memory; and
 - at least one processor coupled to the at least one memory and configured to cause the UE to:
 - receive, from a source cell of a first base station (BS), lower layer-triggered mobility (LTM) configuration information related to a candidate cell of a second BS, wherein the first BS is same as or different from the second BS;
 - receive, from the source cell, an LTM cell switch command for triggering a cell switch procedure, wherein the LTM cell switch command includes at least one of:
 - identifier (ID) information of the candidate cell; or
 - an early timing advance (TA) value for the candidate cell; and
 - perform the cell switch procedure towards the candidate cell upon receiving the LTM cell switch command and start a supervisor timer.
2. The UE of Claim 1, wherein the cell switch procedure is:
 - a primary cell of a master cell group (PCell) switch procedure; or
 - a primary secondary cell group cell (PSCell) switch procedure.
3. The UE of Claim 2, wherein if the cell switch procedure is the PCell switch procedure, the processor is configured to cause the UE to:
 - connect to a cell of a third BS via re-establishment procedure upon an expiry of the supervisor timer;
 - transmit, to the cell of the third BS, information indicating that a report for an LTM cell switch failure is available;
 - receive a request for the report from the third BS; and
 - transmit the report to the third BS.
4. The UE of Claim 3, wherein the report includes at least one of the following:
 - the early TA value for the candidate cell;
 - information indicating whether the cell switch procedure is a random access channel (RACH)-less based LTM cell switch or a RACH based LTM cell switch;

information indicating whether the cell switch procedure is a RACH-less based LTM cell switch failure with configured grant (CG);

information indicating whether the cell switch procedure is a RACH-less based LTM cell switch failure without CG;

information indicating whether the LTM cell switch failure occurs;

a layer-1 (L1) measurement result for the source cell when the LTM cell switch failure occurs; or

a L1 measurement result for the candidate cell when the LTM cell switch failure occurs.

5. The UE of Claim 3, wherein:

the early TA value for the candidate cell is obtained by the source cell via an early TA acquisition, and received by the UE from the source cell;

the early TA value for the candidate cell is set as a fixed value; or

the early TA value for the candidate cell is set as identical with a TA value of the source cell.

6. The UE of Claim 3, wherein the processor is configured to cause the UE to transmit, to the third BS, a total number of LTM executions towards the same candidate cell if subsequent LTM is supported.

7. The UE of Claim 6, wherein the total number includes:

only a total number of successful completion of the cell switch procedure; or

both a total number of the LTM cell switch failure and the total number of successful completion of the cell switch procedure.

8. The UE of Claim 2, wherein if the cell switch procedure is a PSCell switch procedure, the processor is configured to cause the UE to:

transmit a secondary cell group (SCG) failure information message to a master node (MN) serving the UE upon an expiry of the supervisor timer.

9. The UE of Claim 8, wherein the SCG failure information message includes at least one of the following:

information indicating an LTM cell switch failure;

- a layer-1 (L1) measurement result for the source cell when the LTM cell switch failure occurs;
 - a L1 measurement result for the candidate cell when the LTM cell switch failure occurs;
 - information indicating a RACH-less based LTM cell switch failure;
 - information indicating a RACH-less based LTM cell switch failure with configured grant (CG);
 - information indicating a RACH-less based LTM cell switch failure without CG;
 - information indicating a RACH based LTM cell switch failure; or
 - information indicating an expiry of the supervisor timer.
10. The UE of Claim 4 or Claim 9, wherein at least one of the L1 measurement result for the source cell or a L1 measurement result for the candidate cell is encapsulated in a container of a radio resource control (RRC) message.
11. A base station (BS), comprising:
- at least one memory; and
 - at least one processor coupled to the at least one memory and configured to cause the UE to:
 - receive a radio resource control (RRC) reestablishment request from a user equipment (UE) after a failure of a lower layer-triggered mobility (LTM) cell switch procedure occurs; and
 - transmit an RRC reestablishment message to the UE.
12. The BS of Claim 11, wherein the LTM cell switch procedure is:
- a primary cell of a master cell group (PCell) switch procedure; or
 - a primary secondary cell group cell (PSCell) switch procedure.
13. The BS of Claim 11, wherein the processor is configured to cause the BS to:
- receive, from the UE, information indicating that a report for an LTM cell switch failure is available;
 - transmit a request for the report to the UE; and
 - receive the report from the UE.

14. The BS of Claim 13, wherein the processor is configured to cause the BS to transfer the report to a source BS of the source cell.
15. The BS of Claim 13 or Claim 14, wherein the report includes at least one of the following:
 - the early TA value for the candidate cell;
 - information indicating whether the cell switch procedure is a random access channel (RACH)-less based LTM cell switch or a RACH based LTM cell switch;
 - information indicating whether the cell switch procedure is a RACH-less based LTM cell switch failure with configured grant (CG);
 - information indicating whether the cell switch procedure is a RACH-less based LTM cell switch failure without CG;
 - information indicating whether the LTM cell switch failure occurs;
 - a layer-1 (L1) measurement result for the source cell when the LTM cell switch failure occurs; or
 - a L1 measurement result for the candidate cell when the LTM cell switch failure occurs.
16. The BS of Claim 11, wherein the processor is configured to cause the BS to receive, from the UE, a total number of LTM executions towards the same candidate cell if subsequent LTM is supported.
17. The BS of Claim 16, wherein the total number includes:
 - only a total number of successful completion of the cell switch procedure; or
 - both a total number of the LTM cell switch failure and the total number of successful completion of the cell switch procedure.
18. A source base station (BS), comprising:
 - at least one memory; and
 - at least one processor coupled to the at least one memory and configured to cause the UE to:
 - transmit, to a user equipment (UE), lower layer-triggered mobility (LTM) configuration information related to a candidate cell of the UE; and

transmit, to the UE, an LTM cell switch command for triggering a cell switch procedure from a source cell of the source BS towards the candidate cell, wherein the LTM cell switch command includes at least one of:

identifier (ID) information of the candidate cell; or
an early timing advance (TA) value for the candidate cell.

19. The source BS of Claim 18, wherein the processor is configured to cause the source BS to receive a report for an LTM cell switch failure from a third BS, wherein the report is transmitted by the UE to the third BS.
20. The source BS of Claim 19, wherein the report includes at least one of the following:
 - the early TA value for the candidate cell;
 - information indicating whether the cell switch procedure is a random access channel (RACH)-less based LTM cell switch or a RACH based LTM cell switch;
 - information indicating whether the cell switch procedure is a RACH-less based LTM cell switch failure with configured grant (CG);
 - information indicating whether the cell switch procedure is a RACH-less based LTM cell switch failure without CG;
 - information indicating whether the LTM cell switch failure occurs;
 - a layer-1 (L1) measurement result for the source cell when the LTM cell switch failure occurs; or
 - a L1 measurement result for the candidate cell when the LTM cell switch failure occurs.