**3GPP TSG-RAN WG2 Meeting #131 R2-2506225**

**Bengaluru, India, Aug 25–29, 2025**

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.300** | **CR** | **1011** | **rev** | **3** | **Current version:** | **18.6.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

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| ***Title:*** | Introduction of NR mobility enhancements Phase 4 in TS 38.300 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Apple Inc (Rapporteur) | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_Mob\_Ph4-Core | | | | |  | ***Date:*** | | | 2025-08-25 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | B |  | | | | | ***Release:*** | | | Rel-19 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)*  *Rel-20 (Release 20)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | This CR is to introduce the support of NR mobility enhancements Phase 4 | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | In order to support the features of NR mobility enhancements Phase 4, following procedures and changes are introduced in the stage-2 specification.   1. Introduction of inter-CU LTM, as per agreements made from RAN2-125bis, RAN2-126, RAN2-127, RAN2-127bis, RAN2-128, RAN2-129, RAN2-129bis, RAN2-130, RAN2-131. 2. Introduction of L1 event triggered measurement reporting, as per agreements made from RAN2-125bis, RAN2-126, RAN2-127, RAN2#127bis, RAN2-128, RAN2-129, RAN2-129bis, RAN2-130, RAN2-131. 3. Introduction of conditional LTM (C-LTM) as per agreements from RAN2-127bis, RAN2-128, RAN2-129, RAN2-129bis, RAN2-130, RAN2-131. 4. Merge the RAN3 specific changes from R3-254007 5. Merge the RAN3 specific changes from R3-256004 6. Definition of CSI-RS based L1 intra/inter-frequency measurement based on R4-2512334 | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Rel-19 NR mobility enhancements Phase 4 are not supported by TS 38.300. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3.1, 3.2, 9.2.3.1, 9.2.3.5, 9.2.3.6, 9.2.3.X, 9.2.4 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | TS/TR 38.331 CR 5443,5403  TS/TR 38.306 CR 1321  TS/TR 38.321 CR 2098  TS/TR 37.340 CR 0419 | | |
| ***affected:*** | | **X** |  | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | | **X** |  | O&M Specifications | | | |  | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

## 3.1 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1], in TS 36.300 [2] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1] and TS 36.300 [2].

5GC 5G Core Network

5GS 5G System

5QI 5G QoS Identifier

A2X Aircraft-to-Everything

A-CSI Aperiodic CSI

AGC Automatic Gain Control

AI Artificial Intelligence

AKA Authentication and Key Agreement

AMBR Aggregate Maximum Bit Rate

AMC Adaptive Modulation and Coding

AMF Access and Mobility Management Function

AR Augmented Reality

ARP Allocation and Retention Priority

ATG Air to Ground

BA Bandwidth Adaptation

BCCH Broadcast Control Channel

BCH Broadcast Channel

BFD Beam Failure Detection

BH Backhaul

BL Bandwidth reduced Low complexity

BPSK Binary Phase Shift Keying

BRID Broadcast Remote Identification

C-RNTI Cell RNTI

CAG Closed Access Group

CAPC Channel Access Priority Class

CBRA Contention Based Random Access

CCE Control Channel Element

CD-SSB Cell Defining SSB

cellDTRX-RNTI Cell Discontinuous Transmission and Reception RNTI

CFR Common Frequency Resource

CFRA Contention Free Random Access

CG Configured Grant

CHO Conditional Handover

CIoT Cellular Internet of Things

CLI Cross Link interference

CLTM Conditional L1/L2 Triggered Mobility

CMAS Commercial Mobile Alert Service

CORESET Control Resource Set

CP Cyclic Prefix

CPA Conditional PSCell Addition

CPC Conditional PSCell Change

DAA Detect And Avoid

DAG Directed Acyclic Graph

DAPS Dual Active Protocol Stack

DFT Discrete Fourier Transform

DCI Downlink Control Information

DCP DCI with CRC scrambled by PS-RNTI

DCR Direct Communication Request

DL-AoD Downlink Angle-of-Departure

DL-SCH Downlink Shared Channel

DL-TDOA Downlink Time Difference Of Arrival

DMRS Demodulation Reference Signal

DRX Discontinuous Reception

DSR Delay Status Report

DTX Discontinuous Transmission

E-CID Enhanced Cell-ID (positioning method)

EC Energy Cost

EHC Ethernet Header Compression

ePWS enhancements of Public Warning System

ETWS Earthquake and Tsunami Warning System

FS Feature Set

FSA ID Frequency Selection Area Identity

G-CS-RNTI Group Configured Scheduling RNTI

G-RNTI Group RNTI

GFBR Guaranteed Flow Bit Rate

GIN Group ID for Network selection

GNSS Global Navigation Satellite System

GSO Geosynchronous Orbit

H-SFN Hyper System Frame Number

HAPS High Altitude Platform Station

HRNN Human-Readable Network Name

HSDN High Speed Dedicated Network

IAB Integrated Access and Backhaul

IFRI Intra Frequency Reselection Indication

I-RNTI Inactive RNTI

INT-RNTI Interruption RNTI

KPAS Korean Public Alarm System

L2 Layer-2

L3 Layer-3

LBT Listen Before Talk

LDPC Low Density Parity Check

LEO Low Earth Orbit

LTM L1/L2 Triggered Mobility

MBS Multicast/Broadcast Services

MCE Measurement Collection Entity

MCCH MBS Control Channel

MDBV Maximum Data Burst Volume

MEO Medium Earth Orbit

MIB Master Information Block

MICO Mobile Initiated Connection Only

MFBR Maximum Flow Bit Rate

ML Machine Learning

MMTEL Multimedia telephony

MNO Mobile Network Operator

MO-SDT Mobile Originated SDT

MP Multi-Path

MPE Maximum Permissible Exposure

MRB MBS Radio Bearer

MT Mobile Termination

MT-SDT Mobile Terminated SDT

MTCH MBS Traffic Channel

MTSI Multimedia Telephony Service for IMS

MU-MIMO Multi User MIMO

Multi-RTT Multi-Round Trip Time

MUSIM Multi-Universal Subscriber Identity Module

N3C Non-3GPP Connection

NB-IoT Narrow Band Internet of Things

NCD-SSB Non Cell Defining SSB

NCGI NR Cell Global Identifier

NCL Neighbour Cell List

NCR Neighbour Cell Relation

NCRT Neighbour Cell Relation Table

NES Network Energy Savings

NGAP NG Application Protocol

NGSO Non-Geosynchronous Orbit

NID Network Identifier

NPN Non-Public Network

NR NR Radio Access

NSAG Network Slice AS Group

NTN Non-Terrestrial Network

P-MPR Power Management Maximum Power Reduction

P-RNTI Paging RNTI

PCH Paging Channel

PCI Physical Cell Identifier

PDB Packet Delay Budget

PDC Propagation Delay Compensation

PDCCH Physical Downlink Control Channel

PDSCH Physical Downlink Shared Channel

PEI Paging Early Indication

PER Packet Error Rate

PH Paging Hyperframe

PLMN Public Land Mobile Network

PNI-NPN Public Network Integrated NPN

PO Paging Occasion

PQI PC5 5QI

PRACH Physical Random Access Channel

PRB Physical Resource Block

PRG Precoding Resource block Group

PRS Positioning Reference Signal

PS-RNTI Power Saving RNTI

PSDB PDU Set Delay Budget

PSER PDU Set Error Rate

PSI PDU Set Importance

PSIHI PDU Set Integrated Handling Information

PSS Primary Synchronisation Signal

PTM Point to Multipoint

PTP Point to Point

PTW Paging Time Window

PUCCH Physical Uplink Control Channel

PUSCH Physical Uplink Shared Channel

PWS Public Warning System

QAM Quadrature Amplitude Modulation

QFI QoS Flow ID

QMC QoE Measurement Collection

QoE Quality of Experience

QPSK Quadrature Phase Shift Keying

RA Random Access

RA-RNTI Random Access RNTI

RACH Random Access Channel

RANAC RAN-based Notification Area Code

REG Resource Element Group

RIM Remote Interference Management

RLM Radio Link Monitoring

RMSI Remaining Minimum SI

RNA RAN-based Notification Area

RNAU RAN-based Notification Area Update

RNTI Radio Network Temporary Identifier

RQA Reflective QoS Attribute

RQoS Reflective Quality of Service

RS Reference Signal

RSRP Reference Signal Received Power

RSRQ Reference Signal Received Quality

RSSI Received Signal Strength Indicator

RSTD Reference Signal Time Difference

RTT Round Trip Time

RVQoE RAN visible QoE

SCS SubCarrier Spacing

SD Slice Differentiator

SDAP Service Data Adaptation Protocol

SDT Small Data Transmission

SD-RSRP Sidelink Discovery RSRP

SFI-RNTI Slot Format Indication RNTI

SHR Successful Handover Report

SIB System Information Block

SI-RNTI System Information RNTI

SLA Service Level Agreement

SL-PRS Sidelink Positioning Reference Signal

SL-RSRP Sidelink RSRP

SMC Security Mode Command

SMF Session Management Function

SMTC SS/PBCH block Measurement Timing Configuration

S-NSSAI Single Network Slice Selection Assistance Information

SNPN Stand-alone Non-Public Network

SNPN ID Stand-alone Non-Public Network Identity

SpCell Special Cell

SPR Successful PSCell Addition/Change Report

SPS Semi-Persistent Scheduling

SR Scheduling Request

SRAP Sidelink Relay Adaptation Protocol

SRS Sounding Reference Signal

SRVCC Single Radio Voice Call Continuity

SS Synchronization Signal

SSB SS/PBCH block

SSS Secondary Synchronisation Signal

SSSG Search Space Set Group

SST Slice/Service Type

SU-MIMO Single User MIMO

SUL Supplementary Uplink

TA Timing Advance

TB Transport Block

TCE Trace Collection Entity

TN Terrestrial Network

TNL Transport Network Layer

TPC Transmit Power Control

TRP Transmit/Receive Point

TRS Tracking Reference Signal

TSS Timing Synchronization Status

U2N UE-to-Network

U2U UE-to-UE

UAV Uncrewed Aerial Vehicle

UCI Uplink Control Information

UDC Uplink Data Compression

UDM Unified Data Management

UE-Slice-MBR UE Slice Maximum Bit Rate

UL-AoA Uplink Angles of Arrival

UL-RTOA Uplink Relative Time of Arrival

UL-SCH Uplink Shared Channel

UPF User Plane Function

URLLC Ultra-Reliable and Low Latency Communications

VR Virtual Reality

V2X Vehicle-to-Everything

Xn-C Xn-Control plane

Xn-U Xn-User plane

XnAP Xn Application Protocol

XR eXtended Reality

## 3.2 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1], in TS 36.300 [2] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1] and TS 36.300 [2].

**2Rx XR UE**: two antenna port XR UE as specified in TS 38.101-1 [18].

**A2X communication**: A communication to support A2X services leveraging PC5 reference points. A2X services are realized by various types of A2X applications, i.e. BRID or DAA.

**Aerial UE communication:** functionality enabling Aerial UE function, as defined in 16.18.

**Air to Ground network:** An NG-RAN consisting of ground-based gNBs, which provide cell towers that send signals up to an aircraft's antenna(s) of onboard ATG terminal, with typical vertical altitude of around 10,000m and take-off/landing altitudes down to 3000m.

**BH RLC channel**: an RLC channel between two nodes, which is used to transport backhaul packets**.**

**Boundary IAB-node:** as defined in TS 38.401 [4].

**Broadcast MRB**:A radio bearer configured for MBS broadcast delivery.

**CAG Cell**:a PLMN cell broadcasting at least one Closed Access Group identity.

**CAG Member Cell**:for a UE, a CAG cell broadcasting the identity of the selected PLMN, registered PLMN or equivalent PLMN, and for that PLMN, a CAG identifier belonging to the Allowed CAG list of the UE for that PLMN.

**CAG-only cell**: a CAG cell that is only available for normal service for CAG UEs.

**Cell-Defining SSB**: an SSB with an RMSI associated.

**Child node**: IAB-DU's and IAB-donor-DU's next hop neighbour node; the child node is also an IAB-node.

**Conditional Handover (CHO**): a handover procedure that is executed only when execution condition(s) are met.

**Conditional L1/L2 Triggered Mobility (CLTM**): an LTM cell switch procedure that is executed only when execution condition(s) are met.

**CORESET#0**: the control resource set for at least SIB1 scheduling, can be configured either via MIB or via dedicated RRC signalling.

**DAPS Handover**: a handover procedure that maintains the source gNB connection after reception of RRC message for handover and until releasing the source cell after successful random access to the target gNB.

**Data Burst:** A set of multiple PDUs generated and sent by the application in a short period of time, as defined in TS 23.501 [3].

**Direct Path**: a type of UE-to-Network transmission path, where data is transmitted between a UE and the network without sidelink relaying.

**Downstream**: direction toward child node or UE in IAB-topology.

**Early Data Forwarding**: data forwarding that is initiated before the UE executes the handover.

**Earth-centered, earth-fixed**: a global geodetic reference system for the Earth intended for practical applications of mapping, charting, geopositioning and navigation, as specified in NIMA TR 8350.2 [51].

**eRedCap UE**: a UE with enhanced reduced capabilities as specified in clause 4.2.22.1 in TS 38.306 [11].

**Feeder link**: wireless link between the NTN Gateway and the NTN payload.

**Geosynchronous Orbit**: earth-centered orbit at approximately 35786 kilometres above Earth's surface and synchronised with Earth's rotation. A geostationary orbit is a non-inclined geosynchronous orbit, i.e. in the Earth's equator plane.

**Group ID for Network Selection**: an identifier used during SNPN selection to enhance the likelihood of selecting a preferred SNPN that supports a Default Credentials Server or a Credentials Holder, as specified in TS 23.501 [3].

**gNB**: node providing NR user plane and control plane protocol terminations towards the UE, and connected via the NG interface to the 5GC.

**High Altitude Platform Station**: airborne vehicle embarking the NTN payload placed at an altitude between 8 and 50 km.

**IAB-donor**:gNB that provides network access to UEs via a network of backhaul and access links.

**IAB-donor-CU**: as defined in TS 38.401 [4].

**IAB-donor-DU**:as defined in TS 38.401 [4].

**IAB-DU**: gNB-DU functionality supported by the IAB-node to terminate the NR access interface to UEs and next-hop IAB-nodes, and to terminate the F1 protocol to the gNB-CU functionality, as defined in TS 38.401 [4], on the IAB-donor.

**IAB-MT**: IAB-node function that terminates the Uu interface to the parent node using the procedures and behaviours specified for UEs unless stated otherwise. IAB-MT function used in 38-series of 3GPP Specifications corresponds to IAB-UE function defined in TS 23.501 [3].

**IAB-node**: RAN node that supports NR access links to UEs and NR backhaul links to parent nodes and child nodes. The IAB-node does not support backhauling via LTE.

**IAB topology**: the unison of all IAB-nodes and IAB-donor-DUs whose F1 and/or RRC connections are terminated at the same IAB-donor-CU.

**Indirect Path**: a type of UE-to-Network transmission path, where data is forwarded via a U2N Relay UE between a U2N Remote UE and the network.

**Inter-donor partial migration:** migration of an IAB-MT to a parent node underneath a different IAB-donor-CU while the collocated IAB-DU and its descendant IAB-node(s), if any, are terminated at the initial IAB-donor-CU. The procedure renders the said IAB-node as a boundary IAB-node.

**Intra-system Handover**:handover that does not involve a CN change (EPC or 5GC).

**Inter-system Handover**:handover that involves a CN change (EPC or 5GC).

**Late Data Forwarding**: data forwarding that is initiated after the source NG-RAN node knows that the UE has successfully accessed a target NG-RAN node.

**L1/L2 Triggered Mobility**: a cell switch procedure that the network triggers via MAC CE based on L1 or L3 measurement report.

**Mapped Cell ID**: in NTN, it corresponds to a fixed geographical area.

**MBS Radio Bearer**: A radio bearer configured for MBS delivery.

**Mobile-IAB cell**: a cell of a mobile IAB-DU.

**Mobile IAB-DU**: gNB-DU functionality supported by the mobile IAB-node to terminate the NR access interface to UEs, and to terminate the F1 protocol to the gNB-CU functionality on the IAB-donor, as defined in TS 38.401 [4].

**Mobile IAB-DU migration**: procedure for a mobile IAB-node as defined in TS 38.401 [4].

**Mobile IAB-MT**: mobile IAB-node function that terminates the Uu interface to the parent node using the procedures and behaviours specified for UEs unless stated otherwise.

**Mobile IAB-MT migration**: procedure for a mobile IAB-MT as defined in TS 38.401 [4].

**Mobile IAB-node**: RAN node that supports NR access links to UEs and an NR backhaul link to a parent node, and that can conduct physical mobility across the RAN area. The mobile IAB-node function used in 38-series of 3GPP Specifications corresponds to the MBSR function defined in TS 23.501 [3].

**MP Relay UE**: a UE that provides functionality to support connectivity to the network for MP Remote UE(s).

**MP Remote UE**: a UE that communicates with the network via a direct Uu link and a MP Relay UE.

**MSG1**: preamble transmission of the random access procedure for 4-step random access (RA) type.

**MSG3**: first scheduled transmission of the random access procedure.

**MSGA**:preamble and payload transmissions of the random access procedure for 2-step RA type.

**MSGB**:response to MSGA in the 2-step random access procedure. MSGB may consist of response(s) for contention resolution, fallback indication(s), and backoff indication.

**Multicast/Broadcast Service**: A point-to-multipoint service as defined in TS 23.247 [45].

**Multicast MRB**:A radio bearer configured for MBS multicast delivery.

**Multi-hop backhauling**: using a chain of NR backhaul links between an IAB-node and an IAB-donor.

**NCR-Fwd**: Network-Controlled Repeater node function, which performs amplifying-and-forwarding of UL/DL RF signals between gNB and UE. The behaviour of the NCR-Fwd is controlled according to the side control information received by the NCR-MT from a gNB.

**NCR-Fwd access link**: link used for transmissions between the NCR-Fwd and UEs.

**NCR-Fwd backhaul link**: link used for backhauling between the NCR-Fwd and gNB.

**NCR-MT**: NCR-node entity which communicates with a gNB via a control link to receive side control information. The control link is based on NR Uu interface.

**NCR-node**: RAN node comprising NCR-MT and NCR-Fwd.

**ng-eNB**: node providing E-UTRA user plane and control plane protocol terminations towards the UE, and connected via the NG interface to the 5GC.

**NG-C**: control plane interface between NG-RAN and 5GC.

**NG-U**: user plane interface between NG-RAN and 5GC.

**NG-RAN node**: either a gNB or an ng-eNB.

**Non-CAG Cell**: a PLMN cell which does not broadcast any Closed Access Group identity.

**Non-Cell Defining SSB**: an SSB without an RMSI associated.

**Non-Geosynchronous orbit**: earth-centered orbit with an orbital period that does not match Earth's rotation on its axis. This includes Low and Medium Earth Orbit (LEO and MEO). LEO operates at altitudes between 300 km and 1500 km and MEO at altitudes between 7000 km and 25000 km, approximately.

**Non-terrestrial network**: an NG-RAN consisting of gNBs, which provide non-terrestrial NR access to UEs by means of an NTN payload embarked on an airborne or space-borne NTN vehicle and an NTN Gateway.

**NR backhaul link**: NR link used for backhauling between an IAB-node and an IAB-donor, and between IAB-nodes in case of a multi-hop backhauling.

**NR sidelink communication**: AS functionality enabling at least V2X communication as defined in TS 23.287 [40] and/or A2X communication as defined in TS 23.256 [60] and/or the ProSe communication (including ProSe non-Relay and UE-to-Network Relay communication) as defined in TS 23.304 [48], between two or more nearby UEs, using NR technology but not traversing any network node.

**NR sidelink discovery**: AS functionality enabling ProSe non-Relay Discovery and ProSe UE-to-Network Relay discovery for Proximity based Services as defined in TS 23.304 [48] between two or more nearby UEs, using NR technology but not traversing any network node.

**NTN Gateway**: an earth station located at the surface of the earth, providing connectivity to the NTN payload using the feeder link. An NTN Gateway is a TNL node.

**NTN payload**: a network node, embarked on board a satellite or high altitude platform station, providing connectivity functions, between the service link and the feeder link. In the current version of this specification, the NTN payload is a TNL node.

**Numerology**: corresponds to one subcarrier spacing in the frequency domain. By scaling a reference subcarrier spacing by an integer *N*, different numerologies can be defined.

**Parent node**: IAB-MT's or mobile IAB-MT's next hop neighbour node; the parent node can be an IAB-node or IAB-donor-DU

**PC5 Relay RLC channel**: an RLC channel between L2 U2N Remote UE and L2 U2N Relay UE, or between L2 U2U Remote UE and L2 U2U Relay UE, which is used to transport packets over PC5 for L2 UE-to-Network/UE-to-UE Relay**.**

**PDU Set**: one or more PDUs carrying the payload of one unit of information generated at the application level (e.g. frame(s) or video slice(s) for XR Services), as defined in TS 23.501 [3].

**PLMN Cell**: a cell of the PLMN.

**RACH-less LTM**: an LTM cell switch procedure where UE skips the random access procedure.

**RedCap UE**: a UE with reduced capabilities as specified in clause 4.2.21.1 in TS 38.306 [11].

**Relay discovery**: AS functionality enabling 5G ProSe UE-to-Network Relay Discovery as defined in TS 23.304 [48], using NR technology but not traversing any network node.

**Satellite**:a space-borne vehicle orbiting the Earth embarking the NTN payload.

**Service link**:wireless link between the NTN payload and UE.

**Sidelink Discovery RSRP:** RSRP measurements on PC5 link related to NR sidelink discovery.

**Sidelink RSRP:** RSRP measurements on PC5 link related to NR sidelink communication.

**SNPN Access Mode**: mode of operation whereby a UE only accesses SNPNs.

**SNPN-only cell**: a cell that is only available for normal service for SNPN subscribers.

**SNPN Identity**: the identity of Stand-alone NPN defined by the pair (PLMN ID, NID).

**Special Cell:** For Dual Connectivity operation the term Special Cell refers to the PCell of the MCG or the PSCell of the SCG, otherwise, in case of NR Standalone, the term Special Cell refers to the PCell.

**Transmit/Receive Point**:part of the gNB transmitting and receiving radio signals to/from UE according to physical layer properties and parameters inherent to that element.

**U2N Relay UE**: a UE that provides functionality to support connectivity to the network for U2N Remote UE(s).

**U2N Remote UE**: a UE that communicates with the network via a U2N Relay UE.

**U2U Relay UE**: a UE that provides functionality to support connectivity between two U2U Remote UEs.

**U2U Remote UE**: a UE that communicates with other UE(s) via a U2U Relay UE.

**Upstream**: direction toward parent node in IAB-topology.

**Uu Relay RLC channel**: an RLC channel between L2 U2N Relay UE or MP Relay UE and gNB, which is used to transport packets over Uu for L2 UE-to-Network Relay or for indirect path in case of MP.

**V2X sidelink communication**: AS functionality enabling V2X communication as defined in TS 23.285 [41], between nearby UEs, using E-UTRA technology but not traversing any network node.

**Xn**: network interface between NG-RAN nodes.

#### << next change>>

#### 9.2.3.1 Overview

Network controlled mobility applies to UEs in RRC\_CONNECTED and is categorized into two types of mobility: cell level mobility and beam level mobility. Beam level mobility includes intra-cell beam level mobility and inter-cell beam level mobility.

**Cell Level Mobility** requires explicit RRC signalling to be triggered, i.e. handover. For inter-gNB handover, the signalling procedures consist of at least the following elemental components illustrated in Figure 9.2.3.1-1:



Figure 9.2.3.1-1: Inter-gNB handover procedures

1. The source gNB initiates handover and issues a HANDOVER REQUEST over the Xn interface.

2. The target gNB performs admission control and provides the new RRC configuration as part of the HANDOVER REQUEST ACKNOWLEDGE.

3. The source gNB provides the RRC configuration to the UE by forwarding the *RRCReconfiguration* message received in the HANDOVER REQUEST ACKNOWLEDGE. The *RRCReconfiguration* message includes at least cell ID and all information required to access the target cell so that the UE can access the target cell without reading system information. For some cases, the information required for contention-based and contention-free random access can be included in the *RRCReconfiguration* message. The access information to the target cell may include beam specific information, if any.

4. The UE moves the RRC connection to the target gNB and replies with the *RRCReconfigurationComplete*.

NOTE 1: User Data can also be sent in step 4 if the grant allows.

In case of DAPS handover, the UE continues the downlink user data reception from the source gNB until releasing the source cell and continues the uplink user data transmission to the source gNB until successful random access procedure to the target gNB.

Only source and target PCell are used during DAPS handover. CA, DC, SUL, multi-TRP, EHC, CHO, UDC, LTM, NR sidelink configurations and V2X sidelink configurations are released by the source gNB before the handover command is sent to the UE and are not configured by the target gNB until the DAPS handover has completed (i.e. at earliest in the same message that releases the source PCell).

The handover mechanism triggered by RRC requires the UE at least to reset the MAC entity and re-establish RLC, except for DAPS handover, where upon reception of the handover command, the UE:

- Creates a MAC entity for target;

- Establishes the RLC entity and an associated DTCH logical channel for target for each DRB configured with DAPS;

- For each DRB configured with DAPS, reconfigures the PDCP entity with separate security and ROHC functions for source and target and associates them with the RLC entities configured by source and target respectively;

- Retains the rest of the source configurations until release of the source.

The cell switch mechanism triggered by MAC, (i.e., LTM cell switch) requires the UE at least to reset the MAC entity. RLC and PDCP handling depends on the network configuration.

NOTE 2: Void.

NOTE 3: Void.

RRC managed handovers with and without PDCP entity re-establishment are both supported. For DRBs using RLC AM mode, PDCP can either be re-established together with a security key change or initiate a data recovery procedure without a key change. For DRBs using RLC UM mode, PDCP can either be re-established together with a security key change or remain as it is without a key change. For SRBs, PDCP can either remain as it is, discard its stored PDCP PDUs/SDUs without a key change or be re-established together with a security key change.

Data forwarding, in-sequence delivery and duplication avoidance at handover can be guaranteed when the target gNB uses the same DRB configuration as the source gNB.

Timer based handover failure procedure is supported in NR. RRC connection re-establishment procedure is used for recovering from handover failure except in certain CHO, DAPS handover or LTM cell switch scenarios:

- When DAPS handover fails, the UE falls back to the source cell configuration, resumes the connection with the source cell, and reports DAPS handover failure via the source without triggering RRC connection re-establishment if the source link has not been released.

- When initial CHO execution attempt fails or HO fails, the UE performs cell selection, and if the selected cell is a CHO candidate and if network configured the UE to try CHO after handover/CHO failure, then the UE attempts CHO execution once, otherwise re-establishment is performed.

- When LTM execution attempt triggered by LTM cell switch command MAC CE fails, the UE performs cell selection and if the selected cell is an LTM candidate cell and if network configured the UE to try LTM after LTM execution failure, then the UE attempts RACH-based LTM execution once, otherwise re-establishment is performed.

NOTE: PDCP SN gap for SRB may exist upon LTM/CLTM attempt toward the selected cell after LTM/CLTM fails. It is up to network implementation to avoid the latency caused by the PDCP SN gap.

DAPS handover for FR2 to FR2 case is not supported in this release of the specification.

The handover of the IAB-MT in SA mode follows the same procedure as described for the UE. After the backhaul has been established, the handover of the IAB-MT is part of the intra-CU or inter-CU topology adaptation procedures defined in TS 38.401 [4]. Modifications to the configuration of BAP sublayer and higher protocol layers above the BAP sublayer are described in TS 38.401 [4].

The handover of the mobile IAB-MT follows the same procedure as described for the UE. After the backhaul has been established, the handover of the mobile IAB-MT is part of the mobile IAB-MT migration procedure defined in TS 38.401 [4].

#### 9.2.3.5 L1/L2 Triggered Mobility

##### 9.2.3.5.1 General

LTM is a procedure in which a gNB receives L1 or L3 measurement report(s) from a UE, and on their basis the gNB may change UE serving cell by a cell switch command signalled via a MAC CE. The cell switch command indicates an LTM candidate configuration that the gNB previously prepared and provided to the UE through RRC signalling. Then the UE switches to the target configuration according to the cell switch command. The LTM procedure can be used to reduce the mobility latency as described in Annex G.

When configured by the network, it is possible to activate TCI states of one or multiple cells that are different from the current serving cell. For instance, the TCI states of the LTM candidate cells can be activated in advance before any of those cells become the serving cell. This allows the UE to be DL synchronized with those cells, thereby facilitating a faster cell switch to one of those cells when cell switch is triggered. All the activated TCI states except those received in the cell switch command are deactivated upon LTM cell switch execution.

When configured by the network, it is possible to initiate UL TA acquisition (called early TA) procedure of one or multiple cells that are different from the current serving cells. If the cell has the same NTA as the current serving cells or NTA=0, early TA acquisition procedure is not required. The network may request the UE to perform early TA acquisition of a candidate cell before a cell switch. The early TA acquisition procedure is triggered by PDCCH order as specified in clause 9.2.6 or realized through UE-based TA measurement as configured by RRC. In the former case, the gNB/gNB-DU to which the candidate cell belongs calculates the TA value and sends it to the gNB/gNB-DU to which the serving cell belongs via gNB-CU. The serving cell sends the TA value in the LTM cell switch command MAC CE when triggering LTM cell switch. In the latter case, the UE performs TA measurement for the candidate cells after being configured by RRC but the exact time the UE performs TA measurement is up to UE implementation. The UE applies the TA value measured by itself and performs RACH-less LTM upon receiving the cell switch command, if it does not include any valid TA value. The network may also send a TA value in the LTM cell switch command MAC CE without early TA acquisition.

When two TAG IDs are configured for an LTM candidate cell, the gNB-DU to which the LTM candidate cell belongs assigns the same TAG ID pointer value for each TRP to be used by the UEs. Also when two TAG IDs are configured for an LTM candidate cell, UE-based TA measurement is not configured.

Depending on the availability of a valid TA value, the UE performs either a RACH-less LTM or RACH-based LTM cell switch. If the valid TA value is provided in the cell switch command, the UE applies the TA value as instructed by the network. In the case where UE-based TA measurement is configured, but no valid TA value is provided in the cell switch command, the UE applies the valid TA value by itself if available. The UE performs RACH-less LTM cell switch upon receiving the cell switch command whenever a valid TA value is available. If no valid TA value is available, the UE performs RACH-based LTM cell switch.

Regardless of whether the UE is configured for UE-based TA measurement for a certain candidate cell, it will still follow the PDCCH order, which includes performing a random access procedure towards one or more candidate cells. This also applies to the candidate cells for which the UE is capable of deriving TA values by itself. Additionally, regardless of whether the UE has already performed a random access procedure towards the candidate cells, it will still follow the UE-based measurement configuration if configured by the network.

For RACH-less LTM, the UE accesses the target cell using either a configured grant or a dynamic grant. The configured grant is provided in the LTM candidate configuration, and the UE selects the configured grant occasion associated with the beam indicated in the cell switch command. Upon initiation of LTM cell switch to the target cell, the UE starts to monitor PDCCH on the target cell for dynamic scheduling. Before RACH-less LTM procedure completion, the UE shall not trigger random access procedure if it does not have a valid PUCCH resource for triggered SRs.

The following principles apply to LTM:

- Security keys can be changed upon an LTM cell switch based on network indication;

- Subsequent LTM is supported.

LTM supports both intra-gNB mobility, and inter-gNB mobility. LTM supports both intra-frequency and inter-frequency mobility, including mobility to inter-frequency cell that is not a current serving cell. LTM is supported only for licensed spectrum. The following scenarios are supported:

- PCell change in non-CA scenario and non-DC scenario;

- PCell and SCell(s) change in CA scenario;

- Dual connectivity scenarios:

- PCell change together with MCG SCells(s) change and intra-SN PSCell change.

- PSCell change together with SCG SCell(s) change with or without MN involvement.

NOTE: LTM for simultaneous PCell and inter-SN PSCell change is not supported. Inter-gNB LTM configuration for MN and SN at the same time is also not supported.

While the UE has stored LTM candidate configurations the UE can also execute any L3 handover except for DAPS handover. In the RRC message which the UE applies for any L3 handover (except DAPS), LTM candidate configurations can be added/modified/released by the target cell.

##### 9.2.3.5.2 C-Plane Handling

Cell switch command is conveyed in a MAC CE, which contains the necessary information to perform the LTM cell switch.

The overall procedure for intra-gNB LTM is shown in Figure 9.2.3.5.2-1 below. Subsequent LTM is done by repeating the early synchronization, LTM cell switch execution, and LTM cell switch completion steps without the need to release, reconfigure or add other LTM candidate configurations after each LTM cell switch completion. The general procedure over the air interface is applicable to SCG LTM. Further details of SCG LTM can be found in TS 37.340 [21].



Figure 9.2.3.5.2-1. Signalling procedure for intra-gNB LTM

The procedure for intra-gNB LTM is as follows:

1. The UE sends a *MeasurementReport* message to the gNB. The gNB decides to configure LTM and initiates LTM preparation.

2. The gNB transmits an *RRCReconfiguration* message to the UE including the LTM candidate configurations.

3. The UE stores the LTM candidate configurations and transmits an *RRCReconfigurationComplete* message to the gNB.

4a. The UE performs DL synchronization with the LTM candidate cell(s) before receiving the cell switch command. The UE may activate and deactivate TCI states of LTM candidate cell(s), as triggered by the gNB and defined in TS 38.133 [13].

4b. The UE may perform UL synchronization with LTM candidate cell(s) before receiving the cell switch command, by using UE-based TA measurement, if configured, and/or by transmitting a preamble towards the candidate cell, as triggered by the gNB. When UE-based TA measurement is configured, UE acquires the TA value(s) of the candidate cell(s) by measurement. UE performs early TA acquisition with the candidate cell(s) as requested by the network before receiving the cell switch command as specified in clause 9.2.6 and TS 38.133 [13]. This is done via CFRA triggered by a PDCCH order from the source cell, following which the UE sends preamble towards the indicated candidate cell. In order to minimize the data interruption of the source cell due to CFRA towards the candidate cell(s), the UE does not receive random access response from the network for the purpose of TA value acquisition and the TA value of the candidate cell is indicated in the cell switch command. The UE does not maintain the TA timer for the candidate cell and relies on network implementation to guarantee the TA validity.

5. The UE performs L1 measurements on the configured LTM candidate cell(s) and transmits L1 measurement reports to the gNB. L1 measurement should be performed as long as RRC reconfiguration (step 2) is applicable. The UE can also perform L3 measurement reporting to the gNB, including beam level measurement results on cell(s) which are configured as LTM candidate cell(s) according to the received network configuration.

6. The gNB decides to execute cell switch to a target cell and transmits an LTM cell switch command MAC CE triggering cell switch by including a target configuration ID which indicates the index of the candidate configuration of the target cell, a beam indicated with a TCI state or beams indicated with DL and UL TCI states, and a timing advance command for the target cell, if available. The UE switches to the target cell and applies the candidate configuration indicated by the target configuration ID.

7. The UE performs the random access procedure towards the target cell, if UE does not have valid TA of the target cell as specified in clause 5.18.35 of TS 38.321[6].

8. The UE completes the LTM cell switch procedure by sending *RRCReconfigurationComplete* message to target cell. If the UE has performed a RA procedure in step 7 the UE considers that LTM cell switch execution is successfully completed when the random access procedure is successfully completed. For RACH-less LTM, the UE considers that LTM cell switch execution is successfully completed when the UE determines that the network has successfully received its first UL data.

The steps 4-8 can be performed multiple times for subsequent LTM cell switch executions using the LTM candidate configuration(s) provided in step 2.

The overall procedure for inter-gNB LTM is shown in Figure 9.2.3.5.2-2 below.

Msc-generator~|version=8.6.2~|lang=signalling~|size=1294x1483~|text=#This is the default signalling chart.~n#Edit and press F2 to see the result.~n#You can change the default chart~n#with the leftmost button on the Preferences pane of the ribbon.~n~nhscale=~qauto~q;~ndefstyle hgapa [text.gap.left=16, text.gap.right=16];~ndefstyle hgapb [text.gap.left=6, text.gap.right=6];~ndefstyle entity [text.font.face=~qArial~q, text.size.normal=14, text.wrap=no, text.bold=yes];~ndefstyle bs [text.font.face=~qArial~q, text.size.normal=13, vspacing=7, text.wrap=no, hgapb];~ndefstyle br [bs, line.corner=round];~ndefstyle ac [text.font.face=~qTimes~q, text.size.normal=15, text.italic=yes, vspacing=5, arrow.type=sharp, hgapa];~ndefstyle ad [vspacing=-5, arrow.type=sharp];~ndefstyle au [text.font.face=~qArial~q, text.size.normal=13, vspacing=5, hgapa];~ndefstyle n1 [text.font.face=~qArial~q, text.size.normal=13, vspacing=5, weak, text.italic=no, hgapa];~n~nm:UE;~ns:Source gNB;~n//t0:Target gNB-DU\n from source gNB;~nt:Target gNB;~nt1:Other potential\ntarget gNB(s);~na:AMF;~nu:UPF(s);~n~n|||;~nmark HPstart;~nm~l=~gs: User Data [au];~njoin s~l=~gu: User Data [au];~ns--a:0.Mobility control information provided by AMF [br];~nm--s:1.Measurement Control and Reports [br];~ns--s:2. LTM Decison [bs];~n//s-~gt0:3. UE CONTEXT MODIFICATION REQUEST [ac];~ns--s:3a.LTM configuration preparation for intra-gNB candidates [br];~ns-~gt:3. HANDOVER REQUEST [ac];~n//s-~gt [ad];~ns-~gt1:3. HANDOVER REQUEST [ac];~n//s-~gt1 [ad];~nt--t:4. Admission Control [bs];~nt1--t1:4. Admission Control [bs];~n//t0-~gs:5. UE CONTEXT MODIFICATION\nRESPONSE [ac];~nt-~gs:5. HANDOVER REQUEST\nACKNOWLEDGE [ac];~n//t-~gs[ad];~nt1-~gs:5. HANDOVER REQUEST ACKNOWLEDGE [ac];~n//t1-~gs[ad];~ns--s:6a.LTM configuration update for intra-gNB candidates [br];~n//s-~gt0:6. LTM CONFIGURATION UPDATE [ac];~ns~g~gt:6. LTM CONFIGURATION UPDATE [ac];~n//s-~gt [ad];~ns~g~gt1:6. LTM CONFIGURATION UPDATE [ac];~n//s-~gt1 [ad];~n~n//t0-~gs:7. LTM CONFIGURATION UPDATE ACKNOWLEDGE [ac];~nt~g~gs:7. LTM CONFIGURATION UPDATE ACKNOWLEDGE [ac];~n//t-~gs[ad];~nt1~g~gs:7. LTM CONFIGURATION UPDATE ACKNOWLEDGE [ac];~n//t1-~gs[ad];~n~n~ns-~gm:8. RRCReconfiguration [ac];~nm-~gs:9. RRCReconfigurationComplete [ac];~nmark HPend;~n~ns~g~gt:9a. EARLY STATUS TRANSFER [ac];~ns~g~gt1:9a. EARLY STATUS TRANSFER [ac];~n~nu=~gs:User Data [au];~njoin s=~gt1 [au];~n~nmark LEstart;~n~ns~g~gm:10a. PDCCH order [ac];~nm~g~gt:10. Early synchronization[ac];~ns~g~gm:10a. PDCCH order [ac];~nm~g~gt1:10. Early synchronization[ac];~nt~g~gs:11. TA INFORMATION TRANSFER[ac];~nt1~g~gs:11. TA INFORMATION TRANSFER[ac];~n~nmark LEend;~n~nm-~gs:12. L1 or L3 Measurement result[ac];~n~nmark LExstart;~n~ns--s:13. LTM execution[bs];~ns-~gm:14.Cell Switch Command[ac];~ns-~gt:15. CELL SWITCH NOTIFICATION[ac];~nm~l-~gt:16.UE access to the target cell[ac];~nmark LExend;~nt-~gs:17.HANDOVER SUCCESS[ac];~n~n~n~n//mark HEend;~ns~g~gt:18. SN STATUS TRANSFER [ac];~n~nu=~gs:User Data [au];~njoin s=~gt [au];~n~n~nm-~gt:19. RRCReconfigurationComplete[ac];~n~n~nm--u:Figure 9.2.3.2.1-1 step 9-11 [bs];~nt-~gt1:20. LTM CONFIGURATION UPDATE [ac];~nt1-~gt:21. LTM CONFIGURATION UPDATE ACKNOWLEDGE [ac];~nt~g~gs:22. UE CONTEXT RELEASE [ac];~n~n;~nmark HCend;~n|||;~n~nvertical brace HPstart-~gHPend:LTM Preparation/Configuration [n1];~nvertical brace LEstart-~gLEend:Early Synchronization [n1];~nvertical brace LExstart-~gLExend:LTM Execution [n1];~nvertical brace LExend-~gHCend:LTM Completion [n1];~n~|

Figure 9.2.3.5.2-2. Signalling procedure for inter-gNB LTM

The procedure for inter-gNB LTM is as follows:

1. The UE sends a *MeasurementReport* message (L3 measurement result) to the source gNB containing measurements of neighbouring cells.

2. The source gNB decides to configure LTM.

3. The source gNB requests LTM for one or more candidate cells belonging to the source gNB and/or one or more candidate gNB(s). For inter-gNB LTM, the source gNB initiates a HANDOVER REQUEST message per candidate cell containing one candidate cell ID and may contain the CSI resource configuration for subsequent LTM. For both intra and inter-gNB LTM, the source gNB may request the candidate cell(s)/gNB(s) to provide the CSI-RS resource configuration for L1 RSRP measurement and/or for early CSI acquisition. The source gNB may include the LTM security information. For inter-gNB LTM, the source gNB includes the same source NG-RAN node UE XnAP ID for all HANDOVER REQUEST messages to a candidate gNB.

4. Admission Control may be performed by the candidate cells(s)/gNB(s).

5. The candidate cell prepares and provides the LTM configuration(s) to the source gNB. For inter-gNB LTM, the candidate gNB(s) respond(s) with HANDOVER REQUEST ACKNOWLEDGE message to the source gNB including the generated RRC configurations for the accepted candidate cell. For both intra and inter-gNB LTM, the candidate may also include additional information related to the CSI-RS resource configuration and early sync information upon request. The candidate gNB also responds the selected LTM security information. For inter-gNB LTM, each candidate gNB includes the same target NG-RAN node UE XnAP ID for all HANDOVER REQUEST ACKNOWLEDGE messages it responds.

6. The source gNB sends an LTM CONFIGURATION UPDATE message to the candidate gNB(s) to update the LTM configurations of candidate cell(s). The source gNB may include the common CSI resource configuration, the LTM configuration ID mapping list and the LTM security information.

7. The candidate gNB(s) sends the LTM CONFIGURATION UPDATE ACKNOWLEDGE message to the source gNB. The candidate gNB(s) may also provide the CSI report configuration. The candidate gNB may include the CSI report configuration for CSI acquisition of the candidate cell(s).

NOTE: Step 6 may also be triggered after step 14, or after step 17 by implementation for subsequent LTM.

NOTE: Step 6 and Step 7 are triggered if CSI acquisition is applied.

8. The source gNB sends an *RRCReconfiguration* message to the UE.

9. The UE stores the LTM candidate configurations and sends an *RRCReconfigurationComplete* message to the source gNB.

NOTE: The source gNB may initiate CSI-RS Coordination procedure to activate or deactivate CSI-RS resource(s) of some candidate cells(s).

9a. If early data forwarding is applied, the source gNB sends the EARLY STATUS TRANSFER message to the candidate gNB(s).

10/11. Early DL and UL synchronization to some LTM candidate cell(s) may be performed. The source gNB may activate or deactivate the TCI states of the candidate LTM cells. Depending on network configuration, the UE may perform early UL synchronization with LTM candidate cell(s), by using UE-based TA measurement, if configured, and/or by transmitting a preamble towards the candidate cell, as triggered by the source gNB. With a network triggered UL synchronization, a PDCCH order is received from the source cell to trigger CFRA to a candidate cell. The UE performs early TA acquisition by sending preamble towards the indicated candidate cell. In order to minimize the data interruption on the source cell due to CFRA towards the indicated candidate cell(s), the UE does not receive random access response from the network for the purpose of TA value acquisition. The candidate gNB(s) sends the TA INFORMATION TRANSFER message to the source gNB instead.

12. The UE performs L1 measurements on the configured LTM candidate cell(s) and transmits L1 measurement reports to the source gNB, if configured. L1 measurement should be performed as long as RRC reconfiguration (step 8) is applicable.

13. The source gNB determines to initiate LTM. L3 measurement can also be used to determine this step.

14. The source gNB decides to execute cell switch to a target cell and transmits an LTM cell switch command MAC CE triggering cell switch by including a target configuration ID which indicates the index of the candidate configuration, a beam indicated with a TCI state or beams indicated with DL and UL TCI states, and a TA command for the target cell. In case of a security context change, the LTM cell switch command MAC CE also contains the NCC value. The UE switches to the target cell and applies the candidate configuration indicated by the target configuration ID. In case of security context change, the UE generates and applies the new security keys based on the received NCC value.

NOTE: Up to implementation, data forwarding and SN Status Transfer may be initiated once the source gNB triggers the inter-gNB LTM cell switch for the UE in Step 14.

15. The source gNB sends the CELL SWITCH NOTIFICATION message to the target gNB to indicate the initiation of Cell Switch command to the UE. The source gNB may inform the acquired TA related information.

16. The UE performs the random access procedure towards the target cell, if UE does not have valid TA of the target cell as specified in clause 5.18.35 of TS 38.321[6].

17/18. The target gNB sends the HANDOVER SUCCESS message to the source gNB to inform that the UE has successfully accessed the target cell. In return, the source gNB sends the SN STATUS TRANSFER message following the principles described in step 7 of Intra-AMF/UPF Handover in clause 9.2.3.2.1.

NOTE : Late data forwarding may be initiated as soon as the source gNB receives the HANDOVER SUCCESS message.

NOTE : The source gNB may initiate the CSI-RS Coordination procedure to deactivate CSI-RS resource(s) of candidate cell(s) on the candidate gNB(s) after the UE successfully accesses the target cell.

19. The UE completes the LTM cell switch procedure by sending *RRCReconfigurationComplete* message to target cell. If the UE has performed a RA procedure in step 16 the UE considers that LTM cell switch execution is successfully completed when the random access procedure is successfully completed. For RACH-less LTM, the UE considers that LTM cell switch execution is successfully completed when the UE determines that the network has successfully received its first UL data.

NOTE : Steps 17/18 and 19 do not have to occur one after the other. The target gNB may send the HANDOVER SUCCESS message to the source gNB after receiving the *RRCReconfigurationComplete* message.

20. The new source gNB (i.e., the target gNB) sends the LTM CONFIGURATION UPDATE message to the candidate gNBs. This message includes the new security key(s) to be used with the UE.

21. The candidate gNB(s) responds to the LTM CONFIGURATION UPDATE ACKNOWLEDGE message to the new source gNB.

22. The new source gNB may send the UE CONTEXT RELEASE message to inform the old source gNB to release radio and C-plane related resources associated to the UE context if no LTM candidate cell(s) exist in the old source gNB. Any ongoing data forwarding may continue.

The steps 10-22 can be performed multiple times for subsequent LTM cell switch executions using the LTM candidate configuration(s) provided in step 8.

The procedure over the air interface described in Figure 9.2.3.5.2-1 is applicable to both intra-gNB LTM and inter-gNB LTM. The overall LTM procedures over F1-C interface are captured in TS 38.401[4].

#### 9.2.3.6 RACH-less handover

RACH-less handover is supported for an intra-gNB handover procedure in TN and NTN. RACH-less handover is also supported for an inter-gNB handover procedure in the case of NTN or mobile IAB-DU migration procedure. The RACH-less handover procedure applies the following functionality:

- The UE uses the same timing advance value (i.e., NTA value) at the target cell as in the source cell or timing advance value (i.e., NTA value) of 0.

- The handover command for the UE may contain a beam identifier for the beam to be used by the UE at the target cell. The beam may be determined based on a UE measurement report and/or left up to gNB implementation, e.g., using the target cell's knowledge about the beam(s) used by the UE at the co-located source cell.

- The handover command may include a configured UL grant. UE can fallback to RACH when there is no valid configured uplink grant. Alternatively, an UL grant is dynamically signalled by the target cell.

- The UE transmits the *RRCReconfigurationComplete* message using the configured or dynamically signalled UL grant. Successful UL data reception on the target cell terminates the RACH-less handover execution.

#### 9.2.3.X Conditional L1/L2 Triggered Mobility

##### 9.2.3.X.1 General

CLTM cell switch is executed by the UE when L1-based or L3-based LTM cell switch execution conditions are met. The overall procedure for CLTM is as shown in Figure 9.2.3.X.x-1:



Figure 9.2.3.X.x-1. Signalling procedure for CLTM

The procedure for CLTM is as follows:

1. The UE sends a *MeasurementReport* message to the gNB. The gNB decides to configure CLTM and initiates CLTM preparation.

2. The source gNB can request the candidate cells to provide conditional execution configurations and the candidate cells provide the conditional configuration including their own execution conditions, to be used in subsequent CLTM.

3. The source gNB sends an *RRCReconfiguration* message to the UE and this includes the CLTM configurations of candidate cells as well as the execution condition for the CLTM.

4. The UE stores the CLTM candidate configurations and transmits an *RRCReconfigurationComplete* message to the gNB. The UE starts evaluating the execution conditions based on the provided configuration.

5/6. The source gNB can trigger early synchronization (for example, based on the L1 or L3 measurement reports from the UE, if configured) to the UE and steps 4a/4b from figure 9.2.3.5.2-1 are applicable here as well. In addition, the source gNB can provide the TA value for each of the candidate cells the UE has performed UL synchronization with.

7. At the UE, the CLTM execution condition for the candidate LTM cell is satisfied. The UE performs the CLTM switch by applying the configuration of the satisfied LTM candidate cell. If the UE has valid TA as part of the UL early synchronization from step 6, the UE skips RACH. Otherwise, RACH is performed as part of the CLTM switch.

8. The UE completes the CLTM cell switch procedure by sending *RRCReconfigurationComplete* message to the switched LTM cell as in step 8 from intra-gNB LTM from figure 9.2.3.5.2-1. The UE does not release any valid TA value(s) of LTM candidate cells with CLTM configuration.

The steps 5-8 can be performed multiple times for subsequent CLTM cell switch executions using the CLTM candidate configuration(s) provided in step 2.

The following principles apply to CLTM:

- CLTM is supported for intra-gNB LTM when DC is not configured. Inter-gNB CLTM is not supported.

- CLTM can be RACH-based or RACH-less. RACH-based CLTM includes CFRA and CBRA, and only CG based RACH-less CLTM is supported.

- U-Plane handling from clause 9.2.3.5.3 applies to CLTM as well and since there is no LTM cell switch command MAC CE reception for CLTM, the UE performs MAC reset upon CLTM execution.

### 9.2.4 Measurements

In RRC\_CONNECTED, both layer 1(L1) and layer 3(L3) based measurements are supported, L1 measurement reporting is evaluated based on beam quality and L3 measurement reporting is evaluated based on cell quality.

For L3 based measurement, the UE measures multiple beams (at least one) of a cell and the measurements results (power values) are averaged to derive the cell quality. In doing so, the UE is configured to consider a subset of the detected beams. Filtering takes place at two different levels: at the physical layer to derive beam quality and then at RRC level to derive cell quality from multiple beams. Cell quality from beam measurements is derived in the same way for the serving cell(s) and for the non-serving cell(s). Measurement reports may contain the measurement results of the *X* best beams if the UE is configured to do so by the gNB.

For L1 based measurement used in LTM event-triggered measurement, the UE measures the beams configured for LTM. Filtering takes place at the physical layer to derive the beam quality. The measurement reports contain the measurement results of the *X* (at least one) beams and reporting is with MAC CE.

The corresponding high-level measurement model is described below:



Figure 9.2.4-1: Measurement Model

NOTE 1: K beams correspond to the measurements on SSB or CSI-RS resources configured for L3 mobility by gNB and detected by UE at L1.

- **A**: measurements (beam specific samples) internal to the physical layer.

- **Layer 1 filtering**: internal layer 1 filtering of the inputs measured at point A. Exact filtering is implementation dependent. How the measurements are actually executed in the physical layer by an implementation (inputs A and Layer 1 filtering) is not constrained by the standard.

- **A1**: measurements (i.e. beam specific measurements) reported by layer 1 to layer 3 after layer 1 filtering.

**- Beam Consolidation/Selection**: beam specific measurements are consolidated to derive cell quality. The behaviour of the Beam consolidation/selection is standardised and the configuration of this module is provided by RRC signalling. Reporting period at B equals one measurement period at A1.

**- B**: a measurement (i.e. cell quality) derived from beam-specific measurements reported to layer 3 after beam consolidation/selection.

- **Layer 3 filtering for cell quality**: filtering performed on the measurements provided at point B. The behaviour of the Layer 3 filters is standardised and the configuration of the layer 3 filters is provided by RRC signalling. Filtering reporting period at C equals one measurement period at B.

- **C**: a measurement after processing in the layer 3 filter. The reporting rate is identical to the reporting rate at point B. This measurement is used as input for one or more evaluation of reporting criteria.

- **Evaluation of reporting criteria**: checks whether actual measurement reporting is necessary at point D. The evaluation can be based on more than one flow of measurements at reference point C e.g. to compare between different measurements. This is illustrated by input C and C1. The UE shall evaluate the reporting criteria at least every time a new measurement result is reported at point C, C1. The reporting criteria are standardised and the configuration is provided by RRC signalling (UE measurements).

- **D**: measurement report information (message) sent on the radio interface.

- **L3 Beam filtering**: filtering performed on the measurements (i.e. beam specific measurements) provided at point A1. The behaviour of the beam filters is standardised and the configuration of the beam filters is provided by RRC signalling. Filtering reporting period at E equals one measurement period at A1.

- **E**: a measurement (i.e. beam-specific measurement) after processing in the beam filter. The reporting rate is identical to the reporting rate at point A1. This measurement is used as input for selecting the X measurements to be reported.

- **Beam Selection for beam reporting**: selects the X measurements from the measurements provided at point E. The behaviour of the beam selection is standardised and the configuration of this module is provided by RRC signalling.

- **F**: beam measurement information included in measurement report (sent) on the radio interface.

The high-level model for LTM event-triggered measurement is described below:

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**Figure 9.2.4-2: LTM Event-triggered Measurement Model**

NOTE 1: K beams correspond to the measurements on SSB or CSI-RS resources configured for LTM by gNB and detected by UE at L1.

- **A**: measurements (beam specific samples) internal to the physical layer.

- **Layer 1 filtering**: internal layer 1 filtering of the inputs measured at point A. Exact filtering is implementation dependent. How the measurements are actually executed in the physical layer by an implementation (inputs A and Layer 1 filtering) is not constrained by the standard.

- **B**: a measurement after layer 1 filtering. This beam measurement is used as input for one or more evaluation of LTM event triggering and reporting criteria.

- **Evaluation of reporting criteria**: checks whether actual measurement reporting is necessary at point C. The evaluation can be based on more than one flow of measurements at reference point B e.g. to compare between different measurements. This is illustrated by input B and B1. The UE shall evaluate the reporting criteria at least every time a new measurement result is reported at point B, B1. The reporting criteria are standardised and the configuration is provided by RRC signalling (UE measurements).

- **C**: LTM MAC CE measurement report information (message) sent on the radio interface.

Layer 1 filtering introduces a certain level of measurement averaging. How and when the UE exactly performs the required measurements is implementation specific to the point that the output at B fulfils the performance requirements set in TS 38.133 [13]. Layer 3 filtering for cell quality and related parameters used are specified in TS 38.331 [12] and do not introduce any delay in the sample availability between B and C. Measurement at point C, C1 is the input used in the event evaluation. L3 Beam filtering and related parameters used are specified in TS 38.331 [12] and do not introduce any delay in the sample availability between A1 and E.

Measurement reports for L3 based measurements are characterized by the following:

- Measurement reports include the measurement identity of the associated measurement configuration that triggered the reporting;

- Cell and beam measurement quantities to be included in measurement reports are configured by the network;

- The number of non-serving cells to be reported can be limited through configuration by the network;

- Cells belonging to an exclude-list configured by the network are not used in event evaluation and reporting, and conversely when an allow-list is configured by the network, only the cells belonging to the allow-list are used in event evaluation and reporting;

- Beam measurements to be included in measurement reports are configured by the network (beam identifier only, measurement result and beam identifier, or no beam reporting).

Measurement reports for LTM event triggered measurements are characterized by the following:

- Measurement reports include the reporting configuration identity that triggered the reporting;

- The max number of beams and the beam measurement quantities to be included in measurement reports are configured by network;

- The current beam of the serving cell to be included in measurement reports are configured by the network;

- When multi-TRP is configured for the serving cell, the UE uses the best beam of the current beams for LTM event evaluation and reporting. It is up to the UE implementation how to choose the best beam.

Intra-frequency neighbour (cell) measurements and inter-frequency neighbour (cell) measurements are defined as follows:

- SSB based intra-frequency measurement: a measurement is defined as an SSB based intra-frequency measurement provided the SSB frequency configured in the measurement object associated with the serving cell and the center frequency of the SSB of the neighbour cell are the same, and the subcarrier spacing of the two SSBs is also the same.

- SSB based inter-frequency measurement: a measurement is defined as an SSB based inter-frequency measurement provided the center frequency of the SSB of the serving cell and the center frequency of the SSB of the neighbour cell are different, or the subcarrier spacing of the two SSBs is different.

NOTE 2: For SSB based measurements, one measurement object corresponds to one SSB and the UE considers different SSBs as different cells.

NOTE 2a: If a UE is configured to perform serving cell measurements based on an NCD-SSB configured in its active BWP, this NCD-SSB is considered as the SSB of the serving cell in the definition of intra-frequency and inter-frequency measurements as above.

- CSI-RS based intra-frequency measurement: a measurement is defined as a CSI-RS based intra-frequency measurement provided that:

- The subcarrier spacing of CSI-RS resources on the neighbour cell configured for measurement is the same as the SCS of CSI-RS resources on the serving cell indicated for measurement; and

- For 60kHz subcarrier spacing, the CP type of CSI-RS resources on the neighbour cell configured for measurement is the same as the CP type of CSI-RS resources on the serving cell indicated for measurement; and

- The centre frequency of CSI-RS resources on the neighbour cell configured for measurement is the same as the centre frequency of CSI-RS resource on the serving cell indicated for measurement.

- CSI-RS based inter-frequency measurement: a measurement is defined as a CSI-RS based inter-frequency measurement if it is not a CSI-RS based intra-frequency measurement.

NOTE 3: Extended CP for CSI-RS based measurement is not supported in this release.

- CSI-RS based intra-frequency L1 measurement for LTM: a measurement is defined as a CSI-RS based intra-frequency L1 measurement for LTM provided that:

- The subcarrier spacing of the CSI-RS resources of the LTM candidate cell(s) configured for L1 measurement is the same as the subcarrier spacing of active DL BWP; and

- For 60kHz subcarrier spacing, the CP type of the CSI-RS resource of LTM candidate cell(s) configured for L1 measurement is the same as the CP type of active DL BWP; and

- At least 48 RBs of the CSI-RS resource of LTM candidate cell(s) configured for L1 measurement are included within the active DL BWP.

- CSI-RS based inter-frequency L1 measurement for LTM: a CSI-RS L1 based measurement for LTM is defined as a CSI-RS based inter-frequency L1 measurement for LTM if it is not a CSI-RS based intra-frequency measurement for LTM.

Whether a measurement is non-gap-assisted or gap-assisted depends on the capability of the UE, the active BWP of the UE and the current operating frequency:

- For SSB based inter-frequency measurement, if the measurement gap requirement information is reported by the UE, a measurement gap configuration may be provided according to the information. Otherwise, a measurement gap configuration is always provided in the following cases:

- If the UE only supports per-UE measurement gaps;

- If the UE supports per-FR measurement gaps and any of the serving cells are in the same frequency range of the measurement object.

- For SSB based intra-frequency measurement, if the measurement gap requirement information is reported by the UE, a measurement gap configuration may be provided according to the information. Otherwise, a measurement gap configuration is always provided in the following case:

- If the serving cell is associated with SSB, other than the initial BWP, if any of the UE configured BWPs do not contain the frequency domain resources of the SSB associated to the initial DL BWP, and are not configured with NCD-SSB for serving cell measurement;

- If the serving cell is not associated with SSB (i.e. SSB-less SCell), if the initial BWP or any of the UE configured BWPs do not contain the SSB frequency configured in the measurement object associated with the serving cell, and are not configured with NCD-SSB for serving cell measurement.

In non-gap-assisted scenarios, the UE shall be able to carry out such measurements without measurement gaps. In gap-assisted scenarios, the UE cannot be assumed to be able to carry out such measurements without measurement gaps.

Network may request the UE to measure NR and/or E-UTRA carriers in RRC\_IDLE or RRC\_INACTIVE via system information or via dedicated measurement configuration in *RRCRelease*. If the UE was configured to perform measurements of NR and/or E-UTRA carriers while in RRC\_IDLE or in RRC\_INACTIVE, it may provide an indication of the availability of corresponding measurement results to the gNB in the *RRCSetupComplete* message. The network may request the UE to report those measurements after security activation. The request for the measurements can be sent by the network immediately after transmitting the Security Mode Command (i.e. before the reception of the Security Mode Complete from the UE).

If the UE was configured to perform measurements of NR and/or E-UTRA carriers while in RRC\_INACTIVE, the gNB can request the UE to provide corresponding measurement results in the *RRCResume* message and then the UE can include the available measurement results in the *RRCResumeComplete* message. Alternatively, the UE may provide an indication of the availability of the measurement results to the gNB in the *RRCResumeComplete* message and the gNB can then request the UE to provide these measurement results.

======================================END OF CHANGES================================