**3GPP TSG-RAN WG2 Meeting #130 R2-250xxxx**

**Malta, Malta May 19th – 23rd, 2025**

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.300** | **CR** | draftCR | **rev** | **-** | **Current version:** | **18.5.0** |  |
|  | | | | | | | | |
| *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 | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_Mob\_Ph4-Core | | | | |  | ***Date:*** | | | 2025-03-27 |
|  |  | | | |  | |  | | |  |
| ***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 draft 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. 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. 3. Introduction of conditional LTM (C-LTM) as per agreements from RAN2-127bis, RAN2-128, RAN2-129, RAN2-129bis. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Rel-19 NR mobility enhancements Phase 4 are not supported by TS 38.300. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **Y** | Other core specifications | | | | TS/TR 38.331, 38.306, 38.321, 37.340... CR ... | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

# 3 Abbreviations and Definitions

## 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

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

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.

#### 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 NW indication;

- Subsequent LTM is supported.

LTM supports intra-gNB-DU mobility, inter-gNB-DU mobility and inter-gNB-CU 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. LTM operation with shared spectrum channel access is 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 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].

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;~nt0: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--t0:3a.LTM configuration preparation for intra-CU 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--t0:6a.LTM configuration update for intra-CU candidates [br];~n//s-~gt0:6. LTM CONFIGURATION UPDATE [ac];~ns-~gt:6. LTM CONFIGURATION UPDATE [ac];~n//s-~gt [ad];~ns-~gt1:6. LTM CONFIGURATION UPDATE [ac];~n//s-~gt1 [ad];~n~n//t0-~gs:7. LTM CONFIGURATION UPDATE ACKNOWLEDGE [ac];~nt-~gs:7. LTM CONFIGURATION UPDATE ACKNOWLEDGE [ac];~n//t-~gs[ad];~nt1-~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 9.2.3.5.2-1. Signalling procedure for LTM

The procedure for 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. For both intra and inter-gNB LTM, the source gNB may request the candidate cell(s)/gNB(s) to provide the CSI resource configuration .

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

5. The candidate prepares and provides the LTM configuration(s) to the source gNB. For inter-gNB LTM, the candidate gNB(s) respond(s) (with HO REQUEST ACKNOWLEDGE) 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 configuration and early sync information.

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.

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.

*Editor’s Note: FFS on whether step 6 and 7 are mandatory or optional.*

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.

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 NW 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 NW 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.

*Editor’s Note: Further details are FFS on step 10/11.*

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.

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.

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.

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.

*Editor’s Note: The new source gNB may initiate to setup the UE associated Xn singnalling connection with the candidate gNBs. Details are FFS.*

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-DU LTM , inter-gNB-DU LTM and inter-gNB-CU LTM. The overall LTM procedures over F1-C interface are captured in TS 38.401[4].

##### 9.2.3.5.3 U-Plane Handling

After receiving an LTM cell switch command MAC CE, the UE performs MAC reset. Whether the UE performs RLC re-establishment and PDCP data recovery during cell switch is explicitly controlled by the network through RRC signalling.

#### 9.2.3.6 RACH-less handover

During intra-gNB HO procedure, RACH-less handover can be configured for a UE. 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:

Msc-generator~|version=8.6.2~|lang=signalling~|size=651x635~|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:gNB;~n//t0:Target gNB-DU;~n//t:Target gNB;~n//t1:Other potential\ntarget gNB-DU(s);~n//a:AMF;~n//u:UPF(s);~n~n|||;~nmark HPstart;~nm--m:UE in RRC_CONNECTED[bs];~n//m~l=~gs: User Data [au];~n//join s~l=~gu: User Data [au];~n~n//m--u:Figure 9.2.3.2.1-2 step 1-8 [bs];~n~n//s--a:0.Mobility control information provided by AMF [br];~n//m--s:1.Measurement Control and Reports [br];~n//s--s:2. LTM Decison [bs];~n//s-~gt0:3. UE CONTEXT MODIFICATION REQUEST [ac];~n//s-~gt:3. HANDOVER REQUEST [ac];~n//s-~gt [ad];~n//s-~gt1:3. HANDOVER REQUEST [ac];~n//s-~gt1 [ad];~n//t--t:4. Admission Control [bs];~n//t1--t1:4. Admission Control [bs];~n//t0-~gs:5. UE CONTEXT MODIFICATION\nRESPONSE [ac];~n//t-~gs:5. HANDOVER REQUEST\nACKNOWLEDGE [ac];~n//t-~gs[ad];~n//t1-~gs:5. HANDOVER REQUEST ACKNOWLEDGE [ac];~n//t1-~gs[ad];~n~n//s-~gt0:6. LTM CONFIGURATION UPDATE [ac];~n//s-~gt:6. LTM CONFIGURATION UPDATE [ac];~n//s-~gt [ad];~n//s-~gt1:6. LTM CONFIGURATION UPDATE [ac];~n//s-~gt1 [ad];~n~n//t0-~gs:7. LTM CONFIGURATION UPDATE ACKNOWLEDGE [ac];~n//t-~gs:7. LTM CONFIGURATION UPDATE ACKNOWLEDGE [ac];~n//t-~gs[ad];~n//t1-~gs:7. LTM CONFIGURATION UPDATE ACKNOWLEDGE [ac];~n//t1-~gs[ad];~nm-~gs: 1. Measurement Report[ac];~n~ns--s: 2. CLTM candidate preparation[bs];~n~ns-~gm:3. RRCReconfiguration (with CLTM)[ac];~nm-~gs:4. RRCReconfigurationComplete [ac];~nmark HPend;~n~nmark LEstart;~n~nm--s:CLTM Evaluation and Early Sync[bs];~n~nm-~gs:5. L1 or L3 Measurement result[ac];~n~ns~g~gm:6a. PDCCH order for candidate cell A[ac];~nm~g~gs:6b. Early synchronization with candidate cell A[ac];~ns~g~gm:6c. PDCCH order for candidate cell B[ac];~nm~g~gs:6d. Early synchronization with candidate cell B[ac];~n//t0~g~gs:11. TA INFORMATION TRANSFER[ac];~ns-~gm:6e. TA Delivery for cell A [ac];~n//t1~g~gs:11. TA INFORMATION TRANSFER[ac];~n~n~n~ns-~gm:6f. TA Delivery for cell B [ac];~nmark LEend;~nmark LExstart;~n~nm--m:7a. CLTM execution condition satisfied[bs];~n~n//m--m:7b. Detach from source and apply target configuration[bs];~nm~l-~gs:7b. Detach from source, apply target configuraiton\n UE access to the target cell[ac];~n~nm-~gs:8. RRCReconfigurationComplete[ac];~nmark LExend;~n//t-~gs:17.HANDOVER SUCCESS[ac];~n~n~n~n//mark HEend;~n//s~g~gt:18. SN STATUS TRANSFER [ac];~n~n//u=~gs:User Data [au];~n//join s=~gt0 [au];~n~n~n~n~n//m--u:Figure 9.2.3.2.1-1 step 9-11 [bs];~n//t-~gt1:20. LTM CONFIGURATION UPDATE [ac];~n//t1-~gt:21. LTM CONFIGURATION UPDATE ACKNOWLEDGE [ac];~n//t~g~gs:22. UE CONTEXT RELEASE [ac];~n~n//;~nmark HCend;~n|||;~n~nvertical brace HPstart-~gHPend:CLTM Preparation/Configuration [n1];~nvertical brace LEstart-~gLEend:Early Synchronization [n1];~nvertical brace LExstart-~gLExend:CLTM Execution/Completion [n1];~n//vertical brace LExend-~gHCend:CLTM Completion [n1];~n~|

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 10/11 from clause 9.2.3.5 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. The CLTM execution condition is satisfied at the UE and on the satisfied candidate LTM cell, 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. 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-CU LTM when DC is not configured. Inter-CU 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 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 as part of the CLTM execution

### 9.2.4 Measurements

In RRC\_CONNECTED, 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.

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.

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 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).

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 center frequency of the SSB of 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.

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:

- 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.

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.

# Annex A - Collection of RAN2 agreements

RAN2#125bis:

**Agreements on scenarios:**

* RAN2 first focus on inter-CU LTM in NR standalone scenario and use it as baseline for supporting inter-CU LTM in NR-DC scenarios.
* Rel-19 inter-CU LTM also supports mixture of subsequent inter-CU LTM and subsequent intra-CU LTM after an inter-CU or intra-CU LTM switch.
* UE can be configured with a mixture of intra-CU and inter-CU candidate LTM cells and irrespective of how the UE is configured with this mixture, UE measurement and reporting procedures will be the same for both intra-CU and inter-CU candidate LTM cells.

**Agreements on latency analysis:**

* Mobility latency analysis of rel-18 intra-CU LTM is reused for Rel-19 inter-CU LTM.

**Agreements on early sync phase:**

* Early DL and UL sync is also supported for inter-CU LTM. Inform RAN3 of this. Early DL sync using CSI-RS should be considered, pending RAN1 approval.
* PDCCH ordered early RACH is supported for inter-CU LTM.
* For early TA acquisition, Rel-18 option is baseline. FFS for RAR based option.

**Agreements on LTM cell switch execution phase:**

* Upon inter-CU LTM execution, UE performs
* MAC reset
* RLC re-establishment
* PDCP re-establishment
* Security key update
* FFS if there is an inter-CU LTM w/o security key change.

**Agreements on measurements:**

* L1 LTM measurement event configuration is associated with L1 measurement resource configuration provided in LTM configuration via RRC signaling.

RAN2#126:

**Agreements on inter-CU LTM:**

**Clarification of DC**

* An LTM configuration with inter-CU LTM candidate cells can be configured either by the MCG or SCG (but not for both simultaneously) and it is up to the network to handle this (further details up to RAN3, if any). No restriction for intra-CU LTM candidate cells.

**Xn-based and N2-based inter-CU LTM**

* Xn-based inter-CU LTM is prioritized in Rel-19.

**Stage-2 signaling flows and procedures**

* The preparation of inter-CU LTM configuration is initiated by the source gNB-CU.
* For each candidate cell, the preparation of lower layer configuration is initiated by the candidate gNB-CU, based on the LTM request from the source gNB-CU. RAN2 assumes the interaction between the candidate gNB-CU and candidate gNB-DU follows the same signaling procedure for intra-CU LTM.
* The source gNB-CU is responsible to collect the configurations and information of candidate cells from multiple candidate gNB-CUs and generates the common CSI resource configuration for L1 measurement on candidate cells.
* In order to support subsequent LTM, the source gNB-CU needs to inform the candidate gNB-CU(s) about the common CSI resource configuration and the collected information of candidate cells from multiple candidate gNB-CUs. The candidate gNB-CU(s) responds with the candidate configuration to the source gNB-CU accordingly (if needed).

**Preparation:**

**RRC Configuration/structure**

* The RRC signalling structure and modelling for Rel-18 LTM is taken as the baseline for inter-CU LTM.

**LTM Candidate ID**

* For inter-CU LTM, LTM candidate ID is unique across all the participating gNB-CUs.

**Max number of LTM candidate IDs**

* The maximum number of LTM candidate cell configuration is 8, regardless of whether these are intra-CU or inter-CU LTM candidate configurations.

**Early sync:**

**RAR based option**

* RAR-based TA acquisition is not supported for inter-CU LTM for non-conditional LTM. FFS on conditional LTM.

**Execution:**

**LTM Cell Switch Command**

* R18 LTM CSC MAC CE is baseline to trigger LTM cell switch for inter-CU LTM.

**LTM Cell switch completion**

* Support CG-based RACH-less and DG-based RACH-less procedures for inter-CU LTM.
* The LTM completion defined for intra-CU LTM is followed for R19 LTM.

**Agreements on measurement enhancements for LTM:**

* Event triggered L1 measurement should be designed for the following LTM purposes:
* Select the candidate beam/cell to trigger early synchronization.
* Select the target beam/cell and trigger LTM cell switch procedure.
* For event triggered L1 measurement, use of beam level measurement result for event evaluation is baseline. FFS for the cell level measurement.
* Support the following LTM events based on beam specific quality of serving cell and candidate cells as the L1 LTM measurement events.
* Event LTM2: Beam of serving cell becomes worse than absolute threshold;
* Event LTM3: Beam of candidate cell becomes amount of offset better than beam of serving cell;
* Event LTM4: Beam of candidate cell becomes better than absolute threshold;
* Event LTM5: Beam of serving cell becomes worse than absolute threshold1 AND Beam of candidate cell becomes better than another absolute threshold2.
* FFS on what beam(s) of the serving cell and neighboring cell is used for event evaluation. FFS on the need of Event LTM1.
* Support the beam config of both SSB and CSI-RS in L1 measurement resource configuration in LTM config. Working assumption: Same RS type should be used for both serving and neighbouring cell for event LTM3 and event LTM5.
* RAN2 assumes filtering of the L1 measure results is needed. It’s up to RAN1 whether the specified L1 filtering is needed or ok to leave it to UE implementation.
* For LTM event evaluation, TTT, hysteresis for entering/leaving, and/or beam specific (FFS for cell specific) offset can be applied. FFS on the need of measurement reporting once leaving condition is met.

RAN2#127:

**Agreements on inter-CU LTM**

Reference configuration:

1. Inter-CU LTM re-uses the reference configuration from Rel-18 LTM. No additional reference configurations (no multiple reference configurations) are supported.

CSI resource and report configuration:

1. The Rel-18 signaling structure for LTM CSI resource and report configuration is reused for inter-CU LTM, i.e. a common CSI resource configuration and cell-specific CSI report configuration.
2. The source CU is responsible to generate the common CSI resource configuration.

Early DL sync:

1. For inter-CU LTM, the R18 candidate TCI State activation/deactivation design (including MAC CE and related UE handling) is reused.

Inter-CU LTM switch:

1. For inter-CU LTM cell switch, it’s the source DU that triggers the MAC CE and informs the source CU about the target LTM cell.

RLC and PDCP re-establishment in inter-CU LTM:

1. If the security key update is required, the UE shall perform MAC reset, RLC re-establishment and PDCP re-establishment. As baseline introduce a new Rel-19 ID in RRC: if the Rel-19 ID is different for the source cell and the target cell, the UE performs PDCP re-establishment, including security key update, however dependent on SA3 response, we can revisit it.

Handling of candidate configuration after inter-CU LTM cell switch:

1. As in Rel-18 LTM, the UE keeps its LTM candidate cell configurations after at least a inter-CU LTM cell switch procedure where the UE is not configured with DC, unless these are explicitly released by the network.

DRB/PDU session mismatch in subsequent inter-CU LTM:

1. RAN2 understand NW implementation can handle the concern raised in P6, R2-2407421.

LTM and L3 HO:

1. L3 mobility (including both the network triggered L3 HO and CHO) can be configured to UE, while the inter-CU LTM is configured (w/o DC), and the following items can be considered (follow Rel-18 intra-CU LTM):

- When performing the L3 mobility (HO or CHO), the UE does not autonomously release inter-CU LTM configurations, unless these are explicitly released by the network.

- The RRCReconfiguration message to execute an L3 mobility (HO or CHO) procedure may reconfigure inter-CU LTM configurations.

- For the execution order between CHO and LTM, Rel-18 principle is applied.

Inter-CU SCG LTM:

1. Inter-CU SCG LTM preparation can be initiated by source SN.
2. The inter-CU SCG LTM configuration, SN generates SCG part configuration, MN includes it into its MN RRC configuration message.
3. For inter-CU SCG LTM, the LTM cell switch command MAC CE is sent by source SN.
4. RAN2 understands for the security key update of inter-CU SCG LTM, SCPAC security key update mechanism is taken as baseline. We will send LS to SA3 to ask them to take it into account for their works.
5. Only SN-initiated inter-SN LTM (including LTM configuration, early DL/UL synch and LTM execution) is supported in Rel-19.

Inter-CU MCG LTM:

1. SCG configuration can be changed in inter-CU MN and leave how to handle SCG part up to NW implementation (e.g. release or reconfiguration).
2. Upon execution of inter-CU MN LTM with DC, the UE is required to perform refresh of security key, re-establishment of RLC and PDCP, and MAC reset at both MN and SN side (i.e. Rel-15 principle is applied).
3. For the SN key update in inter-CU MN LTM with DC, the UE applies legacy R15 RRC reconfiguration with sync procedure.

**Agreements on L1 MR event evaluation**

1. Event LTM1 is not defined.
2. Current beam (i.e. a beam corresponding to the indicated TCI state) is used for event evaluation in L1 measurement reporting for serving cell.
3. Any beam in candidate RS configuration can be used for LTM event evaluation.
4. Beam level measurement result, not cell level measurement result, is used LTM event evaluation. FFS on the conditional LTM case.
5. R19 LTM event triggered measurement configuration can be taken as baseline:

- LTM measurement resource configuration is provided in LTM-config.

- Event triggered report config is provided in serving cell config.

6. MAC layer handles the event evaluation and measurement report triggering.

**Agreements on L1 measurement reporting**

1. Event-triggered L1-measurements are reported by the UE to the network via MAC CE.

RAN2#127bis:

**Agreements on inter-CU LTM**

1. The Rel18 handling on failure is reused in R19 if the UE selects an intra-CU LTM candidate cell after intra-CU LTM failure; for other cases, e.g. inter-CU LTM failure, the failure handling is FFS (related to SA3’s inputs).
2. For non-DC case, if the new Rel-19 IDs of the serving cell and the target cell have same values, the UE compares the ltm-ServingCellNoResetID and ltm-NoResetID and performs the corresponding L2 reset operation as defined in Rel-18.
3. The SCPAC-similar security update configuration is introduced for inter-CU SCG LTM, i.e. similar to IEs sk-CounterConfiguration, servingSecurityCellSetId and securityCellSetId. The names of the new IEs are to be discussed in stage3.
4. Regarding the candidate and reference configuration generation and signaling design, the following SCPAC-similar principles can be applied for inter-CU SCG LTM as baseline:

- The reference configuration for inter-CU SCG LTM at least include SCG part, FFS on MCG part.

- FFS: Network ensures that when UE combines the reference and candidate configuration for inter-CU SCG LTM, the configuration generated by UE must contain both MCG and SCG part configurations.

- The candidate configuration and reference configuration are modeled as an MN RRCReconfiguration message.

- Upon inter-CU SCG LTM, the UE performs reconfiguration with sync towards SCG, but the reconfiguration with sync in MCG is not allowed.

- The MN generates the MCG part of the reference configuration (if any), while the SN (source or candidate) generates the SCG part of the reference configuration.

- The MN is responsible for the reference configuration generation for SN initiated inter-CU SCG LTM. It can be up to the NW implementation whether to include the MCG part.

- The MN can request an SCG reference configuration from any of the involved SNs.

5. For SN initiated inter-CU SCG LTM, the candidate SN provides the SCG part configuration of each candidate PSCell, and may also provide the L1 RS (e.g. a list of SSB or a list of CSI-RS) configuration for L1 measurement, early UL sync configuration or TCI-state configuration, to the MN.

6. The source SN is responsible to generate the common CSI resource configuration for L1 measurement on candidate SCG cells.

7. The MN sends the received L1 RS configuration, early UL sync configuration, or TCI-state configuration of candidate cells to the source SN. And the source SN responds with the common CSI resource configuration to the MN.

8. In order to support subsequent inter-CU SCG LTM, the MN needs to transfer ,during the LTM preparation phase, the common CSI resource configuration and the collected information of candidate cells to the candidate SN(s). Accordingly, the candidate SN(s) responds with the updated candidate SCG configuration to the MN.

9. Upon execution of inter-SN SCG LTM, the UE sends an MN RRCReconfigurationComplete message to the MN, which includes an SN RRCReconfigurationComplete message.

10. Re-use legacy LTM Cell Switch Command MAC CE for inter-SN LTM.

11. RAN2 confirms to support coexistence of following cases, it is up to network implementation to ensure simultaneous execution for both MCG and SCG will not happen:

- Inter-MN LTM and intra-SN LTM

- Inter-SN LTM and intra-MN LTM

**Agreements on L1 event triggered MR**

1. MR can be sent when the leaving condition is met, based on NW configuration.
2. Event triggered periodic MR can be supported, based on NW configuration.
3. For measurement resource configuration, R18 LTM CSI resource configuration is reused if possible. If CSI-RS resource only IE needs to be defined, we can revisit it in the stage 3.
4. For measurement reporting configuration, R18 LTM-CSI-ReportConfig is reused if possible. We can revisit it in the stage 3 if needed.
5. For association between measurement resource configuration and measurement reporting configuration, R18 LTM way is reused if possible. We can revisit it in the stage 3 if needed.
6. The entire event evaluation procedure is handled by MAC based on the latest L1 measured results reported by L1.
7. TTT operates only based on a timer (like TTT used in L3 event triggered MR).
8. Confirms WA (Same RS type should be used for both serving and neighbouring cell for event LTM3 and event LTM5).
9. Basic information included in MR MAC CE:

- Beam information: FFS if SSBRI/CRI of N beams or (LTM configuration id + SSB/CSI-RS id)

- Beam quantity: L1-RSRP or SINR (up to RAN1) of N beams

- Triggered event information (e.g., ReportConfigID)

MR MAC CE can include up to N beams (FFS whether the beam should satisfy the event or not).

N is configurable by NW.

1. Additional information included in MR MAC CE:

- The information and quantity of current beam, based on NW configuration.

11. The legacy SR procedure for resource allocation is the baseline to send the event-triggered L1 measurements MAC CE.

12. NW can configure a dedicated SR configuration for MR MAC CE transmission.

**Agreements on C-LTM**

1. Source cell sends the conditional LTM configuration via RRCReconfiguration to UE, which includes the LTM candidate configurations, and the corresponding execution conditions.
2. Event LTM3-like and LTM5-like are used as the conditional LTM execution condition. FFS on reuse of CHO conditions.
3. Source cell and each candidate cell provides its own execution condition for conditional LTM.
4. It is DU to generate the L1 execution condition. FFS on a case that L3 measurement is used.
5. RACH-less Conditional intra-CU LTM is supported.
6. RACH based conditional intra-CU LTM is supported.
7. UE based TA measurement mechanism is supported for conditional intra-CU LTM.
8. PDCCH ordered early TA acquisition is supported for conditional LTM.
9. Rel-18 Early candidate TCI State activation/deactivation is supported for conditional intra-CU LTM.
10. For RACH-less conditional LTM, CG-based first UL transmission on target cell is supported. FFS on DG-based approach.
11. The LTM completion defined for Rel-18 intra-CU LTM is reused for conditional LTM.

RAN2#128:

**Agreements on inter-CU LTM:**

1. Rel-19 Set ID is configured for a candidate configuration. For DRB:

- Inter-CU MCG LTM: When Rel-19 Set ID of candidate cell is different from serving cell,

> UE performs PDCP re-establishment to all radio bearers.

- Inter-CU SCG LTM: When Rel-19 Set ID of candidate cell is different from serving cell,

> For MN terminated bearer without change of termination point, UE does not perform PDCP re-establishment. PDCP recovery is needed if it is split bearer.

> For SN terminated bearer without change of termination point, UE performs PDCP re-establishment.

> If there is change of termination point for a radio bearer (the keyToUse in the RadioBearerConfig is different from the keyToUse in the current UE configuration), UE performs PDCP re-establishment.

1. For SRBs in inter-CU SCG LTM, Rel-19 ID is used to determine whether PDCP re-establishment or PDCP SDU discard is performed for LTM execution for SRB3.
2. For SRB1/2 in inter-CU SCG LTM, PDCP re-established is not performed based on NW configuration (PDCP re-establishment flag and SDU discard).
3. RAN2 confirms that inter-CU MCG LTM with SCG addition is supported assuming no much specification effort is required. If there are much specification efforts, we will not have it.
4. RAN2 confirms that the inter-CU MCG LTM with intra-SN PSCell change is supported in Rel19.
5. From RAN2 perspective, the following coexistence cases in NR-DC can be supported:

- Case 1: Intra-CU MCG LTM + Inter-CU MCG LTM

- Case 2: Intra-CU SCG LTM + Inter-CU SCG LTM

7. In coexistence cases of inter-CU MCG/SCG LTM and intra-CU MCG/SCG LTM, when inter-CU MCG or SCG LTM is executed, it’s up to the NW to ensure that maintained LTM candidate configurations are valid, e.g. reconfigure or release invalid intra-CU MCG/SCG LTM candidate configurations. UE does not autonomously release invalid intra-CU candidate configurations.

8. RAN2 to support intra-CU SCG LTM in MN RRC message (i.e. MN RRCReconfiguration message), in addition to SN RRC message.

9. RAN2 to support intra-CU MCG LTM with SCG configuration.

10. It’s up to NW to ensure that the complete configuration includes the MCG part and SCG part configuration when UE combines the reference and candidate configuration for inter-CU SCG LTM.

11. RAN2 assumes that how to indicate the list of candidate PSCells from source SN to MN is up to RAN3. From RAN2 perspective, in INM, source SN may send measurement results of candidate PSCells to the MN. The MN then forwards the measurement results to the candidate SN(s), and then the candidate SN(s) determines the LTM candidate cells based on the measurement results and the upper limit for the number of PSCells that can be prepared by each candidate SN. The existing IEs defined in INM can be reused as a baseline.

**Agreements on L1 event-driven MR:**

1. TTT is evaluated per beam, and measurement report is only triggered by beam that has satisfied the condition (entering/leaving) for the whole duration of TTT.
2. TTT timer is not restarted if the current beam changes and the entering condition is still met with the new current beam.
3. TTT is applied to the leaving condition.
4. Network can configure which RS type (SSB or CSI-RS) is used for LTM event evaluation.
5. Either CSI-RS or SSB could be configured as candidate beam and the measurement RS of the serving cell beam is determined based on the candidate beam to ensure same RS type, i.e. the RS for current beam of serving cell is same as or QCLed with the QCL RS of the indicated TCI state, according to what is agreed in RAN1.
6. SSBRI and CRI is used to represent the candidate beam ID in LTM MR MAC CE.
7. For event-triggered L1 LTM measurement reporting, max N is total number of all beams included into MR MAC CE.
8. For event-triggered L1 LTM measurement reporting, NW controls if the beam(s) not satisfying the event could be reported according to N beams in MR MAC CE.
9. A single MAC CE format for the event-triggered L1 measurement report is used for both the SSB and CSI-RS reference signals.
10. Support the truncated measurement report MAC CE.

**Agreements on C-LTM:**

1. The triggering condition of conditional LTM can be based on L3 measurement.
2. CondEventA3 and CondEventA5 conditions can be baseline for the conditional LTM execution.
3. The L1 execution condition of a candidate cell is associated to only one triggering event.
4. For L3 execution condition, it may consist of one or two triggering condition(s). If there are two triggering conditions associated with the same candidate cell, the UE shall consider the execution condition is fulfilled only when both triggering conditions are met. Only single RS type is supported and at most two different trigger quantities can be configured simultaneously for the evaluation of execution condition of a single candidate cell.
5. To support initial and subsequent conditional LTM, the following items can be considered for the configuration of execution condition:

- The CLTM configuration of each candidate cell shall include the execution condition for initial conditional LTM, which is generated by the initial source cell to trigger the CLTM for the candidate cell.

- The CLTM configuration of each candidate cell may include execution conditions for subsequent conditional LTM, which is generated by the candidate cell to trigger the CLTM for other candidate cells when the candidate cell becomes a serving cell.

1. The network can configure measurement reports e.g., L1 periodic, semi-persistent, aperiodic and event triggered report, or L3 measurement reports for conditional LTM, e.g., to trigger PDCCH ordered early RACH.
2. For CLTM, the Candidate Cell TCI States Activation/Deactivation MAC CE is re-used for the early activation/deactivation of TCI state(s) of a CLTM candidate configuration.
3. The Early TA is signalled to the UE from the source cell (i.e., not from the candidate cell directly to the UE). This agreement will be included in the LS to RAN1/3/4.
4. The network can inform the candidate cell’s TA information to UE via new MAC CE, which is the TA value when UE switches to that candidate cell during CLTM.
5. Candidate cell TA is maintained by a new timer.
6. For L1-based conditional LTM the condition evaluation is at MAC level and for L3-based conditional LTM the condition evaluation is at RRC level.

RAN2#129:

**Agreements on RRC issues:**

1. For inter-CU SCG LTM, introducing the SK counter list in LTM-ConfigSCG-r19, each list associated with one ltm-NoSecurityChangeID.
2. Reuse the selectedSK-Counter-r18 to indicate the selected SK counter upon the execution of inter-CU SCG LTM.
3. The reference configuration related to inter-SN LTM is included within the new ltm-ConfigSCG field.
4. UE does not combine reference configurations from ltm-Config and ltm-ConfigSCG.
5. FFS whether only one indication is needed to indicate LTM configuration as complete configuration.
6. The existing field mrdc-ReleaseAndAdd is always included when SCG configuration is included during an MCG LTM execution. Can be revisited if there is any issue.
7. The release of the LTM configuration (MCG or SCG) follows the Rel-18 principles.
8. A maximum number of 8 candidate configurations (LTM plus CLTM candidate configurations) can be configured.
9. The LTM-Candidate IE is re-used to model an CLTM candidate cell configuration.
10. Re-use existing L1 events for CLTM.
11. For field ltm3-Offset-r19, the granularity is 0.5 dB.
12. Add extension mark “…” to LTM-ConfigSCG-r19, adopt the principle that fields only applicable to inter-CU SCG change should be defined in the root of LTM-ConfigSCG-r19, not LTM-Config-r18.

**Agreements on MAC issues:**

1. CLTM TAT is started/re-started when UE receives TA value for the candidate cell sent by the MAC CE from current serving cell.
2. If the CLTM TAT associated with one candidate cell is running, UE considers the TA for the candidate cell is valid; if CLTM TAT associated with one candidate cell expires, UE considers the TA for the candidate cell is invalid.
3. If UE has valid TA value at the time CLTM execution, UE performs RACH-less CLTM, otherwise UE performs RACH base CLTM.
4. The CLTM TAT is per candidate configuration.
5. FFS on whether the received CLTM TAs of other candidate cells is released or still valid at UE side upon CLTM execution.
6. Absolute TA value is included in the MAC CE for CLTM early TA acquisition.
7. The candidate configuration ID is included in the MAC CE for CLTM early TA acquisition. And one configuration ID for one TA in one MAC CE.
8. RAN2 assumes the CSI-RS could be associated with the indicated TCI state in LTM cell switch MAC CE and in the candidate cell TCI state Activation/Deactivation MAC CE, pending RAN1 confirmation.
9. The Measurement Report MAC CE is transmitted with a higher LCP than 'data from any Logical Channel, except data from UL-CCCH'.
10. The Measurement Report MAC CE is transmitted with the same LCH priority as MAC CE for (Enhanced) BFR.
11. The max number of N (included in the MR MAC CE) is the total number of all candidate beams without counting current serving beam.
12. There is no restriction on which serving cell(s) L1 Measurement Report MAC CE can be transmitted on, i.e. not limited to SpCell.
13. Truncated event-triggered L1 measurement report MAC CE can be used when the available grant is not sufficient to accommodate the normal measurement report MAC CE plus subheader.

**Agreements on inter-CU LTM:**

1. Using the term “LTM” to represent “intra-CU LTM” and “inter-CU LTM” in MAC specification, and introduce separate term for “conditional intra-CU LTM” in the specification(s).
2. Same as Rel-18 intra-CU LTM, Rel-19 inter-CU LTM could coexist with CovE, (e)RedCap, while couldn’t coexist with NRU. FFS on MIMO 2TA and NES.
3. Same as Rel-18 intra-CU LTM, CFRA resource configuration could be included in LTM cell switch command MAC CE for Rel-19 inter-CU LTM.
4. For inter-CU MCG LTM, when Rel-19 ID of candidate cell is different from serving cell, the UE performs PDCP re-establishment for SRB1/SRB2.
5. For inter-CU MCG LTM, when the Rel-19 ID of candidate cell is the same with serving cell, the UE performs PDCP SDU discard for SRB1/SRB2.
6. How to support shared RACH resources for inter-CU LTM is left to RAN3.

**Agreements on L1 event-triggered MR:**

1. Confirm on the previous agreement that "For measurement resource configuration, R18 LTM CSI resource configuration is reused".
2. Continue to carry the bits for SSB resource set when CSI-RS resource set is configured. FFS whether CSI-RS can be configured without SSB (up to R1 to decide).
3. Do not create a new resource configuration just for the event triggered measurements.
4. Confirm on the previous agreement "For measurement reporting configuration, R18 LTM-CSI-ReportConfig is reused".
5. Ask RAN1 what should be the maximum number of beam measurement results that can be reported in event-triggered measurement report.
6. Reuse the existing RSRP values and RSRP offset values and their interpretations in TS 38.133 for event-triggered measurement report. Can revisit if RAN4 identifies any issue.
7. TimeToTrigger and reportInterval of L3 measurement report can be reused. FFS on additional value(s) of reportInterval.
8. Cell specific offset is not supported for LTM L1 event evaluation.
9. The trigger quantity for LTM L1 event triggered measurement is the same as the report quantity.
10. Explicit indication in MR MAC CE to inform which beam(s) meets the event condition with TTT. FFS on the detailed signalling.
11. Explicit indication in MR MAC CE to inform the leaving event condition is met. FFS whether it is per beam.
12. R18 differential RSRP encoding is used as baseline.
13. LTM MR MAC CE only include one triggered measurement event and the LTM MR MAC CE can be multiplexed in any available UL grant.
14. Select the beam not satisfying the event condition, based on the measured quality (i.e. according to the best beam(s))
15. Truncated MR MAC CE includes the triggered beam information:

- One report config ID (event config ID)

- At least one triggered beam id (SSBRI or CRI) + L1 RSRP

1. Common format for normal MR MAC CE and truncated MR MAC CE is used. Details are handled by MAC running CR rapporteur.
2. For truncated LTM MR MAC CE, an LCID separate from that for non-truncated LTM MR MAC CE is used.
3. S-measureConfig is applicable to in the L1 event-triggered MR. No additional change is expected on RRC and MAC.

**Agreements on C-LTM:**

1. From a given source cell, network configures either L1 execution condition or L3 execution condition for a CLTM candidate cell.
2. The UE starts execution condition evaluation once it receives CLTM configuration including C-LTM execution condition.
3. For conditional LTM based on L1 measurements (LTM3/5-like event), the evaluation is per candidate beam. For conditional LTM based on L3 measurements (condA3/condA5 events), the evaluation is per candidate cell (i.e., with consolidation of multiple beams of the candidate cell).
4. When the C-LTM execution condition is satisfied with a candidate beam (any beam from the candidate RS set) / cell, UE performs RACH-less C-LTM (with that triggered beam for L1 based C-LTM case) if UE has a valid TA for the associated candidate cell. Otherwise, UE performs RACH-based C-LTM.
5. For L1 based C-LTM (assuming single beam fulfils C-LTM execution condition), beam selection for RACH-less LTM with CG is based on the beam meets C-LTM execution condition.
6. For L1 based C-LTM events, the C-LTM execution is triggered when at least one beam fulfills the C-LTM event condition. When multiple candidate beams satisfy the C-LTM condition, it is up to UE implementation to select a beam and perform C-LTM.
7. Do not support DG-based first UL transmission for RACH-less conditional LTM.
8. For RACH-based conditional LTM procedure, CFRA can be supported when CFRA resource is included in candidate cell configurations, otherwise CBRA is performed.
9. For intra-CU CLTM, it is up to NW implementation to ensure that only the candidate cells belonging to the same CU as the current serving cell are provided with the execution conditions.
10. Support the CLTM fast failure recovery, which reuses R18 LTM failure recovery mechanism (i.e. based on CBRA).

RAN2#129bis:

**Agreements on inter-CU LTM**

1. For security key update in inter-CU LTM, RAN2 agree to include actual NCC value in the LTM cell switch command MAC CE.
2. NCC is included in the LTM cell switch command MAC CE if the R19 set ID is different between the target cell and source cell. Conversely, if the R19 set ID is same for both cells, the NCC will not be included.
3. NW configures the corresponding sk-Counter in all LTM candidate configurations, and UE uses the configured value for generating the SN key when security key update is performed in MCG.
4. From RAN2 point of view, UE-based TA measurement can be also applicable for the synchronized inter-CU LTM scenario, and no additional RAN2 specification impact is expected. Final decision is up to RAN4.
5. MIMO 2TA can be configured with inter-CU LTM using PDCCH-order based TA measurement.
6. If UE-based TA measurement is supported for inter-CU LTM, it cannot be configured if candidate cell is configured with MIMO 2TA.
7. An LTM target cell will not apply cell DTX/DRX until LTM cell switch is completed. RAN2 will not consider any specification impacts needed for LTM RACH-less cell switch to an NES candidate cell.

**Agreements on L1 event-triggered MR**

1. Introduce new MAC CE to activate/deactivate the semi-persistent CSI-RS resource.
2. The new MAC CE includes: A/D indication, Target configuration id or {SP CSI-RS resource set id and/or candidate id}, TCI state id.
3. In L1 reporting configuration, the UE can be configured with a list of candidate IDs. For each listed candidate ID, the network can configure an offset, this offset applies to all the RSs belong the candidate ID that associated with the reporting configuration (the offset value also includes 0dB); If a candidate ID is not provided in the reporting configuration, it means the UE is not required to measure/evaluate the RSs that belonging to the candidate ID for this event, even if these are configured within the L1 resource configuration (to which the L1 reporting configuration points to).
4. In the MR MAC CE, adopt a uniform format for all the reported beams (i.e., using the same format for beams leaving the entering condition, beams met the entering condition, beams not satisfying the event). Introduce two bits per beam.
5. RAN2 will consider only the following options:

- Option1: To introduce four codepoints to represent one of {type1, type2, type3, type4}

- Option3: To introduce three codepoints to represent one of {type1\_or\_type3, type2, type4}, i.e., type1 beam and type3 beam are not distinguished in reporting.

Type1 beam: a beam that has satisfied the entry condition of the event for TTT and thus triggers the MR MAC CE.

Type2 beam: a beam that has satisfied the leaving condition of the event for TTT and thus triggers the MR MAC CE.

Type3 beam: a beam that is neither type1 nor type2 but has remained in beamsTriggeredList (the beam was reported as type1 beam before).

Type4 beam: a beam that is neither type1 nor type2 and not included in beamsTriggeredList (i.e., just extra beam info)

1. Working assumption: Option1: To introduce four codepoints to represent one of {type1, type2, type3, type4}
2. Intention is that the UE should be able to report the event-triggered beam(s) that were not included in the truncated MR MAC CE by the following grant. Detailed wording can be further discussed as part of the running CR.
3. For co-existence with mTRP, will be revisited in August. If one simple solution is not prepared / agreed until / in August meeting, we will not apply mTRP in Rel-19 event-triggered MR.

**Agreements on C-LTM**

1. Upon C-LTM execution, UE performs the following for received TA values and TA timers for other candidate cells than the target candidate cell: Maintain the TA value and Keep the early TA timer running.
2. C-LTM TAT for target cell is not stopped upon C-LTM cell switch execution to the target cell if it is running, and starts the PTAG using the remaining time from the C-LTM timer.
3. RAN2 confirm CLTM with Rel-18 MIMO 2TA is supported, introducing TAG ID field in LTM candidate TAC MAC CE.
4. For CLTM with Rel-18 MIMO 2TA, two TA timer length (i.e. ltm-TimeAlignmentTimer) can be configured via RRC.