**3GPP TSG-RAN2 Meeting #122 *TDoc R2-2306854***

**Incheon, Korea, 22th – 26th May 2023**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  | **38.300** | **CR** | **0589** | **rev** | **4** | **Current version:** | **17.4.0** |  |
|  |
| *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:***  | 38.300 Running CR for MBS enhancements |
|  |  |
| ***Source to WG:*** | CMCC  |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | NR\_MBS\_enh-Core |  | ***Date:*** | 2023-05-12 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-18 |
|  | *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 canbe 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-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
|  |  |
| ***Reason for change:*** | This CR introduces the enhancements specified on support of MBS in Rel-18 |
|  |  |
| ***Summary of change:*** | Introduction of multicast reception for UEs in RRC\_INACTIVE state and shared processing for simultaneous reception of broadcast and unicast. |
|  |  |
| ***Consequences if not approved:*** | Rel-18 MBS enhancement is not supported in NR. |
|  |  |
| ***Clauses affected:*** | 3.1, 3.2, 16.10.4, 16.10.5.2, 16.10.5.3.X(new), 16.10.5.4, 16.10.5.7, 16.10.6.X(new) |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... 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:*** |  |

*First Modified Subclause*

## 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

A-CSI Aperiodic CSI

AGC Automatic Gain Control

AKA Authentication and Key Agreement

AMBR Aggregate Maximum Bit Rate

AMC Adaptive Modulation and Coding

AMF Access and Mobility Management Function

ARP Allocation and Retention Priority

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

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

CFR Common Frequency Resource

CFRA Contention Free Random Access

CG Configured Grant

CHO Conditional Handover

CIoT Cellular Internet of Things

CLI Cross Link interference

CMAS Commercial Mobile Alert Service

CORESET Control Resource Set

CP Cyclic Prefix

CPA Conditional PSCell Addition

CPC Conditional PSCell Change

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

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

E-CID Enhanced Cell-ID (positioning method)

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

LDPC Low Density Parity Check

LEO Low Earth Orbit

MBS Multicast/Broadcast Services

MCE Measurement Collection Entity

MCCH MBS Control Channel

MCCH-RNTI RNTI for identifying broadcast MCCH

MMCCH-RNTI RNTI for identifying multicast MCCH

MDBV Maximum Data Burst Volume

MEO Medium Earth Orbit

MIB Master Information Block

MICO Mobile Initiated Connection Only

MFBR Maximum Flow Bit Rate

MMTEL Multimedia telephony

MNO Mobile Network Operator

MPE Maximum Permissible Exposure

MRB MBS Radio Bearer

MT Mobile Termination

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

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

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

PDC Propagation Delay Compensation

PDCCH Physical Downlink Control Channel

PDSCH Physical Downlink Shared Channel

PEI Paging Early Indication

PH Paging Hyperframe

PLMN Public Land Mobile Network

PNI-NPN Public Network Integrated NPN

PO Paging Occasion

PRACH Physical Random Access Channel

PRB Physical Resource Block

PRG Precoding Resource block Group

PRS Positioning Reference Signal

PS-RNTI Power Saving RNTI

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

SCS SubCarrier Spacing

SD Slice Differentiator

SDAP Service Data Adaptation Protocol

SDT Small Data Transmission

SFI-RNTI Slot Format Indication RNTI

SHR Successful Handover Report

SIB System Information Block

SI-RNTI System Information RNTI

SLA Service Level Agreement

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

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

U2N UE-to-Network

UCI Uplink Control Information

UDC Uplink Data Compression

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

*Next Modified Subclause*

## 3.2 Definitions

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 MCCH: A PTM downlink control channel used for transmitting MBS broadcast configuration information from the network to the UE.

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.

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.

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].

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.

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

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

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.

MTCH: A PTM downlink traffic channel for transmitting MBS data of an MBS session from the network to the UE.Multicast/Broadcast Service: A point-to-multipoint service as defined in TS 23.247 [45].

Multicast MCCH: A PTM downlink control channel used for transmitting MBS multicast configuration information from the network to the UE in RRC\_INACTIVE state.

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.

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-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 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 next hop neighbour node; the parent node can be IAB-node or IAB-donor-DU

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

PLMN Cell: a cell of the PLMN.

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.

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).

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.

Upstream: direction toward parent node in IAB-topology.

Uu Relay RLC channel: an RLC channel between L2 U2N Relay UE and gNB, which is used to transport packets over Uu for L2 UE-to-Network Relay.

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

Xn: network interface between NG-RAN nodes.

*Next Modified Subclause*

16.10.4 Group Scheduling

The following logical channels are used for MBS delivery:

- MTCH

- DTCH: A PTP channel defined in clause 6.2.2 for transmitting MBS data of a multicast session from the network to the UE in RRC\_CONNECTED state;

- broadcast MCCH: configured per cell which supports broadcast sessions

- multicast MCCH: configured per cell which supports multicast reception in RRC\_INACTIVE state

The following connections between logical channels and transport channels for PTM transmission exist:

- broadcast/multicast MCCH can be mapped to DL-SCH;

- MTCH can be mapped to DL-SCH.

The following depicts the usage of RNTI for PTM transmission:

- A UE can receive different services using same or different G-RNTIs;

- A UE can receive different services using same or different G-CS-RNTIs.

The following depicts the usage of RNTI for broadcast/multicast MCCH:

- A UE can receive broadcast MCCH using MCCH-RNTI;

- A UE can receive multicast MCCH using MMCCH-RNTI.

*Next Modified Subclause*

16.10.5.2 Configuration

A UE can receive data of MBS multicast session in RRC\_CONNECTED state or RRC\_INACTIVE state after joining the MBS multicast session. It is up to gNB whether the UE receives data of MBS multicast session in RRC CONNECTED state or RRC INACTIVE state. The gNB moves the UE from RRC\_CONNECTED state to RRC\_INACTIVE state via dedicated RRC signalling, and moves the UE from RRC\_INACTIVE state to RRC\_CONNECTED state via the group notification or RAN-initiated paging.

If the UE which joined a multicast session is in RRC\_CONNECTED state and when the multicast session is activated, the gNB may send *RRCReconfiguration* message with relevant MBS configuration for the multicast session to the UE.

If the gNB configures the UE to receive the multicast session in RRC\_INACTIVE state, the gNB may provide the PTM configuration for the multicast session via *RRCRelease* message. When the PTM configuration is changed or the UE moves beyond the serving cell, multicast MCCH is used to provide the changed or new PTM configuration. An MCCH change notification mechanism is used to announce the change of MCCH content due to multicast session PTM configuration modification or session deactivation. The configuration of multicast MCCH s provided via SIBX and optionally dedicated signalling. The UE in RRC\_CONNECTED state is not required to read multicast MCCH.

Editor’s Note: FFS that the above description of PTM configuration(s) delivery will be revised according to future conclusions.

The same PDCCH/PDSCH resources can be applied to both UEs in RRC\_CONNECTED state and UEs in RRC\_INACTIVE states for receiving multicast data from the same multicast session.

When there is temporarily no data for a multicast session that is active, the gNB may move the UE receiving the multicast session to RRC\_IDLE state or RRC\_INACTIVE state. When amulticast session is deactivated, the gNB may move the UE in RRC\_CONNECTED state to RRC\_IDLE or RRC\_INACTIVE state. For the UE receiving data of the multicast session in RRC\_INACTIVE state, the gNB notifies the multicast session deactivation via multicast MCCH. In this case, the UE can stay in RRC\_INACTIVE and stop monitoring corresponding G-RNTI. gNBs supporting MBS use a group notification mechanism to notify the UEs in RRC\_IDLE or RRC\_INACTIVE state when a multicast session has been activated by the CN. Upon reception of the group notification, the UE stays in RRC\_INACTIVE state and starts monitoring corresponding G-RNTI, if PTM configuration is available. Otherwise the UE is required to resume RRC connection to get the PTM configuration. The group notification is addressed with P-RNTI on PDCCH, and the paging channels are monitored by the UE as described in clause 9.2.5. Paging message for group notification contains MBS session ID which is utilized to page all UEs in RRC\_IDLE and RRC\_INACTIVE states that joined the associated MBS multicast session, i.e., UEs are not paged individually. The UE stops monitoring group notifications related to a specific multicast session, i.e., stops checking for the MBS session ID in the Paging message, when the UE enters RRC\_CONNECTED state. The UE does not monitor group notifications for these cases, i.e., once this UE leaves this multicast session or the network requests the UE to leave, or the network releases the multicast session. The UE in RRC\_INACTIVE state may be transferred to RRC\_CONNECTED state if notified by RAN-initiated paging individually. If the UE is notified by both group notification and RAN-initiated paging, the UE follows RAN-initiated paging and goes to RRC\_CONNECTED state.

If the UE in RRC\_IDLE state that joined an MBS multicast session is camping on the gNB not supporting MBS, the UE may be notified about multicast session activation or data availability by CN-initiated paging where CN pages each UE individually, as described in clause 9.2.5. If the UE in RRC\_INACTIVE state that joined MBS multicast session is camping on the gNB not supporting MBS, the UE may be notified about data availability individually by RAN-initiated paging, as described in clause 9.2.5.

*Next Modified Subclause (new)*

##### 16.10.5.3.X Service Continuity in RRC\_INACTIVE

Mobility procedures for multicast reception allow the UE in RRC\_INACTIVE state to continue receiving a multicast session when reselecting to a new cell without resuming RRC connection, if the PTM configuration of the new cell can be acquired by the UE fromSIBX and multicast MCCH of the new cell. The UE is required to resume RRC connection to get the PTM configuration upon moving to a new cell, if the PTM configuration of the new cell is not available for the UE.

Editor’s Note: The UE in RRC\_INACTIVE state for multicast reception is not required to support seamless/lossless mobility.

For a multicast session in RRC\_INACTIVE state, gNB may indicate on multicast MCCH the list of neighbour cells providing the same multicast session for UEs in RRC\_INACTIVE state. This allows the UE, e.g., to resume RRC connection if the multicast session is not available in the re-selected cell. To avoid the need to read SIBX and potentially multicast MCCH on a neighbour frequency, the UE is made aware of which frequency is providing which MBS multicast session for RRC\_INACTIVE UEs.

Editor’s Note: Detailed mechanism on how to identify the frequency info (e.g., SAI, USD, or frequency info directly provided by network) is FFS.

The UE applies the normal cell reselection rules with frequency prioritization for multicast reception in RRC\_INACTIVE state taken into account.

Editor’s Note: FFS that the above description of frequency prioritization mechanism will be revised according to future conclusions.

The UE may trigger RRC connection resumption if the reception quality of a multicast session is below a configured threshold.

Editor’s Note: FFS how to specify the threshold/reception quality.

*Next Modified Subclause*

#### 16.10.5.4 Reception of MBS Multicast data

For multicastsessions, gNB may deliver Multicast data packets using the following methods:

- PTP Transmission: gNB individually delivers separate copies of MBS data packets to each UEs independently, i.e., gNB uses UE-specific PDCCH with CRC scrambled by UE-specific RNTI (e.g., C-RNTI) to schedule UE-specific PDSCH which is scrambled with the same UE-specific RNTI.

- PTM Transmission: gNB delivers a single copy of MBS data packets to a set of UEs, e.g., gNB uses group-common PDCCH with CRC scrambled by group-common RNTI to schedule group-common PDSCH which is scrambled with the same group-common RNTI.

If a UE is configured with both PTM and PTP transmissions, a gNB dynamically decides whether to deliver multicast data by PTM leg and/or PTP leg for a given UE based on the protocol stack defined in clause 16.10.3, based on information such as MBS Session QoS requirements, number of joined UEs, UE individual feedback on reception quality, and other criteria. The same QoS requirements apply regardless of the decision.

PTP transmission is not supported for multicast reception for UEs in RRC\_INACTIVE state.

*Next Modified Subclause*

#### 16.10.5.7 Physical Layer

A CFR configured by *RRCReconfiguration* message is defined for multicast scheduling as an 'MBS frequency region' with a number of contiguous PRBs confined within and with the same numerology as the DL BWP, and multicast scheduling may have specific characteristics (e.g., PDCCH, PDSCH and SPS configurations).

Two HARQ-ACK reporting modes are defined for MBS:

- For the first HARQ-ACK reporting mode, the UE generates HARQ-ACK information with ACK value when a UE correctly decodes a transport block or detects a DCI format indicating an SPS PDSCH release; otherwise, the UE generates HARQ-ACK information with NACK value.

- For the second HARQ-ACK reporting mode, the UE does not transmit a PUCCH that would include only HARQ-ACK information with ACK values.

HARQ-ACK feedback for multicast can be enabled or disabled by higher layer configuration per G-RNTI or per G-CS-RNTI and/or indication in the DCI scheduling multicast transmission.

HARQ feedback is not supported for multicast reception for UEs in RRC\_INACTIVE state.

*Next Modified Subclause (new)*

#### 16.10.6.X Shared processing for MBS broadcast and unicast reception

If the UE is interested in receiving an MBS broadcast session, the UE may use MBS Interest Indication message to inform the unicast serving gNB about the baseband resources used for the purpose of using shared processing for MBS broadcast and unicast reception as described in TS 38.331 [12]. The gNB may enable the sending of the MBS Interest Indication by the indication in SIB1, irrespective of the presence or absence of SIB21. The shared processing of the UE for MBS broadcast and unicast reception can be enabled by the gNB based on the UE’s indication of the capability of receiving MBS broadcast from a non-serving cell.

End of Changes

Annex - collection of RAN2 agreements on enhancements of MBS WI

Green highlight – agreement captured in stage-2 specifications

Grey highlight – stage-3 level agreement, not captured in stage-2 specifications

No highlight – agreement with no direct impact on specifications

RAN2#119-e agreements

* In Rel-18, multicast reception for UEs in INACTIVE supports at least the following scenarios, with the assumption that the UE already has a valid PTM configuration:

- Scenario 1: a UE has been receiving multicast in CONNECTED, and it enters INACTIVE and continues the multicast reception.

- Scenario 2: a UE has joined a multicast session and has been directed to INACTIVE, the UE starts to receive the multicast session

**FFS for state changes, e.g. due to service being not provided in INACTIVE anymore etc.**

* It is up to gNB to decide whether a multicast session may be received by UE(s) in INACTIVE. FFS what information gNB may be provided to form such decision (related to SA2 discussion).
* It is supported that gNB transmit one multicast session to both UEs in CONNECTED and INACTIVE in the same cell. FFS how the gNB configures this.
* It is assumed the network can choose which UEs receive in RRC INACTIVE and which in RRC Connected and can move UEs between the states for Multicast service reception.
* The following is taken as baseline: we assume the same PDCCH/PDSCH resources (e.g. resources used for MTCH) can be used for all UEs (including UEs in CONNECTED and/or INACTIVE states) for receiving the same multicast session. Different configuration/resources are not precluded as well. FFS what exactly can be common and what not (e.g. HARQ, SPS etc.) and what is needed in addition (to legacy PTM config).
* For PTM configuration delivery, RAN2 further investigates the following solutions:

Option 1: Dedicated signalling

Option 2: Solution based on SIB+MCCH

We do not preclude some “mix” of the options

* HARQ feedback and PTP are not supported for multicast reception in RRC\_INACTIVE.
* Multicast service continuity after cell reselection in RRC\_INACTIVE state (i.e. without resuming RRC connection) will be supported (if the configuration of the new cell is available for the UE). FFS whether there are cases where the UE needs to resume the connection. FFS RAN3 impacts due to inter-gNB mobility.
* Upon cell reselection to neighbour cells during active multicast session, if the configuration of the session is not available for the new cell for UEs in INACTIVE, then the UE is required to resume RRC connection to get the Multicast MRB configuration.
* RAN2 focuses on solutions taking multi-Rx UEs (i.e. no specific enhancements for 1Rx UEs).

RAN2#119 bis-e agreements

* RAN2 Answer to Q1-a) If there are significant differences in the quality and reliability of the reception of MBS data between UEs in RRC Connected state and UEs in RRC Inactive state:

The quality and reliability of the reception of MBS data between UEs in RRC\_CONNECTED state and UEs in RRC\_INACTIVE state may or may not be different, as HARQ feedback and PTP transmission are not supported and seamless/lossless mobility is not required for multicast reception in RRC\_INACTIVE.

* Revised LS to be provided for final (editorial) review
* Final LS to be provided in R2-2210882
* The following general description is taken as baseline for PTM configuration delivery Option 1:

(1-a) PTM configuration(s) (i.e., configurations used for multicast reception in RRC\_INACTIVE) of one or more multicast sessions for at least one cell are provided via dedicated RRC signaling to a UE.

(1-b) The RRC message for this includes RRCReconfiguration and/or RRCRelease and/or RRCResume (details FFS)

(1-c) UE stores the received configurations while it is in RRC\_INACTIVE, and if there is a need to update some or all the configurations, the UE is notified of such changes and may trigger RRC connection resume to obtain the updated configurations. In case of mobility in RRC\_INACTIVE, the UE triggers RRC connection resume if the configuration of the session is not available for the new cell.

* The following general description is taken as baseline for PTM configuration delivery Option 2:

(2-a) PTM configurations (i.e., configurations used for multicast reception in RRC\_INACTIVE) are provided via an MCCH-like channel (same or different as used for MBS broadcast), and information regarding MCCH scheduling is provided via SIB, FFS dedicated signalling

(2-b) UE can receive such configurations when it is in RRC\_INACTIVE, FFS whether it is allowed/needed to also receive when UE is in RRC\_CONNECTED

(2-c) If there is a need to update some or all the received configurations, UE does not need to resume RRC connection but is notified of such changes (e.g. via MCCH DCI) and obtains the updated configurations via MCCH.

* Dedicated RRC signalling (i.e. RRC release message with suspendConfig) is used for switching a multicast receiving UE from RRC\_CONNECTED to RRC\_INACTIVE and continue multicast reception (details FFS).
* For both option 1 and option 2, as a baseline, group paging can be used to switch UEs receiving multicast from RRC\_INACTIVE to RRC\_CONNECTED, and UEs continue the multicast reception in CONNECTED. FFS if there is any potential issue if Rel-17 group paging is reused. FFS if there are other cases when UE triggers resume. FFS if MCCH can also be used in case of option 2.
* FFS whether to introduce PTM configuration applicable area, i.e., the mechanism that the PTM configurations, once acquired by a UE, may apply to a certain area (i.e., a set of cells instead of a single cell).
* Rel-18 UE in INACTIVE can be informed when the session is activated (Details FFS).
* As a baseline, group paging can be used to inform Rel-18 UE(s) about the session activation (Details FFS, e.g., UE behavior when receiving such group notification).
* If a UE is in RRC\_INACTIVE and is configured to receive a multicast session in RRC\_INACTIVE, the UE may be notified when the multicast session is deactivated. FFS how (e.g., informed via group paging, MCCH, or other ways).
* Rel-17 mechanism (NAS-based indication) is applicable for multicast session release. FFS if any enhancement is needed.
* FFS how UE determines whether it can receive the multicast session in RRC\_INACTIVE or not when the session is activated, taking into account the following solutions (can further update the descriptions if needed, and several solutions may be needed, some solutions may apply only for certain configuration options)

1. When the multicast session is activated, UE can receive the multicast session in RRC\_INACTIVE if the PTM configuration used in RRC\_INACTIVE for the session is available to the UE and the UE has joined the session already (e.g., configuration provided to UE via dedicated RRC signaling or via MCCH), otherwise it goes back to RRC\_CONNECTED to receive the multicast session.

2. When the multicast session is activated, UE is indicated by group paging whether it can receive the multicast session in RRC\_INACTIVE or not (detailed signaling FFS).

3. UE is configured "whether it can receive the multicast session in RRC\_INACTIVE" by dedicated signaling before UE is released. When the multicast session is activated, UE stays in RRC\_INACTIVE or resumes RRC connection accordingly (detailed signaling FFS).

* If option 1 is supported for PTM configuration

As a baseline, group paging may be used to inform the UE when network changes the PTM configurations, and UE upon reception triggers RRC connection resume procedure to obtain the updated configurations (details of group paging can be FFS).

FFS whether and how to solve the issue in signalling/system load when a large number of UEs in the cell need PTM configuration update.

* FFS if there is an issue that a UE can obtain all the PTM configurations for a multicast service via Option 2 without/before joining the multicast session on the condition that security is enabled by service layer. And if yes FFS how to solve the issue (e.g., dedicated configuration + MCCH).
* For shared processing we adopt the following as a baseline:

1) new IE is added in system information to control whether MBSInterestIndication for shared processing can be sent or not;

2) MBSInterestIndication message content and related procedure is updated for shared processing.

* New IE to control whether MBSInterestIndication for shared processing can be sent or not is added to SIB1.
* In MBSInterestIndication, for a broadcast service that the UE is receiving or is interested to receive, at least the following information can be signalled: broadcast frequency, subcarrier spacing, and bandwidth. FFS details/exact parameters and other information. FFS in which scenarios the UE reports this information (e.g. intra-PLMN case, inter-PLMN case)
* FFS whether UE capability is needed to enable shared processing.

RAN2#120 agreements

* We will have a mixed approach and we start with the following:
	+ 1. When NW configures UE to continue the multicast reception in INACTIVE state, NW provides the PTM configuration for the activated multicast session via the RRC dedicated signalling, at least for the serving cell (FFS other cases).
		2. **MCCH is used in case there is a need to indicate a PTM configuration in case there is a need for change in PTM config or during mobility beyond serving cell / gNB. FFS session status change and other indications.**
		3. **We assume that the UE can only receive multicast service after it joined the session.**
		4. **FFS whether MCCH configuration is initially provided to the UE via dedicated signalling.**

RAN2#121 agreements

* UE shall join in the multicast session before receiving multicast in RRC INACTIVE.
* If network finds it useful, the PTM configuration for the (single) serving cell can be configured to UE before the session activation, and UE stores the configuration. When session is activated, UE can receive multicast in INACTIVE state by applying the configuration without going back to RRC\_CONNECTED, if not updated by MCCH after being configured.
* When network configures UE to receive multicast in INACTIVE state, RRCRelease message with suspendconfig can be used to deliver the PTM configuration. Other dedicated RRC messages will not be used to provide PTM configuration for MBS multicast for INACTIVE.
* We introduce a new MCCH logical channel for multicast in INACTIVE (different from broadcast MCCH)
* Multicast MCCH configuration is provided via new SIB.
* Optionally, Multicast MCCH configuration for the serving cell can also be provided in dedicated signalling. Understanding is we are not optimizing mobility case because of this.
* Serving cell will not provide the PTM configuration of neighbour cells from other gNBs.
* FFS whether the network can provide PTM configuration for intra-gNB cells.
* Indicate the capability of receiving MBS broadcast from a non-serving cell. FFS whether the granularity is at FeatureSetDownlink or FeatureSetDownlinkPerCC level.
* FFS Whether to include additional information in MII can be controlled by the network. Should consider whether this would be two-step procedure or one-step procedure (e.g. having more info in SIB1)

RAN2#121bis agreements

* Similar to Rel-17 broadcast reception procedure, UE acquires new SIB and multicast MCCH to get PTM configuration after cell reselection.
* When a UE reselects to a cell for which PTM configuration is not available in multicast MCCH, the UE initiates RRC resumption procedure for an active multicast session it is interested to receive or continue receiving.
* UE may trigger RRC connection resumption if the reception quality of the multicast data is below a configured threshold, FFS how to specify the threshold/reception quality.
* Frequency prioritization may be provided to the UE for cell reselection for multicast reception in RRC\_INACTIVE, detailed mechanism on how to identify the frequency info (e.g., SAI, USD, or frequency info directly provided by network) is FFS.
* No need to define a mechanism other than the frequency prioritization, i.e., per cell based prioritization in cell re-selection, to help UE choose the right cell to camp on.
* The neighbor cell list mechanism for multicast reception in RRC\_INACTIVE may be configured e.g. it can be used by UE to resume RRC connection if service is not available in the re-selected cell by NCL, without reading MCCH in the re-selected cell, in some aspects similar to Rel-17 NCL mechanism in MBS broadcast.
* A "special UE" identified by MBS assistance information from 5GC can be released to RRC\_INACTIVE (e.g., when the session is deactivated). FFS how can network enable such UE to resume to RRC\_CONNECTED upon session activation
* Rel-18 UE can stay in RRC\_INACTIVE and start monitoring corresponding G-RNTI upon an enhanced group paging (e.g., upon session activation or data transmission resumed). Details FFS.
* For one UE already in RRC\_INACTIVE, it can stay in RRC\_INACTIVE and stop monitoring corresponding G-RNTI upon events like session deactivation/temporary no data.
* FFS which option to take: enhanced group paging or enhanced MCCH, to enable Rel-18 UE to stay in RRC\_INACTIVE and stop monitoring corresponding G-RNTI upon events like session deactivation/temporary no data.
* No additional enhancement (with regard to enhancements made for ‘deactivation/temp no data’) is needed specifically for enabling UE to stay in RRC\_INACTIVE and stop monitoring corresponding G-RNTI upon session release.
* Legacy group paging (i.e., Rel-17 group paging) can be used to resume UE to RRC\_CONNECTED state.
* Upon events like session activation/data transmission resumed, if PTM configuration is not available to UE, UE initiates RRC connection resumption.
* UE-specific paging (i.e. PagingRecordList) can be used to move specific MBS multicast UE(s) to RRC\_CONNECTED (i.e. legacy UE behavior).
* When both enhanced group paging and unicast paging are received by the UE (and targeted for this UE), the UE follows unicast Paging and goes to RRC CONNECTED.
* From the location&bandwidth and SCS configuration perspective,follow R17 MBS broadcast CFR principle (i.e. case A,C,E) to provide multicast CFR configuration in RRC\_INACTIVE.
* Multicast CFR in RRC\_INACTIVE and broadcast CFR can be configured differently. FFS whether we need to restrict that one CFR is completely contained within the other in this case (we should understand what the issue is otherwise).
* Case B and case D are not supported for multicast CFR in RRC\_INACTIVE;
* Whether multicast CFR in RRC\_CONNECTED and in RRC\_INACTIVE are different is up to NW implementation. FFS whether this causes some issues which need to be addressed.
* HARQ feedback related information in the DCI is not needed or can be ignored for multicast transmission to RRC\_INACTIVE UE.
* The HARQ operation for multicast reception in RRC\_INACTIVE is same as the operation without HARQ feedback in RRC\_CONNECTED state.
* The multicast transmission in RRC\_INACTIVE is performed via beam sweeping based on SSB index like broadcast MBS (i.e. beam information is not needed in DCI).
* For MTCH, RAN2 assumes to reuse the same DCI format of R17 multicast (i.e. DCI format 4-1/4-2) for dynamic scheduling of multicast in RRC INACTIVE. RAN2 assumes for MCCH scheduling, DCI format 4-0 is used. We will ask RAN1 to confirm whether it is feasible and whether both 4-1 and 4-2 are needed.
* We will also indicate other relevant agreements to RAN1 (e.g. on beam sweeping etc.)
* On support of multicast SPS in RRC\_INACTIVE, postpone RAN2 discussion to next meeting.
* On DRX operation for multicast in RRC\_INACTIVE, take the multicast DRX as baseline. FFS handling on PTM related HARQ RTT Timer and DRX Retransmission Timer.
* The common LCID space is used for multicast MRB and unicast DRB regardless of UE RRC state (i.e. no change on the LCID table for MTCH).
* Postpone the UP discussion on L2 operation during RRC state transition until the signaling design of PTM configuration in RRCRelease message is concluded.
* Postpone the discussion on L2 operation during mobility to next RAN2 meeting.
* Including the following two issues in LS to RAN1:
	+ - Issue 1: RAN1 to confirm RAN2 understanding that PDSCH aggregation is supported for multicast MTCH in RRC\_INACTIVE (as that is supported in Rel-17 multicast MTCH in RRC\_CONNECTED as well as broadcast MTCH).
		- Issue 2: RAN1 to check the feasibility of following Rel-17 CSS design for multicast MTCH and MCCH: 1) reusing the same CSS for multicast MTCH in
		- RRC\_INACTIVE (same as multicast MTCH in RRC\_CONNECTED); 2) separate CSS for MCCH and MTCH.
* Change the working agreement to the agreement below:

Agreement: The same CFR is used for multicast MCCH and MTCH. It can be revisited if there is any issue found, e.g. for RedCap UEs.

* UE in RRC CONNECTED state is not required to read multicast MCCH to be able to receive multicast MBS service i.e. the UE receives the PTM configuration via dedicated signalling. This can be revisited if issues with service continuity are identified.

RAN2#122 agreements

* The multicast MCCH configuration takes the broadcast MCCH configuration structure (i.e., mcch-Config-r17) as baseline.
* To notify the multicast MCCH change, change notification mechanism for Rel-17 broadcast MCCH is the baseline.
* Working assumption (to be confirmed by RAN1 via pending reply LS): One bit in the MCCH DCI is used to notify the change of the multicast MCCH. We reuse the bit used for MCCH change indication from Rel-17 MBS broadcast. This does not cover session deactivation which is FFS.
* It is not supported to provide the PTM configuration of intra-gNB neighbour cells in the dedicated signalling.
* For PTM configuration structure on the multicast MCCH, Rel-17 broadcast PTM configuration structure is taken as baseline.
* As a baseline, The PTM configuration in the RRCRelease message with suspendconfig has the same structure as the PTM configuration in multicast MCCH.
* FFS how existing MRBs are handled.
* Introduce a new indication per tmgi in the group paging which informs Rel-18 UEs having a valid PTM configuration to receive the multicast in RRC\_INACTIVE.
* MCCH is used for notifying MC session deactivation for multicast reception in RRC\_INACTIVE to enable Rel-18 UE to stay in RRC\_INACTIVE and stop monitoring corresponding G-RNTI.
* This is assumed to have no/minor impact on RAN1/PHY
* The granularity for capability of receiving MBS broadcast from a non-serving cell is at FeatureSetDownlinkPerCC level. This capability does not imply simultaneous reception on multiple CCs.
* No additional signalling is introduced to control information to be reported by the UE (on top of what we have already agreed).
* When sending MII, UE reports the whole information (i.e. at least frequency, bandwidth, SCS) when indicated by SIB1 of its unicast serving cell. FFS whether there are cases where this information is not available at the UE and what happens then.
* FFS if any special handling is needed when the non-serving cell updates the configuration (which is relevant for MII)
* No additional information is added to MII on top of what has been already agreed.