**3GPP TSG-RAN WG2 Meeting #117-e........................................................... R2-2202727**

**e-Meeting, 21st February - 3rd March, 2022**

|  |
| --- |
| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **38.300** | **CR** | **0342** | **rev** | **7** | **Current version:** | **16.8.0** |  |
|  |
| *For* [***HELP***](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)*.* |
|  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network | **x** | Core Network |  |

|  |
| --- |
|  |
| ***Title:***  | 38.300 Running CR for MBS in NR |
|  |  |
| ***Source to WG:*** | CMCC, Huawei |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | NR\_MBS-Core |  | ***Date:*** | 2022-02-10 |
|  |  |  |  |  |
| ***Category:*** | ***B*** |  | ***Release:*** | Rel-17 |
|  | *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-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
|  |  |
| ***Reason for change:*** | This CR introduces the enhancements specified on support of MBS in NR |
|  |  |
| ***Summary of change:*** | Introduction of specific MBS, architecture, session management, protocol design, PTM/PTP dynamic switch, and service continuity aspects |
|  |  |
| ***Consequences if not approved:*** | NR MBS is not supported in Rel-17 |
|  |  |
| ***Clauses affected:*** | 3.1, 7.3.1, 8.x, 16.x |
|  |  |
|  | **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 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

A-CSI Aperiodic CSI

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

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

CFRA Contention Free Random Access

CHO Conditional Handover

CIoT Cellular Internet of Things

CLI Cross Link interference

CMAS Commercial Mobile Alert Service

CORESET Control Resource Set

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

ETWS Earthquake and Tsunami Warning System

GFBR Guaranteed Flow Bit Rate

G-RNTI Group RNTI

G-CS-RNTI Group Configured Scheduling RNTI

HRNN Human-Readable Network Name

IAB Integrated Access and Backhaul

I-RNTI Inactive RNTI

INT-RNTI Interruption RNTI

KPAS Korean Public Alarm System

LDPC Low Density Parity Check

MBS Multicast/ Broadcast Services

MCCH MBS Control Channel

MDBV Maximum Data Burst Volume

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

MU-MIMO Multi User MIMO

Multi-RTT Multi-Round Trip Time

NB-IoT Narrow Band Internet of Things

NCGI NR Cell Global Identifier

NCR Neighbour Cell Relation

NCRT Neighbour Cell Relation Table

NGAP NG Application Protocol

NID Network Identifier

NPN Non-Public Network

NR NR Radio Access

P-MPR Power Management Maximum Power Reduction

P-RNTI Paging RNTI

PCH Paging Channel

PCI Physical Cell Identifier

PDCCH Physical Downlink Control Channel

PDSCH Physical Downlink Shared Channel

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

PS-RNTI Power Saving RNTI

PSS Primary Synchronisation Signal

PTM Point to Multipoint

PTP Point to Point

PUCCH Physical Uplink Control Channel

PUSCH Physical Uplink Shared Channel

PWS Public Warning System

QAM Quadrature Amplitude Modulation

QFI QoS Flow ID

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

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

SD Slice Differentiator

SDAP Service Data Adaptation Protocol

SFI-RNTI Slot Format Indication RNTI

SIB System Information Block

SI-RNTI System Information RNTI

SLA Service Level Agreement

SMC Security Mode Command

SMF Session Management Function

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

SRS Sounding Reference Signal

SRVCC Single Radio Voice Call Continuity

SS Synchronization Signal

SSB SS/PBCH block

SSS Secondary Synchronisation Signal

SST Slice/Service Type

SU-MIMO Single User MIMO

SUL Supplementary Uplink

TA Timing Advance

TPC Transmit Power Control

TRP Transmit/Receive Point

UCI Uplink Control Information

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

V2X Vehicle-to-Everything

Xn-C Xn-Control plane

Xn-U Xn-User plane

XnAP Xn Application Protocol

*Next Modified Subclause*

### 7.3.1 Overview

System Information (SI) consists of a MIB and a number of SIBs, which are divided into Minimum SI and Other SI:

- **Minimum SI** comprises basic information required for initial access and information for acquiring any other SI. Minimum SI consists of:

- *MIB* contains cell barred status information and essential physical layer information of the cell required to receive further system information, e.g. CORESET#0 configuration. *MIB* is periodically broadcast on BCH.

- *SIB1* defines the scheduling of other system information blocks and contains information required for initial access. SIB1 is also referred to as Remaining Minimum SI (RMSI) and is periodically broadcast on DL-SCH or sent in a dedicated manner on DL-SCH to UEs in RRC\_CONNECTED.

- **Other SI** encompasses all SIBs not broadcast in the Minimum SI. Those SIBs can either be periodically broadcast on DL-SCH, broadcast on-demand on DL-SCH (i.e. upon request from UEs in RRC\_IDLE, RRC\_INACTIVE, or RRC\_CONNECTED), or sent in a dedicated manner on DL-SCH to UEs in RRC\_CONNECTED (i.e., upon request, if configured by the network, from UEs in RRC\_CONNECTED or when the UE has an active BWP with no common search space configured). Other SI consists of:

- *SIB2* contains cell re-selection information, mainly related to the serving cell;

- *SIB3* contains information about the serving frequency and intra-frequency neighbouring cells relevant for cell re-selection (including cell re-selection parameters common for a frequency as well as cell specific re-selection parameters);

- *SIB4* contains information about other NR frequencies and inter-frequency neighbouring cells relevant for cell re-selection (including cell re-selection parameters common for a frequency as well as cell specific re-selection parameters), which can also be used for NR idle/inactive measurements;

- *SIB5* contains information about E-UTRA frequencies and E-UTRA neighbouring cells relevant for cell re-selection (including cell re-selection parameters common for a frequency as well as cell specific re-selection parameters);

- *SIB6* contains an ETWS primary notification;

- *SIB7* contains an ETWS secondary notification;

- *SIB8* contains a CMAS warning notification;

- *SIB9* contains information related to GPS time and Coordinated Universal Time (UTC);

- *SIB10* contains the Human-Readable Network Names (HRNN) of the NPNs listed in SIB1;

- *SIB11* contains information related to idle/inactive measurements;

- *SIBpos* contains positioning assistance data as defined in TS 37.355 [43] and TS 38.331 [12].

For sidelink, Other SI also includes:

- *SIB12* contains information related to NR sidelink communication;

- *SIB13* contains information related to *SystemInformationBlockType21* for V2X sidelink communication as specified in TS 36.331 clause 5.2.2.28 [29];

- *SIB14* contains information related to *SystemInformationBlockType26* for V2X sidelink communication as specified in TS 36.331 clause 5.2.2.33 [29].

For broadcast MBS, Other SI also includes:

- *SIBx* contains the configuration of MCCH;

- *SIBx1* contains information related to service continuity for MBS broadcast reception.

Editor’s Note: the indices “x” and “x1” in *SIBx* and *SIBx1*, respectively, will be align with that in the stage-3 specification, i.e., TS 38.331.

Editor’s note: An ID (e.g. SAI) of MBS services is provided in *SIBx1* and USD, as LTE SC-PTM. The details of the ID and the definition of USD are pending for the feedbacks of other WGs.

*Next Modified Subclause*

## 8.1 UE Identities

In this clause, the identities used by NR connected to 5GC are listed. For scheduling at cell level, the following identities are used:

- C-RNTI: unique UE identification used as an identifier of the RRC Connection and for scheduling;

- CS-RNTI: unique UE identification used for Semi-Persistent Scheduling in the downlink or configured grant in the uplink;

- INT-RNTI: identification of pre-emption in the downlink;

- MCS-C-RNTI: unique UE identification used for indicating an alternative MCS table for PDSCH and PUSCH;

- P-RNTI: identification of Paging and System Information change notification in the downlink;

- SI-RNTI: identification of Broadcast and System Information in the downlink;

- SP-CSI-RNTI: unique UE identification used for semi-persistent CSI reporting on PUSCH.

For power and slot format control, the following identities are used:

- SFI-RNTI: identification of slot format;

- TPC-PUCCH-RNTI: unique UE identification to control the power of PUCCH;

- TPC-PUSCH-RNTI: unique UE identification to control the power of PUSCH;

- TPC-SRS-RNTI: unique UE identification to control the power of SRS.

During the random access procedure, the following identities are also used:

- RA-RNTI: identification of the Random Access Response in the downlink;

- Temporary C-RNTI: UE identification temporarily used for scheduling during the random access procedure;

- Random value for contention resolution: UE identification temporarily used for contention resolution purposes during the random access procedure.

For NR connected to 5GC, the following UE identities are used at NG-RAN level:

- I-RNTI: used to identify the UE context in RRC\_INACTIVE.

For UE power saving purpose during DRX, the following identity is used:

- PS-RNTI: used to determine if the UE needs to monitor PDCCH on the next occurrence of the connected mode DRX on-duration.

For IAB the following identity is used:

- AI-RNTI: identification of the DCI carrying availability indication for soft symbols of an IAB-DU.

For MBS, the following identities are used:

- G-RNTI: Identifies dynamically scheduled transmissions of MTCH(s);

- G-CS-RNTI: Identifies configured scheduled transmissions of MTCH(s);

- MCCH-RNTI: Identifies transmissions of MCCH(s) and MCCH change notification.

*Next Modified Subclause (new)*

## 16.x Multicast and Broadcast Services

### 16.x.1 General

NR system enables resource efficient delivery of multicast/broadcast services (MBS).

For broadcast communication service, the same service and the same specific content data are provided simultaneously to all UEs in a geographical area (i.e., all UEs in the broadcast service area are authorized to receive the data). A broadcast communication service is delivered to the UEs using a broadcast session. A UE can receive a broadcast communication service in RRC\_IDLE, RRC\_INACTIVE and RRC\_CONNECTED state.

For multicast communication service, the same service and the same specific content data are provided simultaneously to a dedicated set of UEs (i.e., not all UEs in the multicast service area are authorized to receive the data). A multicast communication service is delivered to the UEs using a multicast session. A UE can receive a multicast communication service in RRC\_CONNECTED state with mechanisms such as PTP and/or PTM delivery, as defined in section 16.x.5.4. HARQ feedback/retransmission can be applied to both PTP and PTM transmission.

### 16.x.2 Network Architecture

Editor’s Note: RAN3 to provide architecture aspects here.

### 16.x.3 Protocol Architecture

Figure 16.x.3-1and 16.x.3-2 depict the downlink Layer 2 architecture for multicast session and broadcast session respectively, where MBS protocol stack comprises the same layer 2 sublayers as described in section 6 with the following differences:

* SDAP sublayer provides only the following functionalities:
* Mapping between an MBS QoS flow and an MRB;
* Transfer of user plane data.
* PDCP sublayer provides only the following functionalities:
* Transfer of data;
* Maintenance of PDCP SNs;
* Header compression and decompression using the ROHC protocol or EHC protocal;
* Reordering and in-order delivery;
* Duplicate discarding.
* For multicast session, gNB provides one or more of the following multicast MRB configuration(s) to the UE via dedicated RRC signalling:
* Multicast MRB with DL only RLC-UM or bidirectional RLC-UM configuration for PTP transmission;
* Multicast MRB with RLC-AM entity configuration for PTP transmission;
* Multicast MRB with DL only RLC-UM entity for PTM transmission;
* Multicast MRB with two RLC-UM entities, one DL only for PTP transmission and the other DL only RLC-UM entity for PTM transmission;
* Multicast MRB with three RLC-UM entities, one DL RLC-UM entity and one UL RLC-UM entity for PTP transmission and the other DL only RLC-UM entity for PTM transmission;
* Multicast MRB with two RLC entities, one RLC-AM entity for PTP transmission and the other DL only RLC-UM entity for PTM transmission.

- For multicast session, gNB provides the UE with multicast MRB bearer type configuration change.



Figure 16.x.3-1: Downlink Layer 2 Architecture for Multicast Session

* For broadcast session, gNB provides the following broadcast MRB configuration to the UE:
* Broadcast MRB with one DL only RLC-UM entity for PTM transmission;



Figure 16.x.3-2: Downlink Layer 2 Architecture for Broadcast Session

### 16.x.4 Group Scheduling

The following logical channels are used for MBS delivery:

* MTCH: A point-to-multipoint downlink channel for transmitting MBS data of either multicast session or broadcast session from the network to the UE;
* DTCH: A point-to-point channel defined in section 6.2.2 for transmitting MBS data of a multicast session from the network to the UE;
* MCCH: A point-to-multipoint downlink channel used for transmitting MBS control information associated to one or several MTCH(s) from the network to the UE.

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

* MCCH can be mapped to DL-SCH;
* MTCH can be mapped to DL-SCH.

The following depicts the usage of RNTI for group transmission:

* A UE can receive different services using different G-RNTIs/G-CS-RNTIs.

Editor’s Note: Area specific MCCH is not supported in this release of the specification.

### 16.x.5 Multicast Handling

#### 16.x.5.1 Session Management

Editor’s Note: RAN3 to provide Session management aspects here.

#### 16.x.5.2 Configuration

A UE can receive data of MBS multicast session only in RRC\_CONNECTED state. If the UE which joined a multicast session is in RRC\_CONNECTED state when the multicast session starts, the gNB sends RRC Reconfiguration message with relevant MBS configuration for the multicast session to the UE and there is no need for separate session activation notification for this UE.

When there is (temporarily) no data to be sent to the UEs for a multicast session, the gNB may move the UE to RRC IDLE/INACTIVE state. gNBs supporting MBS use a group notification mechanism to notify the UEs in RRC IDLE/INACTIVE state when a multicast session has been activated by the CN or the gNB has multicast session data to deliver. Upon reception of the group notification, the UEs reconnect to the network. The group notification is addressed with P-RNTI on PDCCH, and the paging channels are monitored by the UE as described in section 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 for group notifications related to a specific multicast session once the UE leaves this multicast session.

gNBs not supporting MBS may notify the UE in RRC IDLE/INACTIVE state about multicast session activation or data availability by paging each UE individually, as described in section 9.2.5.

#### 16.x.5.3 Service Continuity

##### 16.x.5.3.1 Handover between Multicast supporting cells

Mobility procedures for multicast reception allow the UE to continue receiving multicast service(s) via PTM or PTP in a new cell after handover. And the target gNB supporting multicast can indicate the delta (difference) to the UE's AS configuration (as included in HandoverCommand) based on the received AS configuration.

The lossless handover for multicast service is supported for the handover between MBS supporting cells at least for the scenario of both source and target cells supporting PTP RLC AM.

In order to support lossless handover for multicast service, DL PDCP SN synchronization and continuity between the source cell supporting multicast and the target cell supporting multicast needs to be guaranteed. The source gNB may forward the data to the target gNB and the target gNB may deliver the forwarded data. Additionally, the UE may be configured by the network to provide PDCP status report for an MRB for multicast session during a handover.

Editor’s Note: a procedure flow for mobility will be provided in the future.

Editor’s Note: Lossless mobility and data forwarding to be updated along the progress of respective discussions in RAN2 and RAN3.

##### 16.x.5.3.2 Handover between Multicast supporting cell and Multicast non-supporting cells

Mobility from the multicast supporting cell to multicast non-supporting cells can be achieved by switching the traffic from delivery via MRB to delivery via DRB. And the target gNB non-supporting multicast can indicate the delta (difference) configuration to the UE's AS configuration (as included in HandoverCommand), which is only for DRB configuration.

Editor’s note: DAPS handover for MBS is not supported in this release of the specification.

##### 16.x.5.3.3 MRB reconfiguration

The gNB may use *RRCReconfiguration* message to reconfigure a multicast MRB, e.g. add/release/modify the MRB’s RLC entities as described in section 16.x.3. In order to minimize the data loss due to MRB reconfiguration, gNB may configure UE to send a PDCP status report during reconfiguration.

#### 16.x.5.4 PTP/PTM Dynamic Switch

Editor’s Note: Dynamic switch related aspects to be covered here.

For multicast service, gNB may deliver MBS 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 and/or PTP for a given UE based on the protocol stack defined in section16.x.3.

#### 16.x.5.5 DRX

The following DRX configuration for PTM/PTP transmission are possible:

* For PTM transmission, a multicast DRX pattern is configured on a per G-RNTI(s) basis which is independent of UE-specific DRX for unicast transmission;
* For PTP transmission, the UE-specific DRX pattern for unicast is reused, i.e. the UE specific DRX pattern is used for both unicast services and the PTP transmission of MBS;

### 16.x.6 Broadcast Handling

#### 16.x.6.1 Session Management

Editor’s Note: RAN3 to provide Session management aspects here.

#### 16.x.6.2 Configuration

The UE can receive the MBS configuration for broadcast session (e.g. parameters needed for MTCH reception) via MCCH in RRC\_IDLE , RRC\_INACTIVE and RRC\_CONNECTED state. The parameters needed for the reception of MCCH are provided via System Information.

The following principles govern the MCCH structure:

* MCCH provides the list of all broadcast services with ongoing sessions transmitted on MTCH(s) and the associated information for broadcast session including: MBS session ID , associated G-RNTI scheduling information and information about neighbouring cells providing certain MTCH(s). MCCH content is transmitted within periodically occurring time domain windows, referred to as MCCH transmission window defined by MCCH repetition period, MCCH window duration and radio frame/slot offset;
* MCCH uses a modification period and MCCH contents are only allowed to be modified at each modification period boundary; A notification mechanism is used to announce the change of MCCH contents due to broadcast session start, modification or stop and due to neighbouring cell information modification;
* When the UE receives a MCCH change notification, it acquires the updated MCCH in the same MCCH modification period where the change notification is sent. The UE in RRC\_IDLE or RRC\_INACTIVE receives both MCCH and SI/Paging without BWP switch in case of BA.

#### 16.x.6.3 DRX

gNB can configure a PTM DRX pattern for one or multiple G-RNTIs via RRC signalling.

#### 16.x.6.4 Service Continuity

#### 16.x.6.4.1 Service Continuity in RRC\_IDLE or RRC\_INACTIVE

 Mobility procedures for MBS reception allow the UE to start or continue receiving MBS service(s) when changing cells. The gNB may indicate in the MCCH the list of neighbour cells providing the same broadcast MBS service which allows the UE, e.g. to request unicast reception of the service before changing to a cell not providing the broadcast MBS service(s) using PTM tranamission. To avoid the need to read broadcast MBS related system information and potentially MCCH on neighbour frequencies, the UE is made aware of which frequency is providing which broadcast MBS services via PTM, through the combination of the following MBS related information:

- user service description (USD);

- SIBx1, as defined in section 7.3.1.

Editor’s Note: FFS the detailed information, e.g. USD , SAI/TMGI etc.

In RRC\_IDLE and RRC\_INACTIVE, the UE applies the normal cell reselection rules with the following modifications:

- the UE which is receiving or interested to receive MBS broadcast service(s) via PTM and can only receive these MBS broadcast service(s) via PTM while camping on the frequency providing these MBS broadcast service(s) is allowed to make this frequency highest priority when the conditions described in TS 38.304 [10] are met;

- when the MBS broadcast service(s) which the UE is interested in are no longer available (after the end of the session) or the UE is no longer interested in receiving the service(s), the UE no longer prioritises the frequency providing these MBS broadcast service(s);

- the UE can prioritize the frequency indicated in USD when SIBy is provided in the cell but does not provide the frequency mapping for the concerned service.

Editor’s note: The details of the ID of MBS services is pending for the feedbacks of other WGs.

Editor’s note: The detailed mapping between frequency and MBS service ID is pending for the feedbacks of other WGs.

#### 16.x.6.4.2 Service Continuity in RRC\_CONNECTED

To ensure service continuity of MBS broadcast, the UE in RRC\_CONNECTED state may send MBS Interest Indication to the gNB after security activation, consisting of the following information:

* List of MBS frequencies UE is interested to receive, sorted in decreasing order of interest
* Priority between the reception of all listed MBMS frequencies and the reception of any unicast bearer
* List of MBS broadcast services the UE is interested to receive, in case SIBx is scheduled by the UE’s PCell

MBS Interest Indication information reporting can be implicitly enabled/disabled by the presence of SIBx1, and RRC state transition for MBS Interest Indication information reporting is not supported.

The gNB may use this information, together with the information about the UE’s capabilities (e.g, supported band combinations), when providing an RRC configuration and/or downlink assignments to the UE, to allow the UE receive the MBS services the UE is interested in. MBS Interest Indication information can be exchanged between source gNB and target gNB during handover.

# Annex - collection of RAN2 agreements on NR MBS WI

Cyan highlight – agreements captured in stage-2 specifications

Green highlight – stage-3 level agreements, not captured in stage-2 specifications

No highlight – agreements with no direct impact on specifications or agreements are not mature to be captured in the specification

RAN2#111-E agreements

* Focus initially on NR SA, TBD to what extent other scenarios NR DC, NE DC can be supported.
* Confirm Will support PTM transmission in a cell.
* Confirm that We will, for multicast services introduce support for PTP and PTM transmission of shared traffic delivered by 5GC, at least for connected mode (this is not intended to exclude other cases)
* For a UE, gNB dynamically decides whether to deliver multicast data by PTM or PTP (Shared delivery)
* FFS which layer(s) handles reliability (in general), in order delivery / duplicate handling, and it is FFS how it works at PTM PTP switch.
* Focus on MBS-MBS scenario initially (i.e. shared delivery), including both PTM and PTP (if applicable). Other scenarios later, TBD.
* Requirements for lossless mobility are TBD. Assume for now that R2 will anyway discuss service continuity functionality for low or no data loss.
* R2 assumes that for Rel-17 NR multicast Mobility in Connected mode, handover (including variants) is the baseline, TBD exactly which variants.
* R2 expect that there may be HARQ with feedback (for PTM) and this is specified by R1.

RAN2#112-e agreements

***Broadcast and multicast sessions support, RRC states and other aspects related to SA2 LS***

* For Rel-17, R2 specifies two *modes*:

 **1: One *delivery mode* for high QoS (reliability, latency) requirement, to be available in CONNECTED (possibly the UE can switch to other states when there is no data reception TBD)**

 **2: One *delivery mode* for “low” QoS requirement, where the UE can also receive data in INACTIVE/IDLE (details TBD).**

 **R2 assumes (for R17) that delivery mode 1 is used only for multicast sessions.**

 **R2 assumes that delivery mode 2 is used for broadcast sessions.**

 **The applicability of delivery mode 2 to multicast sessions is FFS.**

* No data: When there is no data ongoing for the multicast session, the UE can stay in RRC\_CONNECTED. Other cases FFS
* It is up to SA2 to decide whether the multicast session activation/deactivation mechanism is supported or not, and RAN2 will discuss if there is any RAN2 impacts based on SA2 inputs.
* It is up to SA2 to decide on the support of local MBS service, and RAN2 will discuss the RAN2 impacts based on SA2 inputs.
* In general, Information of MBS services/groups subscribed by the UE (e.g. TMGI) and QOS requirements of a MBS service should be provided to RAN. Detail information e.g. for PTM PTP switch if any is FFS.

***Layer 2 architecture***

* The function of mapping from QoS flows to MBS RBs in SDAP is needed for NR MBS. TBD whether any SDAP header is needed.
* (Working assumption) no SDAP functions other than “mapping from QoS flows to radio bearers” and “transfer of user plane data” are supported for MBS. FFS whether to support QoS flows to radio bearers remapping.
* In general: RAN2 wait for SA3’s progress for discussing security issues. TBD whether we need to send LS to SA3.
* RoHC (at least U-mode) can be configured for NR MBS bearers. This is applicable for Mcast, assume this is applicable also to broadcast.
* RoHC is located at PDCP.
* The reordering and in-order delivery function in PDCP is supported for NR MBS.
* The following PDCP functions are also supported for NR MBS: transfer of data; maintenance of PDCP SNs; duplicate discarding. Other PDCP functions are FFS.
* RLC AM is supported for PTP transmission of NR MBS.
* RLC UM is supported for PTP transmission of NR MBS.
* RLC UM is supported for PTM transmission of NR MBS.
* RLC TM is not supported for PTP transmission of NR MBS.
* RLC TM is not supported for PTM transmission of NR MBS.
* FFS for PTM if multiplexing/de-multiplexing of different logical channels are to be supported in MAC for NR MBS.
* Working assumption: RLC-AM for PTM is not supported (can be revisited but it means that proponents of RLC-AM for PTM need to demonstrate the need, to change this).

***Service continuity***

* R2 aim to support lossless handover for MBS-MBS mobility for service that requires this (TBD which detailed scenario but at least PTP-PTP)
* In order to support the lossless handover for 5G MBS services, at least DL PDCP SN synchronization and continuity between the source cell and the target cell should be guaranteed by the network side to realize. The design of specific approach to realize this can be involved with WG RAN3.
* From network side, the source gNB may forward the data to the target gNB and the target gNB will deliver the forwarding data. Meanwhile, the SN STATUS TRANSFER should be extended to cover the PDCP SN for MBS data; Then (TBD after or in parallel) the UE receives the MBS in the target cell by the target cell according to target configuration.
* From UE side, PDCP status report may be supported as well.

***Idle/Inactive support***

* UE receives the MBS configuration (for broadcast/delivery mode 2) by BCCH and/or MCCH (TBD), and this can be received in Idle / Inactive mode. Connected mode FFS (dep on UE cap and where service is provided etc). A notification mechanism is used to announce the change of MBS Control information.

RAN2#113-e agreements

***Reply LS on 5MBS progress and issues to address***

* [037] RAN2 assumes that MBS session join/leave indications are sent using NAS signalling regardless of the RRC state the UE is in. 5GC should inform RAN about the UE leaving the MBS session.
* [037] If the UE which joined the multicast session is in RR CONNECTED state when the session is started, the gNB sends RRC Reconfiguration message with relevant MBS configuration to the UE and there is no need for separate session start notification for this UE. FFS for session activation.
* [037] RAN2 assumes that from RAN2 perspective, mobility from the source gNB supporting MBS to target gNB not supporting MBS can be achieved by switching the traffic from delivery via MRB to delivery via DRB either before or during the handover. Whether and how this can be done without data losses has to be further investigated and requires progress and input from other WGs, i.e. RAN3 and SA2.
* [037] RAN2 will not provide further reply to SA2 on assistance information from CN to RAN on PTP/PTM delivery method decision and switching.
* [037] RAN2 will reply that it will wait for SA3 to finalize their study on security for MBS before discussing security aspects in RAN2.
* [037] Request a clarification from SA2 on whether and what the difference is between session start and session activation and between the session stop and session deactivation.
* [037] RAN2 will not address the note on 5GC Shared MBS delivery in the reply LS to SA2.
* [037] Reply to SA2/SA4 that:

SYNC protocol is not supported in the specifications in Rel-17

RAN2 has agreed that ROHC is to be located in RAN

***Reliability and UP architecture***

* Confirm P1 P2 P3 (assume that MRB may include both PTP and PTM)
* For the case that both PTM and PTP are RLC-UM, configuration with No L2 ARQ and with PDCP anchored PTM – PTP switching shall be supported (e.g. for services that would typically be configured with RLC UM for unicast).

***Idle and Inactive mode Ues***

* Both idle/inactive UEs and connected mode UEs can receive MBS services transmitted by NR MBS delivery mode 2 (Broadcast service as already agreed, TBD other). The ability for connected mode UEs to receive this may depend on the network provisioning of the service (e.g. which freq), UE connected mode configuration and UE capabilities.
* The two-step based approach (i.e. BCCH and MCCH) as adopted by LTE SC-PTM is reused for the transmission of PTM configuration for NR MBS delivery mode 2.
* Assume it is possible to reuse LTE SC-PTM mechanism for the CONNECTED UEs to receive the PTM configuration for NR MBS delivery mode 2, i.e. broadcast based manner.
* Assume that MCCH change notification mechanism is used to notify the changes of MCCH configuration due to session start for delivery mode 2 of NR MBS (other cases FFS, if any).
* Assume that MBS Interest Indication is supported for UEs in connected mode for Broadcast service (assume that as usual there is no mandatory network requirement, network action is up to network).
* MBS Interest Indication is NOT supported for UEs in idle/inactive mode for NR MBS delivery mode 2.
* Assume that some information for purpose of service continuity can be provided for NR MBS delivery mode 2. (FFS what - need to be revisited, e.g. based on progress in other groups, e.g. USD, SAI/TMGI etc)
* FFS whether support UE awareness of MBS services on frequency basis for service continuity for NR MBS delivery mode 2 (i.e. Reuse LTE SC-PTM mechanism).
* FFS Support frequency prioritization during cell reselection for service continuity for NR MBS delivery mode 2 (i.e. Reuse LTE SC-PTM mechanism).
* P2: Whether UEs that receive Multicast can be released to RRC Inactive / Idle and continue receiving Multicast is Postponed. Should limit to RRC inactive in future discussions

**RAN2#113bis-e agreements**

***Session activation***

* There is Support to have group notification for multicast for MBS supporting nodes (e.g. paging)
* Support group notification for multicast for MBS supporting nodes
* For delivery mode 1 UE is not expected to monitor Group notification channel in RRC\_CONNECTED
* It is FFS whether RAN2 needs to handle PRACH capacity issues due to group notifications
* Use same group notification identity for both RRC\_IDLE and RRC\_INACTIVE states

**For the reply LS**

* For non-supporting nodes, using MBS session ID will not work as it would impact non-MBS nodes. Unicast paging would work.
* For supporting nodes, using MBS session ID is feasible.

***Connected mode UEs***

***Reliability***

* For a given UE, if the MRB’s QoS requirements are not met via PTM, switching to PTP with RLC-AM shall be supported.

***Dynamic PTM PTP switch and service continuity***

Chair: NOTE that the below agreements are only based on architecture decisions so far. The reliability discussion not concluded yet i.e. other cases than RLC UM + RLC UM. PTM PTP switch for such other cases is FFS

* Dynamic PTM/PTP switch is supported for a split MRB bearer (type) with a common (single) PDCP entity.
* As a baseline, no new UE based signalling is introduced to support gNB switch decision (e.g. PDCP SR for high reliability is still TBD)
* Assuming a split-MRB (as agreed during the online session) configured with a PTM leg and PTP leg, the usage of the PTP leg cannot be deactivated (i.e. the UE needs to always monitor C-RNTI) after the necessary split-MRB configuration.
* Assuming a split-MRB (as agreed during the online session) configured with a PTM leg and PTP leg, it is FFS whether the usage of the PTM leg of the split-MRB may be subject to activation or deactivation and the details of such.

***Support of Multicast in Idle Inactive***

* Chair: RAN2 will prioritize Active Multicast support in RRC Connected mode in Rel-17. If time permits Multicast support for RRC Inactive can be considered later (once connected mode Multicast solution, and Broadcast solution has become more mature).

***Idle and Inactive mode Ues***

* The MCCH transmission window is defined by MCCH repetition period, MCCH window duration and radio frame/slot offset.
* New RNTI is defined for scheduling MCCH.
* The concept of MCCH transmission window, similar to the one used for LTE SC-PTM, is used for NR MCCH scheduling. The exact parameters to define the window are FFS (discussed in the following proposals).
* Common search space is needed for MCCH scheduling. RAN2 should request RAN1 to discuss the details of CSS for MCCH.
* R2 assumes PDCCH occasions for MCCH search space are associated with SSBs in a pre-defined manner so that the UE can receive MCCH scheduling on PDCCH occasions according to its detected SSB.
* R2 assumes, In case searchSpace#0 is configured for MCCH (if allowed, pending RAN1 decision), the mapping between PDCCH occasions and SSBs is the same as for SIB1.
* R2 assumes that If common search space other than searchSpace#0 is configured for MCCH (if allowed, pending RAN1 decision), the PDCCH monitoring occasions for MCCH message which are not overlapping with UL symbols are sequentially numbered from one in the MCCH transmission window and mapped to SSBs using the similar rule as defined for OSI in TS 38.331.
* Request RAN1 to discuss the details of the configuration of the bandwidth for MCCH reception.
* The modification period is defined for NR MCCH and NR MCCH contents are only allowed to be modified at each modification period boundary.
* The updated MCCH message should be sent in the same MCCH modification period where the change notification is sent.
* UE in RRC IDLE/INACTIVE should be able to monitor/read both MCCH channel and SI/Paging without BWP switch. It is up to RAN1 to decide how this is ensured.
* It is up to RAN1 to to decide about the RNTI and DCI format used for MCCH change notifications.
* FFS whether to support multiple MCCH, e.g. to support different service types.
* RAN2 will discuss and down-select from the following two options for the UE to get aware of session stop/modification:

Reading MCCH once per each MCCH modification period when receiving an ongoing broadcast session

DCI used for MCCH notification indicates the change of an ongoing broadcast session

RAN2#114-e agreements

*Stage-2 and Multicast activation*

* Use PCCH for Multicast activation notification (also for MBS supporting nodes).
* Confirm that we convey the MBS session ID in the notification.
* Use of paging in all ( ) PO with PRNTI is the baseline assumption (can still discuss other variants)

*Reliability*

* RLC-AM is not supported for PTM (for MBS R17 WI).

*Group scheduling and others*

* One-to-one mapping between G-RNTI and MBS session is supported in NR MBS. Other mappings FFS
* One-to-one mapping between G-CS-RNTI and MBS session is supported in NR MBS. Other mappings FFS.
* A UE can support multiple G-RNTIs/G-CS-RNTIs, It is FFS whether this depends on UE capability. Inform RAN1 of this agreement.
* Multiple MBS QoS flows corresponding to the same MBS session can be mapped to one or more than one MBS radio bearers.
* MCCH is mapped to the DL-SCH for NR MBS delivery mode 2.
* MTCH is specified for PTM transmission of NR MBS.
* MTCH is mapped to the DL-SCH.
* DTCH is reused for PTP transmission of NR MBS.
* FFS if there is a need to have specific LCID spaces for the used channels.
* Multiplexing/de-multiplexing of different logical channels associated with the same G-RNTI is supported for NR MBS.
* FFS if Multiplexing/de-multiplexing of different logical channels associated with the same G-CS-RNTI is supported for NR MBS.
* Multiplexing/de-multiplexing of different logical channels associated with the C-RNTI is supported for NR MBS.
* For NR MBS delivery mode 2, LTE SC-PTM DRX scheme is used as baseline.
* FFS whether For PTM transmission of NR MBS, DRX scheme is independent of DRX for unicast transmission, e.g. supported on a per G-RNTI basis
* FFS whether For PTP transmission, DRX operation for unicast transmission is reused.

*Idle and Inactive UEs*

* MBS specific SIB is defined to carry MCCH configuration.
* MCCH contents should include information about broadcast sessions such as G-RNTI, MBS session ID as well as scheduling information for MTCH (e.g. search space, DRX). L1 parameters that need to be included in MCCH are pending further RAN1 progress and input.
* Postpone the discussion on whether dedicated MCCH configuration is required until RAN1 makes progress on BWP/CFR for MCCH.
* Indication of an MCCH change due to modification of an ongoing session’s configuration (including session stop) is provided with an explicit notification from the network (provided that RAN1 confirms a separate bit for this purpose can be accommodated in the MCCH change notification DCI, in addition to a bit for session start notification). FFS on whether this notification can be reused for modification of other information carried by MCCH, if any.
* FFS whether the possibility of UE missing an MCCH change notification needs to be addressed or can be left to UE implementation.
* At least in case RAN1 decides to utilize RNTI other than MCCH-RNTI for MCCH change notification, MCCH change notification is sent in the first MCCH monitoring occasion of each MCCH repetition period.
* We support single MCCH (in this release)

RAN2#115-e agreements

*RRC running CR*

* MRB configuration and procedures in RRC are separated from DRB configuration and procedures (as in current CR).
* MRB is defined as MBS Radio Bearer, which denotes radio bearers carrying both multicast and broadcast sessions.

*Multicast Service Continuity*

* In RRC signalling, one MRB can be configured with PTM only or PTP only or both PTM and PTP. Whether PTM, PTM+PTP or PTP-only can be changed from one to other via RRC signaling.
* In RRC signalling, Support DL only UM RLC configuiration for PTM, both DL and UL AM RLC configuiration for PTP, DL only UM RLC configuiration for PTP, FFS both DL and UL UM RLC configuiration for PTP.
* FFS whether PDCP SR can be triggered due to bearer type change in RRC signaling and FFS how to tigger PDCP SR if need.
* Will not support PTM deactivation/activation beyond RRC reconfiguration acc to first agreement above (and whatever R1 decides).
* For PTM PDCP state variables setting while configured, the SN part of COUNT values of these variables are set according to the SN of the first received packet (by the UE) and the HFN indicated by the gNB, if needed.
* Initialize the PTM RLC entity for an MRB configuration, the value of RX\_Next\_Highest and RX\_Next\_Reassembly are set according to the SN of the first received packet containing an SN.
* RLC state variables of PTP RLC reception window can be set to initial value, i.e. 0, due to MRB configuration.

*Scheduling and power saving*

* Single bearer ID is used for each Multicast RB. FFS whether DRB ID space can be shared with MRB ID.
* FFS whether to share common LCID space for Multicast PTM and Unicast DTCH. FFS How many PTM LCIDs to be reserved if separate space is used.
* Multicast PTP and Unicast DTCH/DRB share common LCID space.
* Broadcast PTM/MTCH uses reserved LCID(s), which is different than Unicast DTCH/DRB LCID space.
* Broadcast MCCH uses reserved LCID .
* Multiplexing/de-multiplexing of different logical channels associated with the same G-CS-RNTI is supported for NR MBS.
* If Data Inactivity timer is configured, data monitoring is applied both for unicast and MBS multicast (i.e. both PTM and PTP data) (but not MBS broadcast)
* For multicast PTM transmission, Multicast DRX pattern is configured on a per G-RNTI basis (i.e. independent of legacy UE-specific DRX for unicast transmission).
* Legacy UE-specific DRX pattern for unicast is reused for PTP transmission of NR MBS, which means the UE specific DRX pattern are for both unicast services and the MBS PTP bearer of UE
* Multicast long DRX support is baseline for PTM. FFS whether to support optional short DRX or not.
* The Multicast Long DRX operation has to support the following parameters which are similar to the UE-specific DRX for unicast, where the last two parameters are needed if the HARQ- feedback is enabled:

- drx-onDurationTimerPTM

- drx-InactivityTimerPTM

- drx-LongCycleStartOffsetPTM

- drx-SlotOffsetPTM

- drx-HARQ-RTT-TimerDLPTM

- drx-RetransmissionTimerDLPTM

* For NR Broadcast, the DRX pattern is configured per G-RNTI.
* For NR Broadcast, DRX configuration includes: drx-onDurationTimerPTM, drx-SlotOffsetPTM, drx-InactivityTimerPTM, drx-CycleStartOffsetPTM.

*L2 Centric Other*

* ROHC O/R-mode can be used for MRB, for cases when feedback path is available (UL RLC). R2 assumes the detailed operation is up to implementation and expect no further optimizations to be needed.
* Reflective QoS is not supported for MBS.
* No SDAP header is needed for MBS.
* Add p7 to stage-2 CR discussion

*Broadcast Service Continuity*

**For IDLE / INACTIVE:**

* The UE is allowed to prioritize the MBS frequency of interest when the cell of the MBS frequency provides MBS SIB carrying the MCCH configuration, as LTE SC-PTM.
* The UE is allowed to prioritize the MBS frequency of interest when the UE is only capable of receiving the MBS service by camping on the MBS frequency, as LTE SC-PTM.

For IDLE / INACTIVE:

* The UE may consider cell reselection candidate frequencies at which it cannot receive the MBS service to be of the lowest priority during the MBS session, as LTE SC-PTM.
* Working assumption: The mapping between frequency and MBS service ID (e.g. SAI) is provided in the upper layer signalling (e.g. USD), as LTE SC-PTM. (The detailed information included in the upper layer (e.g. USD) is up to the decision of other WGs)
* Send an LS to SA2 and SA4 to check whether the mapping between frequency and MBS service ID (e.g. SAI) is provided in the upper layer signalling (e.g. USD), as LTE SC-PTM.
* The mapping between frequency and MBS service ID (e.g. SAI) is provided in SIB, as LTE SC-PTM. The detailed mapping is pending for the feedbacks of other WGs.
* The mapping between frequency and MBS service ID (e.g. SAI) is allowed to be sent in cells not broadcasting MBS service, as LTE SC-PTM.
* The mapping between frequency and MBS service ID (e.g. SAI) is provided in a new SIB different from the MBS SIB providing the MCCH configuration, as LTE SC-PTM.
* An ID (e.g. SAI) of MBS services is provided in SIB and USD, as LTE SC-PTM. The details of the ID is pending for the feedbacks of other WGs.
* Send an LS to SA2, SA4 and RAN3 to check whether an ID (e.g. SAI) of MBS services can be provided in SIB and USD, as LTE SC-PTM.
* It is FFS whether the gNB may indicate a list of neighbour cells where ongoing broadcast MBS service provided in the current cells are also provided, as LTE SC-PTM.
* The extra offset to cell (which provides the MBS service) for the cell ranking criterion is not supported in Rel-17.

For CONNECTED:

* The UE reports the following MBS interest information (as LTE SC-PTM):

MBS frequency list

priority between the reception of all listed MBMS frequencies and the reception of any unicast bearer

TMGI list

* If MBS frequencies are allowed to be reported, the MBS frequencies reported by the UE is sorted by decreasing order of interest, as LTE SC-PTM.
* Send an LS to SA3 to check whether the MBS interest information can be reported by the UE before security activation.
* FFS whether the MII is reported via *UEAssistanceInformation* or a new RRC message.

*Notifications*

* RAN2 waits for RAN1’s final decision on which RNTI/DCI (i.e. Alt1 and/or Alt 2 as identified by RAN1) for MCCH change notification to be adopted.
* Do not specify any mechanism to address the possibility of UE missing an MCCH change notification and it is left to UE implementation.
* Provided RAN3 confirms, paging for multicast activation notification is used in the relevant legacy POs for the UEs with deactivated multicast session(s).
* RAN2 sends an LS to RAN3 and SA2 to indicate its preference for paging for multicast activation notification to be used in the relevant legacy POs for the UEs with non activated multicast session(s). Further, RAN2 requests RAN3 for confirmation and if so, also specifying required network signalling.
* Confirm extending the unicast paging message to include a new paging record list ( *pagingGroupList)* for group activation notification of multicast sessions.
* NAS is expected to inform UE about multicast session release (e.g. to stop monitoring for multicast session activation).
* It is up to network implementation (e.g. paging repetitions) for addressing scenario of potential notification loss for UEs.
* RAN2 not to prioritize addressing of PRACH capacity issue due to group notification.
* It is FFS that short message or WUS based indication for multicast activation notification in corresponding paging message can be used.
* It is FFS to introduce MBS specific UAC.
* It is FFS on the establishment cause and resume cause for MBS.
* It is FFS if there is a need to prioritize a frequency with multicast support for idle/inactive UEs that monitor multicast activation notification.

*L3 Other*

* [049] Noted, agreements are reflected below
* [049] Send and LS to SA2 to consult on whether TMGI is sufficient for MBS session identification or some additional parameter is required (such as sessionID in LTE).
* [049] There is no SDAP configuration provided to the UE for neither broadcast nor multicast.
* [049] For broadcast, it is FFS whether sn-FieldLength (for RLC) and pdcp-SN-SizeDL parameters are configurable or predefined in specifications (related UE capabilities should be considered).
* [049] For broadcast, it is FFS whether t-Reassembly (in RLC configuration) and t-Reordering (in PDCP configuration) are needed, e.g. considering whether out of sequence reception can happen as there is no HARQ feedback for broadcast.
* [049] For broadcast, it is FFS whether ROHC, when enabled by the network, has a predefined configuration or ROHC parameters are configurable by the network.
* [049] On-demand MCCH mechanism is not introduced in Rel-17.
* [049] A single MCCH channel with multiple modification/repetition periods is not supported, i.e. there is a single configuration of modification/repetition for MCCH (in Rel-17).

RAN2#116-e agreements

*MII*

* MBS Interest indication will be sent after security activation (can still discuss whether additional optimization is needed for better BWP switching behaviour)

*L2 Centric topics*

* A common PDCP entity is used for RRC based MRB bearer type change between PTM only MRB, PTP only MRB and split MRB.
* PDCP entity reestablishment is allowed for the MRB during handover or RRC based MRB bearer type change. When to configure PDCP entity re-establishment is a network implementation.
* It is up to gNB implementation on how to perform PDCP data recovery (in the UP) for RRC based MRB bearer type change and there is expected that no extra standard effort.
* In order to minimize the loss during MRB bearer type change, NW may configure UE to send a PDCP status report for the MRB bearer type change;

For MRB configured by upper layers to send a PDCP status report in the uplink (field *statusReportRequired* in PDCP-Config IE in RRC), the receiving PDCP entity shall (based on the RRC reconfiguration message from the network) trigger a PDCP status report in case of MRB type change;

NW is required to configure a bidirectional PTP leg (e.g. either PTP-only MRB or split MRB) if *statusReportRequired* is provided. It is up to network in which case *statusReportRequired* is configured.

* The SR can be configured only if PTP AM (with Uplink) is in the new configuration.
* EHC is supported for MRB for cases when feedback path is available (UL RLC) and it is expected that no further optimizations are needed.
* for multicast MRB, the initial value of the SN part of RX\_NEXT is (x +1) modulo (2[*PDCP-SN-Size*]), where x is the SN of the first received PDCP Data PDU.
* the initial value of RX\_DELIV is set to a value before RX\_NEXT, e.g. the initial value of the SN part of RX\_DELIV is (x – 0.5 × 2[*PDCP-SN-Size*–1]) modulo (2[*PDCP-SN-Size*]), where x is the SN of the first received PDCP Data PDU.
* If HFN is needed (FFS), the initial value of HFN (maybe + related PDCP SN to avoid ambiguity of HFN FFS) is indicated by the gNB by RRC (e.g. during RRC based MRB bearer type change).
* for multicast MRB, the initial value of the SN part of RX\_NEXT is (x +1) modulo (2[*PDCP-SN-Size*]), where x is the SN of the first received PDCP Data PDU.
* for multicast PTM, the RX\_Next\_Highest is initially set to the SN of the first received UMD PDU containing an SN
* for multicast PTM, the initial value of RX\_Next\_Reassembly is set to a value before the RX\_Next\_Highest.
* The RLC entity release and/or establishment procedures are performed during RRC based MRB bearer type change for PTM only <-> PTP only.
* bidirectional UM RLC configuration is supported for PTP transmission and it is up to NW implementation to configure bidirectional UM RLC or DL only UM RLC for PTP transmission.
* Common LCID space is used for Multicast MRB (in Connected mode).
* one-to-many mapping between G-RNTI and MBS sessions is supported and it is assumed that this does not introduce additional specification work.
* [050] for broadcast MRB, the sn-FieldLength (for RLC) and pdcp-SN-SizeDL parameters are predefined with configuration optionally provided.
* [050] for broadcast MRB, the t-Reassembly (in RLC configuration) are predefined with configuration optionally provided. FFS on t-Reordering (in PDCP configuration, pending to RAN1’s discussion on blind retransmission).
* [050] for broadcast MRB, when enabled by the network, RoHC parameters are predefined with configuration optionally provided.
* [050] it is up to network implementation on how to configure DL RTT and Re-transmission timer of multicast DRX in case of multicast HARQ ACK/NACK feedback using UE specific PUCCH resources. FFS for case of disabled HARQ FB.
* [050] For group common PTM Multicast HARQ PUCCH resources (NACK only feedback), the same group of UEs have aligned HRAQ RTT and DL Re-Tx timer configuration. HARQ RTT timer counting starts from end of common PUCCH resource based NACK transmission (i.e. same as Unicast DRX behaviour). FFS for case of disabled HARQ FB.
* [050] FFS whether short DRX cycle is supported for multicast DRX.
* [050] FFS how UE monitors UE specific PDCCH/C-RNTI for possible PTP transmission for PTM HARQ retransmission in active time of multicast DRX, the following alternatives are on the table (one to be selected):

Option 2: the UE monitors UE specific PDCCH/C-RNTI only when drx-RetransmissionTimerDLPTM is running and PTP retransmission is expected.

Option 3: the UE monitors UE specific PDCCH/C-RNTI only during unicast DRX’s active time. Unicast DRX’s RTT timer can be started when PTP retransmission is expected.

* [050] FFS For DRX command MAC CE for multicast DRX, the following alternatives are on the table (one to be selected):

Option 2b: use a DRX command MAC CE per multicast DRX operation (i.e. per G-RNTI basis)

Option 3: neither legacy DRX command MAC CE nor new DRX command MAC CE is used for multicast DRX, i.e. no DRX command MAC CE for multicast DRX.

*L3 Centric topics*

* As a baseline, the network *may* broadcast in MCCH a list of neighbour cells providing the same broadcast MBS service(s) as provided in the current cell, same as in LTE SC-PTM
* MCCH changes due to neighbouring cell information modification will be notified using the normal MCCH modification notification.
* The RNTI scheduling MCCH is called “MCCH-RNTI”.
* The values of mcch-RepetitionPeriodAndOffset, mcch-WindowStartSlot, mcch-WindowDuration, mcch-ModificationPeriodm, as captured in the RRC running CR in R2-2108970, are confirmed.
* SIBx and SIBy can be available on-demand, same as other SIBs (no additional specification impact)
* RAN2 assumes the UE should be allowed to prioritize a frequency in case this frequency is signaled in SIBy for the UEs service/session of interest (e.g. identified by an additional ID such as SAI) regardless of whether this frequency is included in the USD for this service. This can be revisited once USD definition becomes clearer, if issue is identified
* Confirm that the UE may initiate MII procedure upon successful connection establishment, upon entering or leaving the broadcast service area, upon MBS broadcast session start or stop, upon change of interest, upon change of priority between MBS broadcast reception and unicast reception, upon change to a PCell broadcasting SIBx1. FFS other triggers. FFS network control.
* Introduce definitions of broadcast MRB and multicast MRB in the specifications.
* An extensible IE is not introduced instead of TMGI within PagingGroupList
* When the conditions for frequency prioritization are no longer met, the UE should stop prioritizing the frequency of this cell (e.g. when the cell reselected by the UE due to frequency prioritization for MBS stops providing SIBx etc.). FFS whether there is additional TS impact.
* RAN2 will not specify a mechanism for the UE in RRC IDLE/INACTIVE which joined a multicast session to prioritize a certain frequency for group paging monitoring.
* During MII, the UE should only report the set of MBS frequencies of interest the UE is capable to simultaneously receive, i.e. the UE supports at least one band combination allowing it to receive the indicated set of frequencies.
* When evaluating which frequencies it can receive simultaneously for reporting in MII, the UE does not take into account the serving frequencies that are currently configured i.e. it only considers MBS frequencies it is interested to receive regardless of whether these can be received together with the current serving cells or not.
* Confirm that the same PTM DRX configuration parameters can be applied to multiple G-RNTIs.
* Allow RRC signalling to configure the same DRX configuration instance to multiple G-RNTIs.
* In case mtch-schedulingInfo is absent for a G-RNTI (i.e. no PTM DRX), the UE should monitor for PDCCH scrambled with G-RNTI in any slot according to the search space configured for MTCH.
* From RAN2 point of view, the UE may receive MBS broadcast service from SCell in intra-PLMN case and if supported this may be a separate UE capability. Send an LS to RAN1 to ask to check the feasibility of MBS broadcast reception on SCell.
* If supported by the UE implementation, the idle/inactive UE may receive MBS broadcast service from non-serving cell (no network impact).
* From RAN2 point of view, the connected UE may if supported receive MBS broadcast service from non-serving cell in intra-PLMN case, under the condition this does not have any impact to operation on serving cell(s). This may be a separate UE capability. Send an LS to RAN1 to ask to check the feasibility.

RAN2#116-bis-e

*Multicast Handover*

* RAN2 assumes both source and target cells supporting PTP RLC AM as baseline for supporting Multicast loss-less HO with data forwarding between MBS supporting cells
* RAN2 agrees to support delta configuration in order to support Multicast loss-less HO with data forwarding between MBS supporting nodes.
* RAN2 agrees that for HO from MBS-supporting node to non-MBS supporting node full configuration can be avoided by  providing only DRB configuration with no MRB configuration from source to target node.
* RAN2 agrees using 2 step procedure for supporting loss-less HO from source cell not supporting MBS to target cell supporting MBS.

Step 1: perform legacy DRB based loss-less HO (with delta configuration) ,

Step 2: after HO, target cell will reconfigure UE from DRB to MRB via RRC Reconfiguration procedure.

* RAN2 will not do additional work to support CHO for UEs for which MRB is configured in R17.
* RAN2 agreess that DAPS HO is not supported for MRB and is configured as non-DAPS bearer for R17 MBS UEs.
* FFS whether same mechanisms as for PTP RLC-AM loss-less HO can be applicable in case of source cell with PTM only configuration and target cell supporting PTP only or PTM + PTP configurations. (FFS may come for free).
* RAN2 assumes for MRB to DRB switch to avoid full configuration during loss-less HO from MBS supporting node to Non-MBS supporting node and inform RAN3 accordingly.

Solution 1 is assumed feasible (from procedure point of view): While the UE is still in source cell, source cell can reconfigure UE from MRB to DRB just before HO is initiated.

Solution 2, FFS whether the reconfiguration can be done on the fly: Perform the switch from MRB to DRB during handover to support loss-less HO without full configuration.

* FFS whether to support optimization for either solution 1 or solution 2 or No optimization support to avoid full configuration during Multicast loss-less HO from MBS node to Non-MBS supporting node.

*Multicast start*

* When the group paging is received in RRC\_IDLE, RRC forwards the multicast session ID to upper layer. (already captured in running CR)
* When RRC connection establishment is triggered by group paging, R2 expects that NAS sets the establishment cause to ‘mt-Access’. I.e., no MBS specific establishment cause. FFS for UEs with special access IDs whether other current establishment cause should be used.
* When RRC connection resume is triggered by the group paging, RRC sets the resume casue to ‘mt-Access’. I.e., no MBS specific resume cause. FFS for UEs with special access IDs whether other current resume cause should be used.
* Do not add further functionality to avoid that legacy UE monitors the group-only paging message.
* When UE in RRC\_IDLE simultaneously receives the group paging and CN paging, RRC forwards both the unicast paging information (UE identity and accessType, if present) and the multicast paging information (i.e. TMGI) to upper layers. (It doesn’t require any change of the current running CR.)
* When UE in RRC\_INACTIVE simultaneously receives the group paging and CN paging, RRC forwards both the unicast paging information (UE identity and accessType, if present) and the multicast paging information (i.e. TMGI) to upper layers, and transits to RRC\_IDLE.
* Specify that the UEs that expect group notification ignores PEI (and just monitor paging as usual)

*Broadcast MBS interest Indication*

* A new RRC message would be defined for MII reporting.
* MII reporting is enabled/disabled just by the presence of SIBx1 implicitly
* UE including mbs-Services in MII in case SIBx is scheduled by the UE’s PCell is the baseline, and it could be further revisited during SCell/non-serving cell MBS reception discussion.
* MBS Interest Indication information is exchanged between source gNB and target gNB at handover (FFS SCG change if applicable).
* RRC state transition for MII reporting is not supported.
* MII is not applied to multicast.
* No specification enhancement will be pursued for any early identification enhancement of MII before dedicated BWP configuration in Rel-17.

*Broadcast Cell reselection Prioritization*

* There is no additional TS impact on stopping frequency prioritization.
* UE can prioritize the frequency indicated in USD when SIBy is provided in the cell but does not provide the frequency mapping for the concerned service.
* It is up to UE implementation how to use information in USD (e.g. with other explicit knowledge) to determine whether to (or how to) do the frequency prioritization for specific frequency/frequencies in USD.
* UE is not required to verify that the reselection candidate cell is providing SIBx ahead of cell reselection, this overrides earlier decisions.
* Confirm that if UE reselects based on MBS freq prioritization and the target cell doesn’t contain SIBx then the UE doesn’t consider this freq for prioritization

*MCCH*

* MCCH change notification consists of two bits as follows:

- 1st bit: indicate the MCCH change is due to the session start.

- 2nd bit: indicate the MCCH change is due to the modification of ongoing session, session stop, or the nieghbor cell list update.

* UE interested to receive or receiving a broadcast session via MRB initiates the MCCH information acquisition procedure upon entering the cell supporting a new SIB including MCCH configuration, or upon receiving the MCCH change notification (it doesn’t require any change of the current running CR.)
* If MCCH information acquisition is triggered by the first bit in the MCCH change notification, UE starts acquiring the MCCH message from the slot in which the MCCH change notification was received. (it doesn’t require any change of the current running CR.)
* If UE enters a cell supporting the new MBS SIB including MCCH configuration, UE acquires the MCCH message at the next repetition period. (it doesn’t require any change of the current running CR.)
* Do not support area specific MCCH in R17.
* No agreement to introduce the additional bit in MCCH, which indicates that the neighbour cell and serving cell support the same PTM configuration for all broadcast sessions supported by both cells.
* Do not support any specific handling for change of SIBx/scheduling of SIBx.
* Keep the assumption in the TS that UE starts acquiring the MCCH message from the slot in which the MCCH change notification was received (can revisit if we find it doesn’t work).

*RRC Miscellaneous*

* [024] MCCH/MTCH search space configuration is included as part of PDCCH-ConfigCommon. (Can inform RAN1 about this)
* [024] Confirm with RAN1 that the following parameters should be included in PDSCH configuration for broadcast:

- dataScramblingIdentityPDSCH

- pdsch-TimeDomainAllocationList

- rateMatchPatternToAddModList

- mcs-Table

- xOverhead

* [024] Confirm with RAN1 that only one CFR is configured for MBS broadcast reception.
* [024] FFS whether to use the following principles for MTCH window definition:

a) For G-RNTIs configured with DRX, DRX periodicity and offset are reused for MTCH scheduling window monitoring periodicity and starting of the periodicity, respectively (i.e. explicit MTCH window configuration is not used).

b) Explicit MTCH scheduling window periodicity and starting of the periodicity can be optionally configured and is applicable commonly to all G-RNTIs for which DRX is not configured.

* [024] A parameter is added in RLC-BearerConfig to indicate that an RLC bearer is used for PTM reception.
* [024] PDCP sublayer is not used for MCCH.
* [024] For broadcast MTCH, the default value of t-Reordering in PDCP configuration should be set to 0 ms and the network may optionally configure another value, as in legacy signalling (for future compatibility).
* [024] No modification of the UE actions upon going to RRC IDLE is introduced for the UE receiving MBS broadcast service at the time of state transition.
* [024] Check with RAN1 on the UE requirements with respect to simultaneous reception (in the same slot) of MCCH and MTCH and simultaneous reception of multiple MTCHs.
* [024] Check with RAN1 on the UE capabilities for simultaneous reception (in the same slot) of MBS multicast/broadcast and unicast.
* RAN2 confirms to support CFR Case E.
* It is supported by configuring a CFR for MBS broadcast, which fully contains the CORESET#0 in the frequency domain and has the same CP&SCS as the initial BWP.

*UE capabilities*

* [026] Separate UE capabilities for MBS multicast and broadcast is used.
* [026] Define a UE capability for the number of simultaneous G-RNTIs / G-CS-RNTIs reception for multicast. UE shall inform network of this capability.
* [026] A mandatory UE capability for split-bearer configurations of multicast is adopted without capability signalling.
* [026] Reuse the current defined max RB (i.e. 16 RB per UE). Additional note shall be added to TS 38.306 to clarify the max RB is a total number for MRBs and DRBs, and the total number of RBs for split-MRB is considered as two.
* [026] An optional UE capability of *maxMRB-Add* for additional MRBs support is adopted for multicast.
* [026] A set of mandatory MBS broadcast capabilities is adopted:

  PDCP short SN;

  RLC UM with short SN

  RLC UM with long SN

  DRX with long DRX cycle

* [026] No separate UE capability is needed for the maximum number of RoHC/EHC contexts for multicast MRBs. The limitation are across all DRB/ multicast MRBs configured with RoHC/EHC for a UE.
* [026] MBS DRX with long DRX cycle is mandatory for multicast capable UEs.

*PDCP/RLC initial variables*

* [027] HFN is needed for both multicast and broadcast.
* [027] For multicast, the initial value of HFN is indicated by the gNB via RRC.
* [027] For broadcast, the initial value of HFN is selected by the UE.
* [027] If the initial value of HFN is indicated by the gNB, a reference SN corresponding to the initial value of HFN can be indicated to the UE.
* [027] For both multicast and broadcast, the initial value of the SN part of RX\_DELIV is (x – 0.5 × 2[*PDCP-SN-Size*–1]) modulo (2[*PDCP-SN-Size*]), where x is the SN of the first received PDCP Data PDU.
* [027] For both multicast and broadcast, it is up to UE implementation to set the initial value of RX\_Next\_Reassembly to a value before RX\_Next\_Highest.
* [027] For both multicast and broadcast, the initial value of RX\_Next\_Highest ~~for broadcast~~ is set to the SN of the first received UMD PDU containing an SN.

*MAC Open Issues*

* If the downlink assignment is for C-RNTI, and if the previous downlink assignment indicated to the HARQ entity of the same HARQ process was eithe a downlink assignment received for the MAC entity's G-CS-RNTI or a configured downlink assignment for MBS, or

if the downlink assignment is for G-RNTI, and if the previous downlink assignment indicated to the HARQ entity of the same HARQ process was either a downlink assignment received for the MAC entity's G-CS-RNTI or other G-RNTI or C-RNTI or a configured downlink assignment for MBS or unicast,

Consider the NDI to have been toggled regardless of the value of the NDI.

* One-to-many mapping between G-CS-RNTI and MBS sessions is supported and it is assumed that this does not introduce additional specification work.
* Capature CS-RNTI usage in table for MBS in section 7.1 in MBS MAC running CR, i.e. for PTP for PTM retransmission via CS-RNTI and MBS SPS deactivationvia CS-RNTI when MBS SPS is configured.
* If MBS SPS is configured and CS-RNTI is not configured, the retransmission of SPS via PTP is not supported and MBS SPS deactivation via CS-RNTI is not supported.
* The sps-ConfigIndex should unique in UE no matter the SPS is for unicast or multicast.
* RAN2 assume no RAN2 spec impact when more than one NACK-only based feedback are available for transmission in the same PUCCH slot and UE will transform NACK-only into ACK/NACK HARQ bits.
* Remove the editor note about active time for MBS DRX
* In PTP for PTM retransmission, the UE monitors UE specific PDCCH/C-RNTI only during unicast DRX’s active time. Unicast DRX’s RTT timer can be started when PTP retransmission is expected.
* RAN2 confirm RAN1 agreement “the multicast MBS reception will impact BWP switching inactivity timer, but the broadcast MBS reception will not” and capture it in MAC CR.
* It is up to network implementation not configure the default BWP not contain the initial BWP if UE is receiving broadcast.
* Multicast MBS can be supported in MCG side in NE-DC and NR-DC scenarios, i.e., MN terminated MCG bearer kind of MRB.
* Remove the editor notes for LCID in broadcast in MAC running CR.
* Network may not ensure that all MBS sessions associated one G-RNTI are interested by UE, the proposed spec change is captured in MBS MAC running CR.

*LS out*

* Send LS to RAN1 to confirm the below understanding based on RAN1 agreements from RAN1#106 and 106bis. The content of the LS is the following:

Based on RAN1 agreements above, RAN2 made following understanding and confused whether multiple to one mapping between G-CS-RNTI and SPS is supported or not.

RAN2’s understanding: There will be multiple MBS SPS-config and there will also be multiple G-CS-RNTI. However, the association between G-CS-RNTI and MBS SPS-config will not be specified in RRC signalling. The DCI scrambled with G-CS-RNTI will indicated which MBS SPS-config will be activated via HARQ process id in this DCI and sps-ConfigIndex in a SPS-Config-Multicast. Then this G-CS-RNTI will be associated with the MBS SPS-config.

RAN2 can understand that one to one mapping or one to multiple mapping between G-CS-RNTI and MBS SPS config are supported as legacy today. From RAN2 point of view, multiple to one mapping between G-CS-RNTI and MBS SPS config is not supported due to the complexity. RAN2 would like to confirm with RAN1 the following question.

Q1: Whether multiple to 1 mapping between G-CS-RNTI and SPS-configure are supported or not?