**3GPP TSG-RAN WG2 Meeting #115........................................................... R2-21xxxx**

**Electronic Meeting, August 09 – August 27, 2021**

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.300** | **CR** | **0342** | **rev** | **6** | **Current version:** | **16.6.0** |  |
|  | | | | | | | | |
| *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)*.* | | | | | | | | |
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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 in NR | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | CMCC, Huawei | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_MBS-Core | | | | |  | ***Date:*** | | | 2021-05-09 |
|  |  | | | |  | |  | | |  |
| ***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 can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-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 NR | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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 (new)*

## 16.x Multicast and Broadcast Services

### 16.x.1 General

Editor’s Note: General aspects to be covered here.

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 MBS 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 MBS 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.

Editor’s Note: FFS is the term “MBS service area”, if the term is kept in the normative definitions defined in the SA2 TS 23.xxx.

Editor’s Note: These definitions come from TR 23.757, but should eventually be replaced with normative definitions defined in the SA2 TS 23.xxx.

### 16.x.2 Network Architecture

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

### 16.x.3 Protocol Architecture

Editor’s Note: User plane and control plane protocol architecture to be covered here.

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:

* PDCP sublayer provides only the following functionalities:
* Transfer of data;
* Maintenance of PDCP SNs;
* Header compression and decompression using the ROHC protocol, where ROHC O/R-mode can be used for MRB, for cases when UL feedback path in RLC layer is available;
* Reordering and in-order delivery;
* Duplicate discarding.
* For multicast session, gNB provides the following one or more MRB configuration(s) to the UE via RRC signalling:
* Single bearer ID is used for each MRB for Multicast;
* MRB with one DL RLC-UM or Bi-directional RLC-AM entity for PTP transmission;
* MRB with one DL RLC-UM entity for PTM transmission;
* MRB with two RLC-UM entities, one RLC-UM entity for PTP transmission and the other RLC-UM entity for PTM transmission as described in section 16.x.5.4;
* MRB with two RLC-UM entities, one RLC-AM entity for PTP transmission and the other RLC-UM entity for PTM transmission as described in section 16.x.5.4;
* Multicast PTP and Unicast DTCH/DRB share common LCID space;
* For PTM transmission, multicast DRX pattern is configured on a per G-RNTI basis (i.e. independent of legacy UE-specific DRX for unicast transmission);
* For PTP 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.
* The following definitions apply to DRX for multicast:
  + drx-onDurationTimerPTM
  + drx-InactivityTimerPTM
  + drx-LongCycleStartOffsetPTM
  + drx-SlotOffsetPTM
  + drx-HARQ-RTT-TimerDLPTM, needed if the HARQ feedback is enabled
  + drx-RetransmissionTimerDLPTM, needed if the HARQ feedback is enabled
* If Data Inactivity timer is configured, data monitoring is applied both for unicast and MBS multicast (i.e. both PTM and PTP data).

Editor’s Note: Multicast long DRX support is baseline for PTM. FFS whether to support optional short DRX or not.

Editor’s Note: Whether to support security in PDCP requires progress and input from other WG, i.e. SA3.

Editor’s Note: FFS both DL and UL UM RLC configuiration for PTP.



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

* For broadcast session, gNB provides the following one or more MRB configuration(s) to the UE:
* MRB with one RLC-UM entity for PTM transmission;
* Broadcast PTM/MTCH uses reserved LCID(s), which is different from LCID space for unicast DTCH of DRB;
* Broadcast MCCH uses reserved LCID;
* The DRX pattern for broadcast, is configured per G-RNTI.
* The following definitions apply to DRX for broadcast:
  + drx-onDurationTimerPTM
  + drx-SlotOffsetPTM
  + drx-InactivityTimerPTM
  + drx-CycleStartOffsetPTM



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

### 16.x.4 Group Scheduling

Editor’s Note: Group scheduling related aspects to be covered here.

The following logical channels are used in MBS delivey:

* 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 traffic data of multicast ;
* MCCH: A point-to-multipoint downlink channel used for transmitting MBS control information for broadcast session from the network to the UE, for one or several MTCH(s);

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 decipts the usage of RNTI for group transmission:

* There is a one-to-one mapping between MBS Session and G-RNTI used for the reception of the DL-SCH to which a MTCH is mapped;
* There is a one-to-one mapping between MBS Session and G-CS-RNTI used for the reception of the DL-SCH to which a MTCH is mapped;
* A UE can receive different services using different G-RNTIs/G-CS-RNTIs;
* Different logical channels associated with the same G-RNTI may be multiplexed/de-multiplexed together ;
* Different logical channels associated with the same C-RNTI may be multiplexed/de-multiplexed together;
* Different logical channels associated with the same G-CS-RNTI may be multiplexed/de-multiplexed together.

Editor’s Note: FFS if there is a need to have specific LCID spaces for the MTCH/MCCH and whether the LCID space for MTCH and DTCH is shared or separate.

Editor’s Note: FFS if Multiplexing/de-multiplexing of different logical channels associated with the same G-CS-RNTI is supported for NR MBS.

Editor’s Note: 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

Editor’s Note: FFS whether for PTP transmission, DRX operation for unicast transmission is reused.

Editor’s Note: FFS whether multiple G-RNTIs/G-CS-RNTIs are supported depends on UE capability.

Editor’s Note: FFS other mappings between MBS session and G-RNTI.

### 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

Editor’s Note: FFS how multicast configuration is provided for supporting multicast reception in RRC\_CONNECTED state.

If the UE which joined the multicast session is in RRC\_CONNECTED state, the gNB sends RRC Reconfiguration message with relevant MBS configuration for multicast session to the UE and there is no need for separate session activation notification for this UE.

MBS supporting gNBs notify the UEs in RRC IDLE/INACTIVE state about a multicast session activation using a group notification mechanism. 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. And each UE is not paged individually, and the same group notification identity, i.e., MBS session ID, is used for UEs with the same multicast session in both RRC IDLE and RRC INACTIVE states. Extending the unicast paging message to include a new paging record list 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).

gNBs not supporting MBS may notify the UEs in RRC IDLE/INACTIVE state about a multicast session activation through *Paging* messages in the PO as described in section 9.2.5, where each UE is paged individually.

#### 16.x.5.3 Service Continuity

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

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

Mobility procedures for multicast reception allow the UE to continue receiving multicastservice(s) via PTM or PTP during handover.

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 will deliver the forwarded data. Additionally, the UE may be configured by the network to provide PDCP status report for a MRB for multicast session during a handover.

Editor’s Note: FFS which detailed scenario but at least PTP-PTP.

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

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

Editor’s Note: Handover between multicast supporting cell and multicast non-supporting cells related aspects to be covered here.

Mobility from the multicast supporting cell to mulicast non-supporting cells can be achieved by switching the traffic from delivery via MRB to delivery via DRB.

Editor’s note: FFS whether the switching the traffic from delivery via MRB to delivery via DRB either before or during the handover.

Editor’s note: 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.

#### 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 utilizes UE-specific RLC entity, MAC entity and Physcial layer to individually generate and deliver separate copies of MBS data packets to each UEs independently, and uses 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 utilizes group RLC entity, MAC entity and Physcial layer to generate and deliver copies of MBS data packets to a set of UEs independently and 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.

A UE can be configured with a MRB, which can be one of the following modes, and the mode can be changed from one to other via RRC signaling:

* PTM only;
* PTP only;

Split MRB: both PTM and PTP.If a UE is configured with a split MRB, a gNB dynamically decides whether to deliver multicast data by PTM or PTP for a given UE based on the protocol stack defined in section16.x.3.

For a split MRB, the usage of the PTP leg cannot be deactivated, i.e. the UE needs to always monitor C-RNTI and the state of RLC entity for PTP delivery is always active, after the necessary split MRB configuration.

For an MRB configured PTM, PDCP state variables for PTM is setting while configured, and 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.

For an MRB configured PTM, during the initialize the PTM RLC entity for the 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;

For an MRB configured PTP, RLC state variables of PTP RLC reception window can be set to initial value, i.e. 0, due to MRB configuration.

Editor’s Note: When two RLC entities are configured for a MRB for PTP delivery and PTM delivery respectively by RRC, it is FFS whether the state of RLC entity for PTM delivery can be active or deactive and can be dynamically controlled.

Editor’s Note: FFS whether PDCP SR can be triggered due to bearer type change in RRC signaling and FFS how to tigger PDCP SR if need.

#### 16.x.5.5 Reliability

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

### 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 in RRC\_IDLE , RRC\_INACTIVE and RRC\_CONNECTED state via MCCH.. BCCH delivers the parameters needed for the reception of MCCH in the MBS specific SIB, which in turns delivers parameters needed for MTCH reception.

The following principles govern the MCCH structure:

* The 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 and scheduling information for MTCH; Each 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 and stop;
* When the UE receives a 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 channel and SI/Paging without BWP switch in case of BA.

Editor’s Note: FFS that RAN1 inputs are needed for the definition of MBS control information on the MCCH acquisition, e.g. the definition of common search space for MCCH scheduling, and the details of the configuration of the bandwidth for MCCH reception.

Editor’s Note: FFS that RAN1 inputs are needed for to decide about the RNTI and DCI format used for MCCH change notifications.

Editor’s note: FFS on whether this notification can be reused for modification of other information carried by MCCH, if any.

Editor’s note: FFS whether the possibility of UE missing an MCCH change notification needs to be addressed or can be left to UE implementation.

#### 16.x.6.3 Service Continuity

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

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

The gNB may provide the UE with information, enabling service continuity for broadcast session.

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

#### 16.x.6.3.1 Service Continuity in RRC\_IDLE or RRC\_INACTIVE

The UE is allowed to prioritize the MBS frequency of interest when the cell of the MBS frequency provides SIBx carrying the MCCH configuration or the UE is only capable of receiving the MBS service by camping on the MBS frequency.

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.

The mapping between frequency and MBS service ID (e.g. SAI) is provided either in the upper layer signalling (e.g. USD) or in SIBx1 (i.e. different from the SIBx providing the MCCH configuration), which is allowed to be sent in cells not broadcasting MBS service. And the MBS service ID (e.g. SAI) is provided in SIB and USD as well.

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

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

#### 16.x.6.3.2 Service Continuity in RRC\_CONNECTED

The UE in RRC\_CONNECTED state may send MBS Interest Indication to the gNB for broadcast session, which consists of the following information:

* 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.

Editor’s note: FFS whether the MII is reported via UEAssistanceInformation or a new RRC message.

# 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 (legacy) 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).