**3GPP TSG-RAN WG2 Meeting #113-e........................................................... R2-21XXXX**

**Electronic Meeting, Jan 25 – Feb 5, 2021**

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.300** | **CR** | **0342** | **rev** | **4** | **Current version:** | **16.4.0** |  |
|  | | | | | | | | |
| *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:*** | | | 2020-12-20 |
|  |  | | | |  | |  | | |  |
| ***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

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 and Broadcast Services

MCCH Multicast 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

MT Mobile Termination

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 and broadcast services (MBS).

In 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 coverage area are authorized to receive the data). A broadcast communication service is delivered to the UEs using broadcast session. In the case of broadcast session, the UE can receive MBS data in RRC\_IDLE, RRC\_INACTIVE and RRC\_CONNECTED state.

In 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 coverage are authorized to receive the data). A multicast communication service is delivered to the UEs using multicast session. In the case of multicast session, the UE can receive MBS data in RRC\_IDLE, RRC\_INACTIVE and RRC\_CONNECTED state. And the UE is allowed to use additional assistance mechanisms such as feedback/retransmission and/or PTP delivery in RRC\_CONNECTED.

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.

#### 16.x.3.1 Overview

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 UEs, 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, i.e., 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.

For broadcast service, gNB may deliver MBS data packets using PTM transmission.

Whether a UE in RRC\_CONNECTED can receive the MBS service may depend on the network provisioning of the MBS service (e.g. the carrier frequency which providing the MBS service), MBS configuration for the UE and UE’s capabilities.

Editor’s Note: the protocol stack for multicast and broadcast will be provided based on more solid conclusion on L2 structure of MBS.

#### 16.x.3.2 MAC

The following control logical channels are used in MBS:

* **Broadcast Control Channel (BCCH)**

A downlink channel for broadcasting system control information.

**- Multicast Control Channel (MCCH)**

A point-to-multipoint downlink channel used for transmismitting MBS control information from the network to the UE, for one or several MTCHs. This channel is only used by UEs that receive or are interested to receive MBS.

**Dedicated Control Channel (DCCH)**

A point-to-point bi-directional channel that transmits dedicated control information between a UE and the network. Used by UEs having an RRC connection.

The following traffic logical channels are used in MBS:

**- Multicast Traffic Channel (MTCH)**

A point-to-multipoint downlink channel for transmitting traffic data from the network to the UE. This channel is only used by UEs that receive MBS.

**- Dedicated Traffic Channel (DTCH)**

A Dedicated Traffic Channel (DTCH) is a point-to-point channel, dedicated to one UE, for the transfer of MBS in case of PTP transmission.

The following connections between logical channels and transport channels exist:

- BCCH can be mapped to BCH;

- BCCH can be mapped to DL-SCH;

- DCCH can be mapped to UL- SCH;

- MCCH can be mapped to MCH;

-- DTCH can be mapped to DL-SCH;

- MTCH can be mapped to MCH.

#### 16.x.3.3 RLC

Both UM and AM are used in PTP transmission while only UM is used in PTM transmission for multicast or broadcast service.

#### 16.x.3.4 PDCP

 RoHC (at least U-mode) can be configured for multicast or broadcast service.

#### 16.x.3.5 SDAP

#### 16.x.3.6 RRC

### 16.x.4 Group Scheduling

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

LTE SC-PTM mechanism can be reused for the UEs in RRC\_IDLE, RRC\_INACTIVE and RRC\_CONNECTED to receive MBS data, i.e. broadcast based manner. And the two-step based approach (i.e. BCCH and MCCH) as adopted by LTE SC-PTM can be reused for the transmission of PTM configuration for NR MBS in Broadcast based manner.

The following principles govern the MCCH structure:

- the MCCH is sent on DL-SCH;

- the MCCH provides the list of all MBMS services with ongoing sessions transmitted on MTCH(s), (detail information is FFS)

- MCCH is transmitted by RRC every MCCH repetition period;

- MCCH uses a modification period;

- MCCH notification mechanism is used to announce changes of MCCH due to Session Start:

- Detail is FFS.

The following principles are for MBS signalling on BCCH:

- BCCH only points to the resources where the MCCH can be found i.e. it does not indicate the availability of the services;

- BCCH indicates the MCCH modification period, MCCH repetition period and MCCH offset.

#### 16.x.5 Multicast Session Handling16.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.

#### 16.x.5.3 Service Continuity

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

##### 16.x.5.3.1 Handover between MBS cells

Mobility procedures for MBS reception allow the UE to start or continue receiving MBS service(s) via PTM or PTP when changing cell(s).

In order to support for lossless handover for multicast session, DL PDCP SN synchronization and continuity between the source cell supporting MBS and the target cell supporting MBS 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 an RB for multicast session during a handover.

Editor’s Note: the term of “an RB for multicast session” here can be replaced by official MRB term defined in RAN2.

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 MBS cell and non-MBS cells

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

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

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

A gNB node dynamically decides whether to deliver multicast data by PTM or PTP for a given UE. To ensure the reliability of data transmission, PDCP sublayer is taken as the anchor for PTP and PTM dynamic switch as in Figure 16.x.5.4-1.



Figure 16.x.5.4-1: PDCP anchored PTM/PTP Dynamic Switch

#### 16.x.5.5 Reliability

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

### 16.x.6 Broadcast Session 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.

#### 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.

To support service continuity in broadcast session, some information can be provided for NR MBS delivery . (FFS what need to be revisited, e.g. based on progress in other groups, e.g. USD, SAI/TMGI etc).

#### 16.x.6.4 Interest Indication

MBS Interest Indication is supported for UEs in RRC\_CONNECTED for Broadcast service , while it is not supported for UEs in RRC\_IDLE and RRC\_INACTIVE.

# Annex - collection of RAN2 agreements on NR MBS WI

Green highlight – agreement captured in stage-2 specifications

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

No highlight – agreement with no direct impact on specifications

RAN2#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

***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