**3GPP TSG-RAN WG2 Meeting #124R2*-*231xxxx**

**Chicago, USA, Nov. 13th – 17th, 2023**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **38.300** | **CR** | **0732** | **rev** | **1** | **Current version:** | **17.6.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

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| ***Title:*** | Introduction of eMBS in TS 38.300 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | CMCC | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_MBS\_enh-Core | | | | |  | ***Date:*** | | | 2023-11-21 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-18 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories 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-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | This CR introduces the enhancements specified for support of MBS in Rel-18 | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Introduction of multicast reception for UEs in RRC\_INACTIVE state and shared processing for simultaneous reception of broadcast and unicast. | | | | | | | | |
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| ***Consequences if not approved:*** | | Rel-18 MBS enhancement is not supported in NR. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 16.10.4,16.10.5.1, 16.10.5.2, 16.10.5.3.X(new), 16.10.5.4, 16.10.5.6, 16.10.5.7, 16.10.6.X(new), 16.10.6.Y(new) | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | TS 38.331 CR xx  TS 38.321 CR yy  TS 38.323 CR zz  TS 38.304 CR ??  TS 38.306 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*

### 16.10.4 Group Scheduling

The following logical channels are used for MBS delivery:

- MTCH: A PTM downlink channel for transmitting MBS data of either multicast session or broadcast session from the network to the UE;

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

- MCCH: A PTM downlink channel used for transmitting MBS broadcast or MBS multicast control information associated to one or several MTCH(s) from the network to the UE. Broadcast MCCH and multicast MCCH are independent channels. The multicast MCCH is used only for multicast reception in RRC\_INACTIVE state.

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

- MCCH can be mapped to DL-SCH;

- MTCH can be mapped to DL-SCH.

The following depicts the usage of RNTI for PTM transmission:

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

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

*Next Modified Subclause*

### 16.10.5 Multicast Handling

#### 16.10.5.1 Session Management

There are two delivery modes as specified in TS 23.247 [45]:

- 5GC Shared MBS traffic delivery;

- 5GC Individual MBS traffic delivery.

As specified in TS 23.247 [45], if the gNB supports MBS, the network shall use the 5GC Shared MBS traffic delivery in which case an MBS Session Resource context for a multicast session is setup in the gNB when the first UE joins the multicast session.

For 5GC Shared MBS traffic delivery mode, shared NG-U resources are used to provide MBS user data to the gNB. The gNB initiates the Multicast Distribution Setup procedure towards the 5GC, to allocate shared NG-U resources for a multicast session. In case multiple MBS session areas as specified in TS 23.247 [45] are associated with the same multicast session for location dependent MBS services, multiple NG-U shared resources are established for the same multicast session per MBS Area Session ID served by the gNB.

A shared NG-U resource applies one of the following transport options:

- unicast transport;

- multicast transport.

For 5GC Shared MBS traffic delivery an MBS Session Resource comprises one or several MRBs. If minimisation of data loss is applied for a given MRB, synchronisation of allocation of PDCP COUNT values is applied by either or a combination of the following methods:

- derivation of the PDCP COUNT values by means of a DL MBS QFI Sequence Number provided on NG-U. Synchronisation in terms of MBS QoS flow to MRB mapping and PDCP SN size of the corresponding MRB among gNBs are achieved by means of network implementation.

- deployment of a Shared NG-U Termination at NG-RAN, shared among gNBs, which comprises a common entity for assignment of PDCP COUNT values. Synchronisation in terms of MBS QoS flow to MRB mapping and PDCP SN size of the corresponding MRB among gNBs may be achieved by means of network implementation.

If PDCP COUNT values are derived from a DL MBS QFI Sequence Number provided on NG-U and only one QoS Flow is mapped to an MRB, the gNB shall set the PDCP COUNT value of PDCP PDU to the value of the DL MBS QFI Sequence Number provided with the received packet over NG-U. If PDCP COUNT values are derived from a DL MBS QFI Sequence Number provided on NG-U and multiple QoS Flows are mapped to an MRB, the gNB may derive the PDCP COUNT value of the PDCP PDU from the sum of the DL MBS QFI Sequence Numbers of the QoS Flows mapped to this MRB.

NOTE: Synchronisation of PDCP COUNT values in case user data for MBS QoS flows mapped to the same MRB arrive over NG-U at different gNBs in different order or in case of loss of data over NG-U, and related handling of minimisation of data loss is left to implementation.

As specified in TS 23.247 [45], the gNB may receive from the 5GC MBS Assistance Information associated with a multicast MBS session for a UE, which assists the gNB in configuring the UE properly. The MBS Assistance Information indicates that the UE is expected to require dedicated resources very frequently. Based on this information, the gNB may decide the RRC state of the UE.

*Next Modified Subclause*

#### 16.10.5.2 Configuration

A UE can be configured to receive data of MBS multicast session in RRC\_CONNECTED state or RRC\_INACTIVE state. To receive the multicast service, the UE needs to perform MBS Session Join procedure as specified in TS 23.247 [45]. It is up to gNB to decide whether the UE receives data of MBS multicast session in RRC\_CONNECTED state or RRC\_ INACTIVE state. The gNB moves the UE from RRC\_CONNECTED state to RRC\_INACTIVE state via *RRCRelease* message, and moves the UE from RRC\_INACTIVE state to RRC\_CONNECTED state via group notification or UE-specific paging.

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

If the gNB configures the UE to receive the MBS multicast session in RRC\_INACTIVE state, the gNB may provide the PTM configuration via *RRCRelease* message for the MBS multicast session.

The gNB may indicate, in *RRCRelease* message, which multicast service(s) can be continued to be received in RRC\_INACTIVE state. The UE doesn’t suspend MRBs of the multicast session indicated to be continued to be received in RRC\_INACTIVE state if indicated so by the network. Multicast MCCH is used in case a cell supports updating PTM configuration or providing PTM configuration to UEs in RRC\_INACTIVE state moved from other cells. Otherwise, Multicast MCCH can be optionally present.

After transitioning to RRC\_INACTIVE state:

- If the UE selects in the same cell in which it received *RRCRelease* message; and

- If the UE is not indicated to stop monitoring PDCCH addressed by G-RNTI for at least one multicast service; and

- If the PTM configuration for the multicast service is delivered to the UE in *RRCRelease* message.

The UE does not perform MCCH information acquisition immediately, but starts to monitor for multicast MCCH change notification, MRBs received in RRC\_CONNECTED state can be kept receiving in RRC\_INACTIVE state by the UE with the same LCIDs.

A notification mechanism is used to announce the change of the multicast MCCH contents due to multicast session modification or session deactivation and due to neighbouring cell information modification. The scheduling information for multicast MCCH reception is provided via *SIBx* and optionally via *RRCRelease* message.

When there is temporarily no data to be sent to the UEs for a multicast session that is active, the gNB may move the UE to RRC\_INACTIVE state. When an MBS multicast session is deactivated, the gNB may move the UE in RRC\_CONNECTED state to RRC\_IDLE or RRC\_INACTIVE state. For UEs receiving data of MBS multicast session in RRC\_INACTIVE state, the gNB notifies the UE to stop monitoring PDCCH addressed by corresponding G-RNTI via *RRCRelease message* or multicast MCCH when there is temporarily no data to be sent or when the session is deactivated. gNBs supporting MBS use a group notification mechanism to notify the UEs in RRC\_IDLE or RRC\_INACTIVE state when a multicast session has been activated by the CN. gNBs supporting MBS use a group notification mechanism to notify the UEs in RRC\_INACTIVE state when the session is already activated and the gNB has multicast session data to deliver. If the UE receiving data of MBS multicast session in RRC\_INACTIVE state in a cell is notified to stop monitoring PDCCH addressed by G-RNTI for all the joined multicast sessions, the UE does not monitor PDCCH addressed by multicast-MCCH-RNTI until the group notification is received. Upon reception of the group notification, the UEs reconnect to the network or resume the connection and transition to RRC\_CONNECTED state from either RRC\_IDLE state or RRC\_INACTIVE state. Upon reception of the group notification with TMGI-specific indication(s) for multicast reception in RRC\_INACTIVE state, the UE stays in RRC\_INACTIVE state and behaves as specified in TS 38.331 [12] .

The group notification is addressed with P-RNTI on PDCCH, and the paging channels are monitored by the UE as described in clause 9.2.5. Paging message for group notification contains MBS session ID which is utilized to page all UEs in RRC\_IDLE and RRC\_INACTIVE states that joined the associated MBS multicast session, i.e., UEs are not paged individually. The UE stops monitoring for group notifications related to a specific multicast session, i.e., stops checking for the MBS session ID in the Paging message, when the UE enters RRC\_CONNECTED state. The UE does not monitor for group notifications for these cases, i.e., once this UE leaves this multicast session or the network requests the UE to leave, or the network releases the multicast session. If the UE is notified by both group notification and the UE-specific paging, the UE follows the UE-specific paging and goes to RRC\_CONNECTED state.

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

*Next Modified Subclause (new)*

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

Mobility procedures for multicast reception allow the UE in RRC\_INACTIVE state to continue receiving MBS service(s) when changing cells without resuming RRC connection if the PTM configuration of the new cell can be acquired by the UE from the multicast MCCH after cell reselection. During an active MBS multicast session, the UE is required to resume RRC connection to get the PTM configuration if the PTM configuration is not provided on the multicast MCCH of the new cell. Even if the UE in RRC\_INACTIVE state received indication to stop monitoring PDCCH addressed by G-RNTI for an MBS multicast session in the source cell, the UE acquires MCCH in the reselected cell after cell reselection.

The gNB may indicate in the multicast MCCH the list of neighbour cells providing the same MBS multicast service(s) for UEs in RRC\_INACTIVE state as provided in the serving cell. This allows the UE, e.g., to resume RRC connection without reading *SIBx* and multicast MCCH of the neighbour cell, if the interested service which is activated is not available to the UE in RRC\_INACTIVE state.

The gNB may provide an indication on cell PDCP COUNT synchronization for an MBS session with PTM configuration in *RRCRelease* message, once indicated by the gNB, all cells within the RNA are synchronized for PDCP COUNT MRBs of the corresponding MBS service, the order of MRBs for the same MBS multicast session in the MCCH of source cell and reselected cell within the RNA should be consistent. Upon reselection to a cell indicated as synchronized in terms of PDCP COUNT value, the UE doesn’t initialize the PDCP state variables. Otherwise, the UE initializes the PDCP state variables as defined in TS 38.323 [8].

The UE may be configured with dedicated frequency priorities in *RRCRelease* message which the UE applies during cell reselection while receiving data of MBS multicast session in RRC\_INACTIVE state.

The UE receiving multicast session(s) in RRC\_INACTIVE state triggers RRC connection resumption if the latest measured RSRP or RSRQ of the serving cell becomes lower than the threshold configured by the network. The threshold can be configured per MBS session via *RRCRelease* message or multicast MCCH.

MRB need to be received continuously only when the UE transits from RRC\_CONNECTED state to RRC\_INACTIVE state in the same cell.

*Next Modified Subclause*

#### 16.10.5.4 Reception of MBS Multicast data

For multicast service, gNB may deliver Multicast 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 leg and/or PTP leg for a given UE based on the protocol stack defined in clause 16.10.3, based on information such as MBS Session QoS requirements, number of joined UEs, UE individual feedback on reception quality, and other criteria. The same QoS requirements apply regardless of the decision.

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

SPS is not supported for MBS multicast session data reception for UEs in RRC\_INACTIVE state.

*Next Modified Subclause*

16.10.5.6 DRX

The following DRX configurations for PTM/PTP transmission by RRC\_CONNECTED UEs are possible:

- For PTM transmission, multicast DRX is configured per G-RNTI/G-CS-RNTI which is independent of UE-specific DRX;

- For PTP transmission, UE-specific DRX is reused, i.e., UE-specific DRX is used for both unicast transmission and PTP transmission of MBS multicast. For PTM retransmission via PTP, UE monitors PDCCH scrambled by C-RNTI/CS-RNTI during UE-specific DRX's Active Time.

The following DRX configuration for PTM transmission by RRC\_INACTIVE UEs is possible:

- For PTM transmission, multicast DRX is configured per G-RNTI.

*Next Modified Subclause*

#### 16.10.5.7 Physical Layer

A CFR configured by *RRCReconfiguration* message is defined for multicast scheduling as an 'MBS frequency region' with a number of contiguous PRBs confined within and with the same numerology as the DL BWP, and multicast scheduling may have specific characteristics (e.g., PDCCH, PDSCH and SPS configurations). The CFR for the multicast reception in RRC\_INACTIVE state and the CFR for broadcast can be configured differently, and if one CFR is not completely contained within the other CFR, the UE in RRC\_INACTIVE state is not required to receive both broadcast and multicast simultaneously.

Two HARQ-ACK reporting modes are defined for MBS:

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

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

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

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

*Next Modified Subclause (new)*

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

If the UE in RRC\_CONNECTED state is receiving or interested to receive an MBS broadcast service from a non-serving cell, the UE may use MBS Interest Indication message to inform the serving gNB about the parameters used for the non-serving cell broadcast reception as described in TS 38.331 [12]. The gNB may enable the sending of the MBS Interest Indication by including an indication in SIB1. The UE may indicate to the serving cell the UE capability for receiving MBS broadcast service from a non-serving cell. It is up to gNB implementation to consider the MBS Interest Indication and the UE capability for receiving MBS broadcast service from a non-serving cell, if indicated, when scheduling the UE.

In case the UE only reports the frequency for broadcast service reception from the non-serving cell in MBS Interest Indication due to some parameters (e.g., SCS, bandwidth) not available, the UE may transmit updated MBS Interest Indication once the parameters are available to the UE. It is up to network implementation on how to enable the UE to acquire these parameters from the non-serving cell.

*Next Modified Subclause (new)*

16.10.6.Y Support of Resource Sharing across multiple Broadcast MBS sessions in RAN Sharing Scenario

NGAP supports resource sharing efficient scheme for broadcast delivery in RAN sharing. Such scheme enables the gNB to identify broadcast MBS sessions from different PLMNs providing identical content. The identification is based on information provided by the involved 5GCs in the Associated Session ID as specified in TS 23.247 [x].

If in the MBS Broadcast Setup Request message an Associated Session ID is received from a 5GC participating in RAN sharing, the gNB uses it to determine whether MBS Session resources can be shared with a broadcast MBS session(s) associated with the same Associated Session ID requested from another 5GC participating in RAN sharing.

The identification of MBS Broadcast Sessions providing identical content may also be based on implementation specific configuration as specified in TS 23.247 [45].

The gNB applying this resource efficiency scheme,

- may decide whether NG-U resources are established towards all involved 5GCs or only some of them.

- resolves different QoS requirements or different S-NSSAIs received from the participating 5GCs in an implementation specific way.

The gNB may also trigger the NGAP Broadcast Session Transport procedure towards one 5GC participating in RAN sharing to set up NG-U resources to maintain NG-U connectivity as specified in TS 23.247 [45].

End of Changes

Annex - collection of RAN2 agreements on enhancements of MBS WI

Green highlight – agreement captured in stage-2 specifications

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

No highlight – agreement with no direct impact on specifications

RAN2#119-e agreements

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

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

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

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

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

Option 1: Dedicated signalling

Option 2: Solution based on SIB+MCCH

We do not preclude some “mix” of the options

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

RAN2#119 bis-e agreements

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

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

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

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

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

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

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

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

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

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

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

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

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

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

* If option 1 is supported for PTM configuration

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

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

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

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

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

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

RAN2#120 agreements

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

RAN2#121 agreements

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

RAN2#121bis agreements

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

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

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

RAN2#122 agreements

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

RAN2#123 agreements

* For a UE receiving multicast in RRC\_INACTIVE, the UE resumes the RRC connection when the measured RSRP or RSRQ based on the existing measurement requirements (whichever is configured by the NW) of the serving cell becomes lower than the threshold configured by network. FFS whether/how we need to address ping-pong issue
* The threshold can be configured in PTM configuration per MBS session via RRCRelease or multicast MCCH message.
* Unless issues are identified with using one of existing resume causes, no new resume causes are introduced for UEs receiving MC in INACTIVE when they resume due to bad quality or lack of SIBx/PTM configuration
* Dedicated frequencies in RRCRelease can be used by the NW, as legacy
* FFS whether we need something more, e.g. frequency priorities in MCCH or a solution based on FSAI
* NW indicates which multicast service can be received in INACTIVE in suspendConfig of RRC Release. FFS how exactly this is indicated
* Unless blocking issues are identified, UE behaviour is not to suspend corresponding multicast MRBs and to keep using them in INACTIVE
* For “non-synchronised“ cell (in terms of PDCP COUNT), upon cell reselection, UE sets the initial PDCP count of the MRB for the multicast reception in RRC\_INACTIVE state based on the same mechanism as R17 MBS broadcast.
* One cell can indicate "synchronized", if by implementation, it follows a common QoS flow to MRB mapping rule and at the same time PDCP COUNT is set according to the MBS QoS Flow SN.
* FFS how the UE is indicated about cells being synchronized (i.e. what information the NW needs to provide to the UE)
* Solutions which require COUNT broadcasting via MCCH are not considered
* SPS is not supported for multicast reception in RRC\_INACTIVE.
* RAN2 enables RRC\_INACTIVE UE receiving multicast to also receive possible PTM retransmissions initiated by UEs receiving multicast in RRC\_CONNECTED.
* Allow configuration of drx-HARQ-RTT-TimerDL-PTM and drx-RetransmissionTimerDL-PTM for INACTIVE UEs (38.331).
* UE receiving MBS multicast in RRC\_INACTIVE should start drx-HARQ-RTT-TimerDL-PTM and drx-RetransmissionTimerDL-PTM when reception of the transport block has not been successful. FFS the details, e.g. when the timers are started exactly.
* This is optional UE capability
* As per the previous agreement, if the UE is able to get the additional information (i.e. its current configuration does not prevent it from doing so), the UE shall do this (if capable and configured by the network)
* In case additional information (SCS, bandwidth) is not available at the time of sending the MII to the unicast serving cell (e.g. the UE is not able to read SIB1 from the non-serving cell), the UE reports whatever is available information at that time (i.e. at least the frequency, and optionally SCS and/or BW as available).
* UE reports updated MII after acquiring additional information from the non-serving cell (if previously it reported only frequency) or if the information in the non-serving cell changes.
* The SCS in the MII is set to the SCS of the CORESET#0 for the MBS broadcast cell.
* Combination of FreqBandIndicatorNR and ARFCN-ValueNR is used to signal the frequency information in the MII for shared processing.
* At least CFR bandwidth is reported by the UE in MII. FFS whether “location” needs to be also reported and how exactly this is captured in RRC (i.e. which IE is used).

RAN2#123bis agreements

* Introduce an explicit indication in the multicast MCCH/RRCRelease(i.e., in the IE MBSMulticastConfiguration) for the UE to stop G-RNTI monitoring. It is used for notification triggered by the multicast session deactivation or the temporary no data.
* UE in RRC\_INACTIVE does not need to monitor multicast MCCH DCI in the current cell until next group paging is received if UE is notified “the stop of G-RNTI monitoring” for all the joined multicast sessions, including the following cases,
  + - Case 1: UE is receiving multicast in RRC\_INACTIVE and then is notified about the session deactivation via MCCH.
    - Case 2: UE transits from RRC\_CONNECTED to RRC\_INACTIVE, and “the stop of G-RNTI monitoring” is indicated in RRCRelease message.
* If UE receives PTM configuration of multicast session(s) in RRCRelease and “the stop of G-RNTI monitoring” is indicated for the corresponding session(s) and then UE selects the same cell as on which it received RRCRelease, UE starts to monitor MCCH DCI upon receiving group paging that indicates to allow the multicast reception in RRC\_INACTIVE.
* If “the stop of G-RNTI monitoring” for a session is indicated in RRCRelease message and the PTM configuration of the corresponding multicast session is not included in same message , UE reads multicast MCCH(if present) upon receiving group paging that indicates to allow the multicast reception in RRC\_INACTIVE.
* If the whole Rel-18 multicast related configuration is absent in RRC Release, UE behaves the same as Rel-17 MBS UE.
* If the session is active and UE receives PTM configuration in RRCRelease message and then UE selects the same cell as it received RRCRelease, UE does not perform Multicast MCCH information acquisition immediately but starts to monitor MCCH DCI for possible change notification after transiting to INACTIVE.
* FFS UE in RRC\_INACTIVE reads MCCH(if present) on the reselected cell after cell reselection to acquire the PTM configuration session if UE received“the stop of G-RNTI monitoring” indication for the session.
* FFS If UE receives PTM configuration of multicast session(s) in RRCRelease and “the stop of G-RNTI monitoring” is indicated for the corresponding session(s) and then UE selects the same cell as on which it received RRCRelease, UE acquires the PTM configuration from MCCH (if present) upon receiving group paging that indicates to allow the multicast reception in RRC\_INACTIVE. FFS if the UE uses the configuration from RRCRelease until having read the one from MCCH
* FFS whether there can be case where MCCH is not present
* If UE in RRC\_INACTIVE received “the stop of G-RNTI monitoring” indication for the session in the source cell, the UE reads MCCH(if present) in the reselected cell after cell reselection.
* If UE receives PTM configuration of multicast session(s) in RRCRelease and “the stop of G-RNTI monitoring” is indicated for all of the the corresponding session(s) and if UE selects the same cell as on which it received RRCRelease, UE acquires the PTM configuration from MCCH (if present) upon receiving group paging that indicates to allow the multicast reception in RRC\_INACTIVE.
* UE can use the PTM configuration from RRCRelease until having read the one from MCCH.
* Multicast MCCH can be optionally present for a cell providing multicast reception in RRC\_INACTIVE. We do not optimize for this in RAN2, e.g. we are targeting a single cell scenario without mobility and without PTM configuration update for optional MCCH.
* The RSRP/RSRQ measurement as specified in TS 38.304 are reused (i.e. no new measurements and measurement requirements).
* No TTT is introduced
* All MRBs corresponding to the same multicast session to be received in RRC\_INACTIVE should be continued.
* MRB ID is not configured in PTM configuration for multicast in INACTIVE. FFS if anything is needed.
* mt-Access is selected for multicast reception when it is applicable to the legacy mt-Access use case (i.e. it is not applicable to access identities 1, 2 and 11-15).
* UE selects '0' as the Access Category when the resumption of the RRC connection is triggered for multicast reception.
* A UE starts the drx-HARQ-RTT-TimerDL-PTM for the corresponding HARQ process in the first symbol after the end of the corresponding multicast transmission.
* Potential agreement: A 1-bit indication on cell PDCP COUNT synchronization for an MBS service is present with the INACTIVE MRB PTM configuration provided in RRCRelease/MCCH. FFS whether the indication is for RNA or another area.
* Offline ZTE to understand whether there are concerns with the above and clarify how it works in detail
* A 1-bit indication on cell PDCP COUNT synchronization for an MBS service is present with the INACTIVE MRB PTM configuration provided in RRCRelease, and cells in the RNA area are synchronized for PDCP COUNT.
* UE initiates the MII reporting for the non-serving cell upon stopping the reception of all the broadcast services that UE were receiving on a non-serving cell (TP in [R2-2309559](file:///D:\3GPP\Extracts\R2-2309559%20Remaining%20Issues%20on%20Shared%20Processing.docx) can be taken as baseline).
* For Rel-18 MII reporting, frequency of interest determination is amended to add a condition that at least one of the MBS sessions is from non-serving cell for the concerned frequency included in SIB21 from the non-serving cell and/or USD (TP in [R2-2310088](file:///D:\3GPP\Extracts\R2-2310088%20Shared%20processing%20for%20broadcast%20and%20unicast%20reception.docx) can be taken as baseline).
* For MII for shared processing, *FreqInfoMBS* in the running CR refers to the frequency information obtained from the USD or the SIB21 (i.e. same understanding as Rel-17).
* For MII for shared processing, signalling will support reporting CFR location & BW (i.e. actual value of *locationAndBandwidthBroadcast-r17* encoded as INTEGER (0..37949)) as well as point A of non-serving cell, i.e. information enough to point to the exact location of CFR, if available at the UE. It is an optional IE in MII.

RAN2#124 agreements

* If not captured already properly, we can clarify in stage-2 specs that the UE can only receive MCCH with multicast configurations after joining multicast session.
* Other open issues discussed based on company contributions
* Support the simultaneous configuration of SDT and MBS multicast reception in RRC\_INACTIVE to one UE, unless serious issues are identified during implementation in the CR.
* MRB cannot be configured as SDT bearer.
* The UE is not required to monitor group Paging during SDT procedure.
* The understanding is NW can send the UE directly to INACTIVE with PTM config for MC in INACTIVE.
* In a “synced” RNA area, the order of MRBs within the same session configuration in the source and target cells’ MCCH messages should be consistent.
* For transition from RRC CONNECTED to RRC INACTIVE, the same LCIDs are used for the same MRBs if UE continues in the same cell from which it received RRCRelease.
* Offline on different cell case and RRC INACTIVE to CONNECTED transition (ZTE)
* MRB continuity is guaranteed only when the UE transits from RRC CONNECTED to RRC INACTIVE in the same cell.
* Understanding is the UE uses the latest available measurement for condition evaluation, no need to capture special cases. Check whether this requires some spec changes, e.g. a NOTE.
* NW should be able to configure eLCID for multicast MRB in RRC\_INACTIVE, similar as in Rel-17.
* The max number of thresholds for resume is set to 8.
* For RRC\_INACTIVE, when Multicast CFR for RRC\_INACTIVE and broadcast CFR are configured differently, if one CFR is not completely contained within the other CFR, then UE is not required to receive both broadcast and multicast simultaneously.
* If multicast CFR for RRC\_INACTIVE is not configured, the default is same as CORESET#0 (check whether/not already captured in the running CR).
* Upon transition to RRC\_INACTIVE from RRC\_CONNECTED, MAC is reset (including flushing of soft buffer for HARQ process used for multicast reception in RRC\_INACTIVE). No spec impact is expected.
* Upon cell reselection, MAC is reset (including flushing of soft buffer for HARQ process used for multicast reception in RRC\_INACTIVE). There may be impact to RRC spec (to indicate the MAC reset).
* Upon transition to RRC\_INACTIVE from RRC\_CONNECTED, MAC is reset (including stopping of drx-HARQ-RTT-TimerDL-PTM and drx-RetransmissionTimerDL-PTM, if running). No spec impact is expected.