**3GPP T****SG-RAN WG2 Meeting #114-electronic R2-210xxxx**

**Online, May 19th – May 27th, 2021**

**Agenda item: 8.1.2.4**

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**Title:** **Summary on MBS Group Scheduling**

**Document for: Discussion and Decision**

# 1 Introduction

This contribution is aimed at providing a summary of contributions regarding MBS group scheduling aspect. The following 22 contributions, submitted in RAN2#114-e meeting, providing understandings on the RAN2 impacts of NR MBS group scheduling and potential solutions are summarized:

1. [R2-2105015](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2105015.zip), NR Multicast and Broadcast Radio Bearer Architecture aspects, Qualcomm Inc
2. [R2-2105756](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2105756.zip), Architecture aspects for NR MBS, Ericsson
3. [R2-2106238](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2106238.zip), Discussion on MBS L2 Structure, CMCC
4. [R2-2106282](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2106282.zip), Multicast and Broadcast transport channels, Huawei, CBN, HiSilicon
5. [R2-2106417](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2106417.zip), Discussion on overall architecture of MBS traffic delivery, LG Electronics Deutschland
6. [R2-2105764](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2105764.zip), Discussion on MRB Architecture, Samsung
7. [R2-2104756](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2104756.zip), Discussion on Group Scheduling, CATT
8. [R2-2104824](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2104824.zip), Discussion on Group Scheduling for NR MBS, ZTE, Sanechips
9. [R2-2104876](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2104876.zip), MBS MAC layer and group scheduling aspects, Intel Corporation
10. [R2-2104938](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2104938.zip), Discussion on group based scheduling for MBS, OPPO
11. [R2-2104950](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2104950.zip), RAN2 aspects of Group Scheduling for NR MBS, MediaTek Inc
12. [R2-2104951](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2104951.zip), L1 HARQ operation for PTM transmission, MediaTek Inc
13. [R2-2104993](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2104993.zip), Considerations on Multiplexing & Scheduling Aspects, Samsung
14. [R2-2105098](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2105098.zip), MBS reception in CONNECTED state, Apple
15. [R2-2105287](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2105287.zip), Group Scheduling for MBS, vivo
16. [R2-2105311](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2105311.zip), Consideration on Group Scheduling Aspects, Shanghai Jiao Tong University
17. [R2-2105572](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2105572.zip), RAN2 aspects of group scheduling, TCL Communication Ltd
18. [R2-2105654](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2105654.zip), Open issues group scheduling, Ericsson
19. [R2-2105834](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2105834.zip), MBS Group Scheduling Aspects, Lenovo, Motorola Mobility
20. [R2-2106241](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2106241.zip), Discussion on group scheduling for MBS, CMCC
21. [R2-2106283](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2106283.zip), RAN2 aspects of group scheduling, Huawei, CBN, HiSilicon
22. [R2-2106422](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2106422.zip), Discussion on RAN2 aspects of group scheduling and DRX, LG Electronics Deutschland

# 2 Summary for MBS group scheduling

## 2.1 L2 modeling for MBS group scheduling

### 2.1.1 Mapping between G-RNTI/G-CS-RNTI and MBS session

In LTE SC-PTM, there is a one-to-one mapping between MBMS session, which is identified by the TMGI, and MBMS traffic logical channel (e.g. SC-MTCH). Further, the transmissions of an SC-MTCH are associated with a G-RNTI. Hence, there is a one-to-one mapping between TMGI and G-RNTI.

For NR MBS, considering that each MBS session can support one or multiple QoS flows according to the SA2 agreement, it is worthy to reconsider the mapping relation between G-RNTI and MBS session. Further, as agreed in RAN1#104bis-e meeting, G-CS-RNTI was defined for both the activation/deactivation of SPS group-common PDSCH and PTM scheme 1 based dynamic retransmission. Then, it seems a spontaneous logic that the mapping relation between G-CS-RNTI and MBS session needs to be also considered.

Contributions [1][2][7][8][9][11][13][15][17][18][19][20][21] proposed that there could be one-to-one mapping between G-RNTI and MBS session, the same as LTE SC-PTM. The intention is to avoid UE from receiving/processing MBS services in which the UE is not interested. With this, both UE complexity and power consumption on blind PDCCH detection can be largely reduced.

Furthermore, contributions [2][15][18][21][22] proposed that the mapping between G-RNTI and MBS session can be extended to one-to-multiple mapping (based on network configuration and UE capability). The main reason supporting this mapping relation is that the mandate LTE one-to-one mapping rule makes it difficult for the network to efficiently satisfy the service requirements of various UEs interested in multiple MBS services (e.g. configured with different numbers of G-RNTIs). In practice, the gNB should be allowed to schedule multiple multicast services to a given UE via the same G-RNTI (also considering the limited UE capability on simultaneous PDCCH detection with different RNTIs).

Similar to the G-RNTI case, contributions [9][10][15][19][20] proposed that the mapping between G-CS-RNTI and MBS session/service can be one-to-one mapping or one-to-multiple mapping. Specifically, (3/5) companies proposed one-to-one mapping only while the other (2/5) companies proposed one-to-multiple mapping can be additionally supported.

On the other hand, contributions [22] proposed that the multiple-to-one mapping between G-RNTI and MBS session should be considered so that one-to-one mapping between G-RNTI and MBS radio bearer can be achieved. With this mapping, separate QoS treatments (i.e. different MRBs within the same MBS session may need different handling over Uu) for a specific MBS radio bearer can be provided by gNB.

**Rapporteur’s Summary:**

(14/22) contributions have provided proposals on the mapping relation between G-RNTI/G-CS-RNTI and MBS session. Based on these contributions, the most majority of companies (13/14) agree that using a one-to-one mapping between G-RNTI/G-CS-RNTI and MBS session can help to UE power saving. Specifically,

* (6/14) companies explicitly support only one-to-one mapping between G-RNTI and MBS session.
* (3/14) companies explicitly support only one-to-one mapping between G-CS-RNTI and MBS session.
* (5/14) companies explicitly propose that the one-to-multiple mapping between G-RNTI and MBS session should be also supported.
* (2/14) companies explicitly propose that the one-to-multiple mapping between G-CS-RNTI and MBS session should be also supported.
* (1/15) company considers the multiple-to-one mapping between G-RNTI and MBS session.

Therefore, the following is proposes:

**Proposal 1: One-to-one mapping between G-RNTI and MBS session is supported in NR MBS. FFS one-to-multiple mapping between G-RNTI and MBS session.**

**Proposal 2: One-to-one mapping between G-CS-RNTI and MBS session is supported in NR MBS. FFS one-to-multiple mapping between G-CS-RNTI and MBS session.**

### 2.1.2 Support of multiple G-RNTIs/G-CS-RNTIs

Based on P1 and P2, next, we can review the questions asked by RAN1 in the LS R2-2104710 regarding the support of multiple G-RNTIs and G-CS-RNTIs. Specifically,

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| **RAN1 LS R2-2104710:**RAN1 seeks answers from RAN2 regarding the following questions:**Question 1**: Whether RAN1 should consider the case of UE supporting multiple G-RNTIs?**Question 2**: Whether RAN1 should consider the case of UE supporting multiple G-CS-RNTIs? |

Companies in contributions [2][6][7][9][10][13][15][18][20][21] all agreed that multiple G-RNTIs/G-CS-RNTIs can be supported based on network configuration/UE capability/UE implementation. On the contrary, the company in contribution [19] thinks only one G-CS-RNTI is supposed to be used for PTM transmission, which is similar to the legacy NR mechanism with multiple CG configurations.

**Rapporteur’s Summary:**

(11/22) contributions have provided proposals on the question in the RAN1 LS. It seems a majority view (10/11) that multiple G-RNTIs/G-CS-RNTI can be supported by UE for both NR MBS broadcast and multicast. Therefore, the following is proposed,

**Proposal 3: A UE can support multiple G-RNTIs/G-CS-RNTIs. Inform RAN1 of this agreement.**

### 2.1.3 Mapping between MBS QoS flow and MBS radio bearer

According to TR 23.737, the following principles are applied for normative work for multicast and broadcast communication services:

- The network shall support QoS control per MBS session instead of per user.

- The network shall support one or multiple QoS flow for an MBS session.

Besides, in the past RAN2 meeting, it was agreed that the function of mapping from QoS flows to MBS radio bearers in SDAP is needed for NR MBS. So, we have to consider the mapping relation between QoS flow and MBS radio bearer.

Contributions [1][7][8][12][15][20][21] all held a view that one MBS session (including one or multiple MBS QoS flows) can be mapped to one MBS Radio Bearer. More specifically, multiple MBS QoS flows corresponding to one MBS session can be mapped into one or more MBS radio bearers.

**Rapporteur’s Summary:**

(7/22) contributions have provided proposals on the mapping relation between MBS QoS flow and MBS radio bearer. All these contributions share the same view. Rapporteur thinks the proposed view is just following the existing NR QoS flow mapping rules and SA2 conclusions. So the following proposal is given,

**Proposal 4: Multiple MBS QoS flows corresponding to the same MBS session can be mapped to one or more than one MBS radio bearers.**

### 2.1.4 Logical channel modeling

In RAN2#113-e meeting, it was agreed that 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. It implies that a new NR MBS logic channel called MCCH is introduced for NR MBS. For the upcoming RAN#114-e meeting, there are contributions [1][4][7][8][9][11][13][17][21] discussing the NR MBS logical channel terminologies and mapping. Specifically,

Contributions [1][7][9][13][21] proposed that MTCH should be introduced and contribution [1] further propose it should be mapped to DL-SCH. Contributions [4][8][11][17] proposed that both MCCH and MTCH are specified for PTM transmission and they are all mapped to the DL-SCH transport channel, same as LTE. Contribution [19] also shares a similar view in the case of delivery mode 2 and additionally considers the LCH for delivery mode 1 as an FFS issue (i.e. whether to use DTCH, or MTCH, or introduce a new logical channel). Moreover, Contributions [13][17][21] proposed that the PTP leg reuses the legacy DTCH logical channel.

**Rapporteur’s Summary:**

(9/22) contributions have provided understanding about the NR MBS logical channel terminologies and mapping. The majority (8/9 companies) view is that MTCH should be introduced for the PTM leg and is mapped to the DL-SCH. For the PTP leg, although only (3/22) inputs are given, all 3 companies think the existing DTCH can be reused.

Based on the above, the following four proposals are made:

**Proposal 5: MCCH is mapped to the DL-SCH for NR MBS delivery mode 2.**

**Proposal 6: MTCH is specified for PTM transmission of NR MBS.**

**Proposal 7: MTCH is mapped to the DL-SCH.**

**Proposal 8: DTCH is reused for PTP transmission of NR MBS.**

### 2.1.5 Identity space of MBS radio bearer and logical channel

For NR split bearer, the network configures one DRB identity (ID) for the bearer and two LCIDs for the LCHs that are corresponding to the bearer. Considering that the majority of companies prefer PDCP anchor based protocol architecture for NR MBS, we can discuss whether the existing DRB/LCH ID configuration method can be reused for NR MBS when PTM and PTP are configured for a given UE.

Regarding the ID of MBS radio bearer, contribution [10][20] proposed that only one ID needs to be configured for MBS radio bearer since the PDCP is common for PTP and PTM. Besides, it further proposed that a separate radio bearer ID space should be considered for MBS radio bearer.

Regarding the ID space of LCH (i.e. LCID space) for MTCH in NR MBS, contributions [1][7][8][9][10] [13][15][20][21] had provided proposals. Specifically, contribution [1] proposed that multicast RLC entity can be associated with 2 LCIDs (i.e. one LCID for multicast and second LCID for unicast). Contribution [7] a range of LCID should be defined for MTCHs but no detailed solution is proposed.

For PTM transmission, contributions [10][13][15][20] thought a separate LCID space should be reserved/used while contributions [8][9] proposed that LCID values for DL-SCH can be reused. Meanwhile, contribution [21] thinks that the LCID allocation scheme is different based on MBS delivery mode. For example, a common LCID space can be shared for PTM transmission in MBS delivery mode 1 while an independent space should be considered for PTM transmission in MBS delivery mode 2.

For PTP transmission, contributions [8][9][10][13][20][21] thought that a common LCID space is shared by unicast logical channels and MTCHs for multicast.

Last, contribution [21] proposed that an LCID should be reserved for MCCH.

**Rapporteur’s Summary:**

Only (2/22) contributions have provided a proposal on ID configuration for MBS radio bearer. It seems there is no common concern on this issue in the stage-2 phase. Rapporteur thinks it might be better to put it as an open issue and further discuss it based on contributions in the stage-3 phase.

(9/22) contributions have provided proposals on LCID allocation for MBS PTM/PTP transmission. Specifically,

* (5/9) companies support a separate LCID space for PTM logical channels (at least for broadcast) while (2/9) company thinks not.
* (4/9) companies support separate space while (3/9) companies not supporting for PTM transmission in MBS delivery mode 1.

It seems hard to conclude the LCID allocation method for PTM transmission in MBS delivery mode 1.

Besides, (6/9) companies share the same view that a common LCID space is shared by unicast logical channels and MTCHs for PTP transmission. It is necessary to further consider the LCID value allocated for MCCH.

Based on the above, rapporteur proposes the proposals below,

**Proposal 9: For NR MBS delivery mode 1, a common LCID space is shared between DTCHs for DRBs and DTCHs for multicast PTP transmission.**

**Proposal 10: For NR MBS delivery mode 1, RAN2 to consider the following options for LCID space of logical channels for multicast PTM transmission:**

* **Option 1: Separate LCID space;**
* **Option 2: A common LCID space shared with DTCHs for DRBs.**

**Proposal 11: For NR MBS delivery mode 2, separate LCID space is used for logical channels for broadcast transmission. FFS the LCID value allocated for MCCH.**

### 2.1.6 Multiplexing/de-multiplexing of MAC SDU

There are two multiplexing/de-multiplexing issues about MBS logical channels, i.e. MBS PTM logical channel multiplexing and MBS PTP logical channel multiplexing.

Contributions [2][3][5][7][8][9][11][13][15][19][20][21] proposed that multiplexing/de-multiplexing of different logical channels for PTM leg associated with the same G-RNTI is supported in MAC. Besides, it is also proposed that multiplexing/de-multiplexing of different logical channels for PTP legs, which are corresponding to the same or different MBS sessions, and the unicast session is supported in MAC due to scheduling by the same C-RNTI.

**Rapporteur’s Summary:**

(12/22) contributions have provided proposals on the multiplexing/de-multiplexing of MAC SDU. Obviously, the most majority of contributions share the same on the MAC multiplexing/demultiplexing rule in NR MBS.

Therefore, the following are proposed,

**Proposal 12: Multiplexing/de-multiplexing of different logical channels associated with the same G-RNTI is supported for NR MBS.**

**Proposal 13: Multiplexing/de-multiplexing of different logical channels associated with the C-RNTI is supported for NR MBS.**

### 2.1.7 DRX

In LTE SC-PTM, group DRX is introduced for UE power saving. In NR MBS, similar DRX mechanism needs to be considered as well. Contributions [7][9][10][11][13][15][18][19][20][21][22] all proposed supporting DRX for NR MBS and had further discussed DRX related detailed operation. Overall, the majority view can be concluded as follows,

* MBS DRX configuration for PTM transmission is configured on a per G-RNTI basis (NOTE: a common MBS DRX configuration might be used for multiple MBS services); [7][11][13][15][18][19][21][22]
* the general DRX parameters (e.g. *drx-onDurationTimer*, *drx-SlotOffset*) and timer operations of C-DRX/LTE SC-PTM DRX should be taken as baseline (e.g. for NR MBS delivery mode 2, LTE SC-PTM DRX can be directly reused); [9][15][18][20]
* legacy unicast DRX pattern is reused for PTP transmission. [9][13][15][21].

Furthermore, contributions [10][15] would RAN2 to consider whether a common DRX configuration can be used for CONNECTED UE with both multicast (including PTM and/or PTP) and unicast transmission. Contribution [9] considered to configure DRX configuration for each MCCH.

**Rapporteur’s Summary:**

(11/22) contributions have provided proposals on DRX for NR MBS. Obviously, it is a majority view that DRX operation is supported in NR MBS. Then, rapporteur thinks all three conclusions mentioned above with the majority company supporting can be considered as baseline for the future detailed design of NR MBS DRX mechanism. Therefore, the following proposals are made,

**Proposal 14: For PTM transmission of NR MBS, DRX scheme is supported on a per G-RNTI basis (i.e. independent of DRX for unicast transmission).**

**Proposal 15: For NR MBS delivery mode 2, LTE SC-PTM DRX scheme is reused.**

**Proposal 16: For PTP transmission, DRX operation for unicast transmission is reused.**

**Proposal 17: NR MBS DRX configuration can include drx-onDuration timer****, drx-inactivity timer, drx-long cycle start offset, drx-slot offset, drx-HARQ RTT timer DL, and** **drx-DL retransmission timer.**

### HARQ operation

In the previous RAN1#104 meeting, RAN1 agreed to support PTM initial transmission and PTP HARQ retransmission for multicast, as per the quoted agreement,

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| RAN1#104-e meeting: For RRC\_CONNECTED UEs, if ACK/NACK based HARQ-ACK feedback is supported for PTM scheme 1, and if initial transmission for multicast is based on PTM transmission scheme 1, support retransmission(s) using PTP transmission. * The HARQ process ID and NDI indicated in DCI is used to associate the PTM scheme 1 and PTP transmitting the same TB.
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With this, at the UE side, the UE shall be able to combine different RV versions for the same TB received from PTM HARQ operation and PTP HARQ operation. To realize this, in reality, the UE needs to use a single HARQ process within the HARQ entity for the reception of the corresponding transport block. 2 contributions [10][12] have given proposals regarding the HARQ operation in this case. In short, from the RAN2 perspective, a HARQ process should be used by PTM initial transmission and L1-PTP HARQ retransmission.

Further, the company in contributions [10] also gives some considerations and proposal about the HARQ process id allocation for SPS group-common PDSCH.

**Rapporteur’s Summary:**

(2/22) contributions have provided proposals on HARQ operation based on the latest RAN1 agreement. In rapporteur’s understanding, the proposed RAN2 proposals in [10][12] (e.g. a combined HARQ process is allocated at UE to receive the data from both PTM and PTP HARQ process) seem merely to confirm that it is feasible to support the RAN1 agreement from RAN2 perspective. In this sense, it seems no proposal is needed since there is no necessary RAN2 action from now. Also, the HARQ operation for SPS group-common PDSCH is supposed to be further studied with more RAN1 input.

No proposal is made.

### 2.1.9 Others

#### 2.1.9.1 UE capability

In contributions [13][14][18][21], it was proposed the exact number of G-RNTIs that can be allocated to UE (i.e. the number of concurrent sessions supported) should be discussed and confirmed, taking the UE capability into account.

**Rapporteur’s Summary:**

(4/22) contributions have provided proposals on the UE capability of simultaneous G-RNTI processing. Rapporteur thinks we can discuss this issue in the stage-3 phase.

No proposal is made.

#### 2.1.8.2 MBS impacts on data inactivity monitoring

Contributions [13][19] proposed that both unicast and MBS data should be considered during data inactivity monitoring while contribution [18] proposed to discuss this issue regarding the multicast data reception.

**Rapporteur’s Summary:**

(3/22) contribution has provided a proposal on data inactivity monitoring. Rapporteur generally thinks this issue is very stage-3 and not so urgent. Thus, it might be better to put it as an FFS and discuss it later.

No proposal is made.

#### 2.1.8.3 Multiple MCCHs

Contribution [16] proposed that multiple sets of scheduling information of MBS control information should be introduced in NR to meet different QoS requirements.

**Rapporteur’s Summary:**

Rapporteur thinks whether multiple MCCHs can be supported is FFS and it is under the scope of MCCH scheduling in AI 8.1.3. So, no proposal is made.

No proposal is made.

#### 2.1.8.4 eLCID

In contributions [18], it was proposed that RAN2 should consider the support for eLCID for UEs supporting MBS.

**Rapporteur’s Summary:**

Rapporeur thinks this is a stage-3 MAC and capability issue. We may discuss this issue in the stage-3 phase.

No proposal is made.

## 2.2 Cross-layer modeling for MBS group scheduling

### 2.2.1 BWP operation

In the previous RAN1#104-e and RAN1#104bis-e meetings, the following agreements regarding BWP aspect for NR MBS had been agreed, from which we can know that the relation between common frequency resource (CFR) for MBS reception via PTM mode and active BWP is still in discussion.

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| **RAN1#104-e agreements:** * From RAN1 perspective, the CFR (common frequency resource) for multicast of RRC-CONNECTED UEs, which is confined within the frequency resource of a dedicated unicast BWP and using the same numerology (SCS and CP), includes the following configurations:
	+ Starting PRB and the number of PRBs
	+ One PDSCH-config for MBS (i.e., separate from the PDSCH-Config of the dedicated unicast BWP)
	+ One PDCCH-config for MBS (i.e., separate from the PDCCH-Config of the dedicated unicast BWP)
	+ SPS-config(s) for MBS (i.e., separate from the SPS-Config of the dedicated unicast BWP)
	+ FFS: Other configurations and details including whether signaling of starting PRB and the length of PRBs is needed when CFR is equal to the unicast BWP
	+ FFS: Whether a unified CFR design is also used for broadcast reception for RRC\_IDLE/INACTIVE and RRC\_CONNECTED
	+ FFS: Whether Coreset(s) for CFR in addition to existing Coresets in UE dedicated BWP is needed
	+ Note: The terminology of CFR is only aiming for RAN1 discussion, and the detailed signaling design is up to RAN2
	+ Note: This agreement does not negate any previous agreements made on CFR
* For multicast of RRC-CONNECTED UEs, a common frequency resource for group-common PDCCH / PDSCH is confined within the frequency resource of a dedicated unicast BWP to support simultaneous reception of unicast and multicast in the same slot.
	+ Down select from the two options for the common frequency resource for group-common PDCCH/ PDSCH.
		- Option 2A: The common frequency resource is defined as an MBS specific BWP, which is associated with the dedicated unicast BWP and using the same numerology (SCS and CP).
			* FFS BWP switching is needed between the multicast reception in the MBS specific BWP and unicast reception in its associated dedicated BWP.
		- Option 2B: The common frequency resource is defined as an ‘MBS frequency region’ with a number of contiguous PRBs, which is configured within the dedicated unicast BWP.
			* FFS: How to indicate the starting PRB and the length of PRBs of the MBS frequency region.
	+ FFS whether UE can be configured with no unicast reception in the common frequency resource.
	+ FFS on details of the group-common PDCCH / PDSCH configuration.
	+ FFS whether to support more than one common frequency resources per UE / per dedicated unicast BWP subjected to UE capabilities.
	+ FFS whether the use of a common frequency resource for multicast is optional or not.
	+ FFS whether the common frequency resource is applicable for PTM scheme 2 (if supported) or not.
* If Option 2A is supported for common frequency resource for multicast of RRC-CONNECTED UEs, the configurations of the starting PRB and the length of PRBs of the MBS frequency resource reuse the legacy BWP configuration.
* If Option 2B is supported for common frequency resource for multicast of RRC-CONNECTED UEs, the starting PRB and the length of PRBs of the MBS frequency region within a dedicated unicast BWP are configured via UE-specific RRC signaling.

**RAN1#104bis-e agreements:*** If a CFR is configured for multicast in RRC-CONNECTED state and confined within a dedicated unicast BWP, further study the following options.
	+ Option 1: the CORESET configured in PDCCH-config for unicast in the dedicated unicast BWP can be used for multicast transmission if the CORESET is fully contained in the CFR in frequency domain, and the CORESET configured in PDCCH-config for MBS in the CFR can be used for unicast transmission.
	+ Option 2: the CORESET configured in PDCCH-config for unicast in the dedicated unicast BWP cannot be used for multicast transmission even if the CORESET is fully contained in the CFR in frequency domain, and the CORESET configured in PDCCH-config for MBS in the CFR cannot be used for unicast transmission.
	+ Option 3: the CORESET configured in PDCCH-config for unicast in the dedicated unicast BWP can be used for multicast transmission if the CORESET is fully contained in the CFR in frequency domain, but the CORESET configured in PDCCH-config for MBS in the CFR cannot be used for unicast transmission.
	+ Option 4: the CORESET configured in PDCCH-config for unicast in the dedicated unicast BWP cannot be used for multicast transmission even if the CORESET is fully contained in the CFR in frequency domain, but the CORESET configured in PDCCH-config for MBS in the CFR can be used for unicast transmission.
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Contributions [10][13][14] had discussed MBS related BWP issues. Some proposals are provided from the perspective of BWP switching while some other proposals are clarifying the relation between MBS reception (via G-RNTI) and MBS common frequency resources.

**Rapporteur’s Summary:**

It is the rapporteur’s understanding that BWP related issues are strongly related to RAN1. Thus, RAN2 should wait for a further definition of the MBS common frequency resources.

No proposal is made.

### 2.2.2 SPS group-common PDSCH

RAN1 had agreed to support SPS group-common PDSCH for MBS for RRC\_CONNECTED UEs. Contributions [7][9][10] discussed SPS related issues (e.g. configuration, UE behaviour regarding (de)activation and retransmission) for MBS.

**Rapporteur’s Summary:**

Rapporteur understands that RAN2 should wait for RAN1's further conclusion on SPS group-common PDSCH for MBS.

No proposal is made.

# 3 Conclusion

The contribution is summarized as follows,

**Proposals for online decision:**

**Proposal 1: One-to-one mapping between G-RNTI and MBS session is supported in NR MBS. FFS one-to-multiple mapping between G-RNTI and MBS session.**

**Proposal 2: One-to-one mapping between G-CS-RNTI and MBS session is supported in NR MBS. FFS one-to-multiple mapping between G-CS-RNTI and MBS session.**

**Proposal 3: A UE can support multiple G-RNTIs/G-CS-RNTIs. Inform RAN1 of this agreement.**

**Proposal 4: Multiple MBS QoS flows corresponding to the same MBS session can be mapped to one or more than one MBS radio bearers.**

**Proposal 5: MCCH is mapped to the DL-SCH for NR MBS delivery mode 2.**

**Proposal 6: MTCH is specified for PTM transmission of NR MBS.**

**Proposal 7: MTCH is mapped to the DL-SCH.**

**Proposal 8: DTCH is reused for PTP transmission of NR MBS.**

**Proposal 9: For NR MBS delivery mode 1, a common LCID space is shared between DTCHs for DRBs and DTCHs for multicast PTP transmission.**

**Proposal 10: For NR MBS delivery mode 1, RAN2 to consider the following options for LCID space of logical channels for multicast PTM transmission:**

* **Option 1: Separate LCID space;**
* **Option 2: A common LCID space shared with DTCHs for DRBs.**

Proposal 11: For NR MBS delivery mode 2, separate LCID space is used for logical channels for broadcast transmission. FFS the LCID value allocated for MCCH.

**Proposal 12: Multiplexing/de-multiplexing of different logical channels associated with the same G-RNTI is supported for NR MBS.**

**Proposal 13: Multiplexing/de-multiplexing of different logical channels associated with the C-RNTI is supported for NR MBS.**

**Proposal 14: For PTM transmission of NR MBS, DRX scheme is supported on a per G-RNTI basis (i.e. independent of DRX for unicast transmission).**

**Proposal 15: For NR MBS delivery mode 2, LTE SC-PTM DRX scheme is reused.**

**Proposal 16: For PTP transmission, DRX operation for unicast transmission is reused.**

**Proposal 17: NR MBS DRX configuration can include drx-onDuration timer, drx-inactivity timer, drx-long cycle start offset, drx-slot offset, drx-HARQ RTT timer DL, and drx-DL retransmission timer.**

**Open issues for further discussion:**

1. **Further discuss the configuration for the identity of MBS radio bearer. Whether the identity is separately configured.**
2. **Further discuss the maximum number of G-RNTIs/G-CS-RTNIs that can be allocated for a UE, taking UE capability into account.**
3. **Whether to take MBS data into account during data inactivity monitoring.**
4. **Whether to support eLCID for NR MBS.**
5. **BWP operation in NR MBS from RAN2 perspective.**
6. **Further study MBS SPS group-common PDSCH configuration/related procedure from RAN2 perspective.**