**3GPP TSG RAN WG1 #107-e R1-211XXXX**

**e-Meeting, November 11th – 19th, 2021**

**Agenda item: 8.12.3**

**Source:** Moderator (BBC)

**Title:** Feature lead summary #1 on RAN basic functions for broadcast/multicast for UEs in RRC\_IDLE/ RRC\_INACTIVE states

**Document for:** Discussion and Decision

# Introduction

During TSG RAN #86, 3GPP approved a Release-17 Work Item (WI) to introduce support for Multicast and Broadcast Services in NR (NR MBS) [1]. The NR MBS WI includes the following objective:

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| * Specify RAN basic functions for broadcast/multicast for UEs in RRC\_IDLE/ RRC\_INACTIVE states [RAN2, RAN1]:
	+ Specify required changes to enable the reception of Point to Multipoint transmissions by UEs in RRC\_IDLE/ RRC\_INACTIVE states, with the aim of keeping maximum commonality between RRC\_CONNECTED state and RRC\_IDLE/RRC\_INACTIVE state for the configuration of PTM reception. [RAN2, RAN1].

Note: the possibility of receiving Point to Multipoint transmissions by UEs in RRC\_IDLE/ RRC\_INACTIVE states, without the need for those UEs to get the configuration of the PTM bearer carrying the Broadcast/Multicast service while in RRC CONNECTED state beforehand, is subject to verification of service subscription and authorization assumptions during the WI. |

The agreements for AI 8.12.3 on Basic functions for broadcast/multicast for RRC\_IDLE/ RRC\_INACTIVE UEs in previous RAN1 and RAN Plenary meetings are listed in the Annex A of this document.

As announced by the Chair, the email discussion details with check points for agreements are as follows:

[107-e-NR-MBS-03] Email discussion/approval on basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs with checkpoints for agreements on November 15 and 19 – David (BBC)

In this document, the Feature Lead (FL) presents a list of open Issues to enable reception of Point to Multipoint transmissions by UEs in RRC\_IDLE/ RRC\_INACTIVE states based on the technical documents (tdocs) submitted to RAN1#107-e. Each of the Issues has the following subsections: background, Tdoc analysis, FL assessment and a set of proposals that are updated based on rounds of discussion between companies. The final section of this document also contains the agreements reached at RAN1#107-e.

The reader can use the “Navigation Pane” utility of Word to quickly find the Issues and the rounds of discussion for the set of Proposals for this meeting.

# Issues

## Issue 1: PDCCH: Design of DCI format for MCCH and MTCH channels

### **Background**

The following agreements at RAN1#105-e and RAN1#106-e on RRC idle/inactive UEs are relevant for this discussion:

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| Agreement:For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, DCI format 1\_0 is used as baseline for GC-PDCCH of MCCH and MTCH.* FFS details of FDRA.

Agreement:For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, study the following alternatives for MCCH change notification indication due to session start:* Alt 1: Define a dedicated RNTI to scramble the CRC of a DCI indicating a MCCH change notification;
* Alt 2: Use of a field in a DCI format scheduling a MCCH without a dedicated RNTI for MCCH change notification;

Other solutions are not precluded and it is also not precluded whether to support both Alt1 and Alt2.Conclusion:It is up to RAN2 to decide the specific contents of the MCCH change notification, e.g, whether notification only informs about session start, whether or not notification also informs about session modification/stop or whether or not the notification informs about any other information.Agreement:Study and reach an agreement by RAN1#106b-e on whether Alt1 and Alt2 for MCCH change notification indication can accommodate at least 2 bits for the notification of MCCH configuration changes due to a session start and the notification of MCCH configuration changes of an ongoing session (including session stop).Agreement:The DCI format for GC-PDCCH scheduling a GC-PDSCH carrying MCCH/MTCH at least includes the following fields for broadcast reception with UEs in RRC\_IDLE/INACTIVE state: * FDRA field
* TDRA field
* Modulation and coding scheme
* Redundancy version
* FFS:
	+ MCCH change notification (if supported and only for MCCH),
	+ RB numbering starts from the lowest RB of the CFR and support of resource allocation with granularity of single or multiple RBs.
	+ HARQ process number and New data indicator
	+ VRB-to-PRB mapping
	+ other fields if needed.

Agreement:For broadcast reception with UEs in RRC\_IDLE/INACTIVE state, the DCI size of GC-PDCCH scheduling a GC-PDSCH carrying MCCH/MTCH is aligned with DCI format 1\_0 with CRC scrambled by C-RNTI in the CSS. |

The following agreements at RAN1#106bis-e on RRC connected UEs are relevant for this discussion:

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| Agreement:For FDRA determination of the first DCI format for GC-PDCCH, Option 2 is supported.* + Option 2:
		- is given by
			* the size of CORESET 0 if CORESET 0 is configured for the cell; and
			* the size of initial DL bandwidth part if CORESET 0 is not configured for the cell.
		- For resource indication value (*RIV*) of downlink resource allocation type 1, the similar scheme as for the case that the DCI size for DCI format 1\_0 in USS is derived from the size of DCI format 1\_0 in CSS but applied to an active BWP is used.
			* If the size of CFR (i.e. $N\_{CFR}$) is larger than the size of CORESET0/initial DL bandwidth part, the resource indication value (*RIV*) is defined as in section 5.1.2.2.2 in TS38.214, where K is the maximum value from set {1, 2, 4, 6, 8, 10, 12} which satisfies $K\leq \left⌊N\_{CFR}/N\_{BWP}^{initial}\right⌋$;otherwise, $K=1.$

Agreement: For GC-PDSCH scheduled with the first DCI format for multicast, RB numbering starts from the lowest RB of the CFR. |

### **Tdoc analysis**

* In [R1-2110779, Huawei]
	+ *Discuss:* Besides, the field for MCCH change notification has been reflected in the CR of TR38.212.
	+ *Discus*: DCI format 1\_0 scrambled by G-RNTI can be used for multicast scheduling and broadcast scheduling. However, the fields needed for multicast are not useful for broadcast, e.g., HARQ process number, New data indicator. VRB-to-PRB mapping can increase the frequency diversity gain for resource allocation type1, so that it can be included in the DCI format. TB scaling field is used for increasing robustness for the transmission of paging message or random access response, which does not seem useful for MTCH.
	+ Proposal 5: For DCI format 1\_0 scrambled by MCCH-RNTI/G-RNTI for MCCH/MTCH, at least the following field can be included in addition to those fields have been agreed:
		- VRB-to-PRB mapping
* In [R1-2110897, TD Tech]
	+ *Discuss*: Because the interleaved VRB-to-PRB mapping will bring the SNR gain in UE, we suggest to add the field VRB-to-PRB in the DCI format for MCCH/MTCH.
	+ Proposal 14: The following field is included in the DCI format for MCCH/MTCH:
		- VRB-to-PRB mapping
* In [R1-2110912, ZTE]
	+ Discuss: Regarding TDRA, VRB-to-PRB mapping, MCS and RV field, they are the same as the legacy UE behaviour.
	Regarding MCCH change notification, as agreed in RAN1#106b-e meeting, it should be included in the DCI scheduling MCCH. In order to share the same DCI fields design for DCI scheduling MCCH and DCI scheduling MTCH of broadcast, we can directly include MCCH change notification in the DCI format.
	Regarding the bit size of FDRA, it is proposed to have the same handling as what we agreed in last meeting for the first DCI format for multicast. Also, if FDRA is determined by the CFR, it may end up with different FDRA bit sizes for MCCH scheduling and MTCH scheduling since the CFR size may be different for MCCH and MTCH. Thus, to have a unified solution, it is preferred to use the same mechanism for MCCH and MTCH of broadcast.
	+ Proposal 7: The following information is transmitted by means of the DCI format 1\_0 with CRC scrambled by MCCH-RNTI/G-RNTI for broadcast:
		- Frequency domain resource assignment – bits
			*  is the size of CORESET 0
			* If the size of CFR (i.e. $N\_{CFR}$) is larger than the size of CORESET0, the resource indication value (RIV) is defined as in section 5.1.2.2.2 in TS38.214, where K is the maximum value from set {1, 2, 4, 6, 8, 10, 12} which satisfies $K\leq \left⌊N\_{CFR}/N\_{BWP}^{initial}\right⌋$;otherwise, $K=1.$
		- Time domain resource assignment – 4 bits
		- VRB-to-PRB mapping – 1 bit
		- Modulation and coding scheme – 5 bits
		- Redundancy version – 2 bits
		- MCCH change notification – 2 bits if the CRC of the DCI format 1\_0 is scrambled by MCCH-RNTI. Otherwise, this bit field is reserved.
		- Reserved bits – 14 bits
* In [R1- 2111041, vivo]
	+ *Discuss*: Regarding the DCI field for broadcast in RRC\_IDLE/RRC\_INACTIVE, besides FDRA, TDRA, MCS, and RV, HARQ process number and new data indicator should also be included as slot-level repetition for MTCH has been already supported.
	+ *Discuss*: For UE in RRC\_IDLE/RRC\_INACTIVE, as no unicast and groupcast transmission is expected, HARQ processes defined for unicast and groupcast can be used for combing broadcast PDSCH repetition. And it is possible to leave it to RRC\_IDLE/RRC\_INACTIVE UE implementation to select one HPN without any indication in DCI. However, broadcast PDSCH with repetition can be also received by RRC\_CONNECTED UE, if HPN and NDI is not indicated in DCI and RRC\_CONNECTED UE randomly chooses a free HPN for combination, then it will cause chaos for further unicast and multicast reception. This is because network has no information about the HPN selected by UE for broadcast PDSCH combination and may indicate the same one for the subsequent unicast and multicast transmission.
	+ Proposal 4: HARQ process number and new data indicator should be included in the DCI 1\_0 format for GC-PDCCH scheduling a GC-PDSCH carrying MTCH.
* In [R1-2111137, Nokia]
	+ Proposal-14: Confirm DCI format 1\_0 is sufficient for broadcast reception for RRC\_IDLE/INACTIVE UEs.
		- FFS: If DCI format other than format 1\_0 is agreed, further discuss the resource allocation type applied for Rel17 broadcast for RRC\_IDLE/INACTIVE UEs.
	+ Proposal-15: If DCI format 1\_0 is the only DCI format to be supported, the VRB-to-PRB mapping can be fixed with interleaved, and this field is not needed.
	+ Proposal-16: Considering of TB scaling field be included in the DCI.
	+ Proposal-17: It is beneficial to support of HARQ combining for broadcast with slightly increase UE complexity, where a single additional dedicated HARQ process seems to be sufficient for all broadcast services associated with different G-RNTIs. And there is no need of including HARQ process number in the DCI field.
	+ Proposal-18: It is beneficial to support NDI in the DCI field for broadcast to assist UE RV combining.
	+ Proposal-19: Further discuss other fields to be included in the DCI, i.e. MCCH change notification field (if supported for MCCH), and TRS related field (if supported for MTCH).
* In [R1-2111232, CATT]
	+ *Discuss*: It has been agreed that for RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, DCI format 1\_0 is used as baseline for GC-PDCCH of MCCH and MTCH, so a fixed 1 bit VRB-to-PRB mapping field should be included in in DCI format for broadcast reception with UEs in RRC\_IDLE/INACTIVE state. It implies that only the interleaved VRB-to-PRB mapping is supported for the group-common DCI.
	Regarding HARQ process number (HPN) and New data indicator (NDI), to improve the reliability of UE in the edge of cell, blind retransmission should be applied. So, HPN and NDI fields should be included for the soft-combination.
	+ Proposal 10: MCCH change notification, HARQ process number, new data indicator and VRB-to-PRB mapping (1 bit) fields can be included in the DCI format.
* In [R1-2111305, OPPO]
	+ Proposal 9: The DCI format for GC-PDCCH scheduling a GC-PDSCH carrying MCCH/MTCH additionally includes the following fields for broadcast reception with UEs in RRC\_IDLE/INACTIVE state:
		- Modulation and coding scheme
		- Reserve bits.
	+ Proposal 10: The size of FDRA field in DCI for scheduling GC-PDSCH carrying MCCH/MTCH can be determined by the configuration of CFR used for broadcast MBS services transmission, i.e. CORESET#0 or SIB1 configured initial BWP.
* In [R1-2111518, Intel]
	+ *Discuss*: UEs in RRC IDLE/INACTIVE mode can be configured to monitor for DCI format 1\_0 which can be used to schedule MBS PDSCH. Based on the subsequent agreement that the CFR is assumed to have the same size of the CORESET#0 or initial BWP, the FDRA field in the for the DCI 1\_0 will be dimensioned with respect to the CORESET#0 or initial BWP. This is assuming that Case E as proposed above is agreed. Otherwise special handling for Case E may be required.
	+ Proposal 5: The FDRA field of DCI 1\_0 is based on the starting PRB index and size of CORESET#0 or initial BWP.
* In [R1-2111551, Xiaomi]
	+ Discuss: Regarding VRB-to-PRB mapping information field, we think it’s better to keep it in the DCI considering there are sufficient room for such 1 bit information. It can provide more flexibility for scheduling especially considering multiplexing between MBS PDSCH and SIB PDSCH is necessary in some cases. Furthermore, notification of MCCH configuration changes should be included in the DCI scheduling GC-PDSCH. All the other fields should be reserved.
	+ Proposal 12: DCI format 1\_0 with CRC scrambled by G-RNTI is used to schedule a GC-PDSCH carrying MCCH/MTCH for broadcast reception with UEs in RRC\_IDLE/INACTIVE state, including the following information fields:
		- FDRA field
		- TDRA field
		- VRB-to-PRB mapping
		- Modulation and coding scheme
		- Redundancy version
		- MCCH configuration change notification
		- Reserved bits
	+ Proposal 13: The FDRA should be determined by CORESET#0 or initial DL BWP if CORESET#0 is not configured.
* In [R1-2111629, CMCC]
	+ *Discuss*: As for blind retransmission soft buffer combination, dedicated HARQ process is defined for system information in NR and similar mechanism can be used for broadcast service. In addition, as different G-RNTI are used to differentiate broadcast services, which means the HARQ buffer has one to one mapping with G-RNTI, it is up to UE’s implementation to buffer different services in different HARQ buffer without the necessary to be indicated the HARQ process number in the DCI.
	+ Proposal 5. HARQ process number and New data indicator are not needed in the DCI format for GC-PDCCH scheduling a GC-PDSCH carrying MCCH/MTCH.
	+ Proposal 6. The FDRA field bit length in DCI format for GC-PDCCH scheduling a GC-PDSCH carrying MCCH/MTCH is related to CFR size but not CORESET#0 size and the resource allocation granularity is single RB.
* In [R1-2112130, NTT DOCOMO]
	+ Observation 1: If the existing RB numbering rule for PDSCH scheduled with DCI format 1\_0 in CSS is reused for PDSCH scheduled with the DCI format scheduling MCCH/MTCH, there may be RBs that cannot be allocated GC-PDSCH.
	+ Proposal 4: For GC-PDSCH carrying MCCH/MTCH, RB numbering starts from the lowest RB of the CFR.
	+ Proposal 5: Include VRB-to-PRB mapping field in the DCI format scheduling MCCH/MTCH.
* In [R1-2112163, Lenovo]
	+ *Discuss*: Consequently, the number of bits required for FDRA indicator is based on the bandwidth of CORESET 0 or SIB-1 configured initial DL BWP. Since RAN1 has already agreed that the group-common DCI format has same payload size as DCI format 1\_0 with CRC scrambled by C-RNTI and monitored in CSS, and the FDRA field of DCI format 1\_0 with CRC scrambled by C-RNTI and monitored in CSS is also given by the bandwidth of CORESET 0 or SIB-1 configured initial DL BWP, it is quite easy to align both DCI payload size.
	+ Proposal 4: The number of bits for FDRA in the group-common DCI is determined based on the CFR in Case A and Case C with single RB granularity.
	+ Proposal 5: RB numbering starts from the lowest RB of the CFR and the granularity of resource allocation only supports single RB.
	+ Proposal 6: The number of bits in TDRA field in the group-common DCI format is determined by the number of entries in the time domain resource allocation table configured for MBS.
	+ *Discuss*: Regarding VRB-to-PRB mapping, this field can be also configurable for group-common PDSCH transmission. The size is 0 bit if only resource allocation type 0 is configured or if interleaved VRB-to-PRB mapping is not configured for group-common PDSCH transmission, or 1 bit otherwise, only applicable to resource allocation type 1.
	+ Proposal 7: VRB-to-PRB mapping in the group-common DCI format is 0 or 1 bit dependent on RRC configuration.
	+ Proposal 8: For HARQ combining, 5 bits MCS, 1 bit NDI, 2 bits RV and 4 bits HARQ process number are included in the group-common DCI format.
	+ Proposal 9: DAI/TPC/PRI/HARQ-timing indicator in the group-common DCI are removed.
	+ Proposal 10: New field is introduced for indicating MCCH change notification.
	+ Proposal 11: Support fields and sizes in Table 1 for the first DCI format.
	+ Proposal 12: Zero bits are appended to the group-common DCI format in case its size prior to padding is smaller than the size of DCI format 1-0 with CRC scrambled by C-RNTI and monitored in CSS.
	+ *Discuss*: Considering coverage is critic to broadcast transmission, the 2nd DCI format is not supported for RRC Idle/Inactive UEs.
	+ Proposal 13: The second group-common DCI format is not supported for RRC Idle/Inactive UEs for broadcast reception.
* In [R1-2112314, MediaTek]
	+ *Discuss*: Regarding the “HARQ process number” field, we think there is no clear motivation to add this. Even though the slot level repetition is supported for MTCH, the similar mechanism for SIB combining can be reused and it does not need to add a new “HARQ process number” field for broadcast reception. In addition, if more HARQ process are introduced for MBS broadcast services, it is not friendly to UE’s power saving and needs more device hardware affect, which is against the current WID description as copied following: *Restrictions and assumptions in MBS WID: In order to facilitate implementation and deployment of the feature, the overall implementation impact should be limited, and the UE complexity should be minimized (e.g. device hardware impact should be avoided)*.
	+ Proposal 7: “HARQ process number” field is not supported for MBS broadcast DCI.
* In [R1-2112348, Ericsson]
	+ Observation 14: Multicast and broadcast can share the same DCI formats, with broadcast specific and multicast-specific fields made optional.
	+ Observation 15: A broadcast DCI format limited to be based on legacy DCI format 1\_0 would limit the potential of NR broadcast, by not allowing for cross-polar (two layer) MIMO or frequency diversity supported by Resource allocation Type 0.
	+ Proposal 20: Support a first DCI format for broadcast, which is the same as the first DCI format for multicast, with broadcast specific and multicast-specific fields made optional.
	+ Proposal 21: Support a second DCI format for broadcast, which is the same as the second DCI format for multicast, with broadcast specific and multicast-specific fields made optional.

### **FL Assessment**

This issue was discussed at the last meeting without reaching a conclusion.

***On DCI format 1\_0 fields for MCCH / MTCH***

* *FDRA*

[OPPO, Intel, Xiaomi, CMCC, Lenovo] propose that the size of the FDRA field is determined by the size of the CFR. This aspect of the size of the FDRA was already discussed based on a proposal at the last meeting. However, it was discussed to wait until the conclusion of a related discussion in AI 8.12.1. However, as per the background section, an agreement has already been reached for AI 8.12.1. Another concern brought was whether there could be a mismatch between the CFR received by idle/inactive UEs and connected UEs. However, this has not been discussed in any of the submitted tdocs and it is also FL’s understanding that the FDRA parameters in connected state also depends on the CFR which would align both RRC states. **Proposal 2.1-1** is put forward for discussion.

[Intel, NTT DOCOMO, Lenovo] propose that the starting PRB index is based on the CFR, rather than CORESET#0 as per existing numbering rule legacy with DCI format 1\_0 in CSS. **Proposal 2.1-2** is therefore put for discussion that also aligns with an agreement in AI 8.12.1.

[CMCC, Lenovo] propose that the resource allocation for broadcast is a single RB providing increased scheduling flexibility. However, [ZTE] proposes to have the same handling to what has been agreed for multicast in AI 8.12.1 to have a unified solution, which allows to have RB granularity larger than one. Although not many companies have discussed the resource allocation granularity for broadcast, the starting point for discussion is single RB resource allocation as per **Proposal 2.1-3**.

* *HARQ Process Number (HPN)*

[Huawei, Nokia, CMCC, MediaTek] discuss that HPN is not necessary for broadcast reception. However, [vivo, CATT, Lenovo] propose to include HPN. [vivo] discusses that it is necessary, based on the support of PDSCH repetition for broadcast reception. Although, this parameter may not be needed solely on the operation of RRC idle/inactive UEs, since broadcast can also be received in RRC connected UEs, these two parameters are needed to avoid collisions between HARQ processes used for unicast/multicast and broadcast.

This discussion is related to the progress on PDSCH repetition. However, companies have already discussed different options for the operation of HARQ process at the UE. Based on the discussion from [vivo], it seems this parameter is needed for the case when HARQ processes are shared between unicast/multicast and broadcast in RRC connected state. To promote discussion, the starting point is that HPN field is not included as per **Proposal 2.1-4** (for conclusion) to collect companies’ views.

* *New Data Indicator (NDI)*

[Huawei, CMCC] discuss that NDI is not necessary for broadcast reception. However, [vivo, CATT, Lenovo] propose that NDI is necessary. [vivo] argues its introduction based on the support of PDSCH repetition for broadcast reception. Although, this parameter may not be needed solely on the operation of RRC idle/inactive UEs, since broadcast can also be received in RRC connected UEs, these two parameters are needed to avoid collisions between HARQ processes used for unicast/multicast and broadcast. [Nokia] also supports the introduction of NDI field to assist the UE RV combining. Although there is no clear position to include this field the starting point for the discussion is to include this field as per **Proposal 2.1-5** to collect company views.

* *VRB-to-PRB mapping*

[Huawei, TD Tech, ZTE, Xiaomi, NTT DOCOMO] support to include this field where the main argument to included it is the increased diversity gain that can be achieved, which is especially useful for broadcast reception without knowledge at the gNB of the UEs’ channel frequency responses. [Nokia, CATT], proposes to fix this parameter to interleaved, where [Nokia] further argues that this field could therefore be saved. On the other hand, [Xiaomi] argues that is adequate to keep the field due to cases when MBS PDSCH and SIB PDSCH need to be multiplexed. [Lenovo] proposes that whether this field is included depends on RRC configuration and only for type 1 resource allocation. Given the different alternatives have been proposed for this field, **Question 2.1-6** below discusses the 3 options in the table to collect companies’ views.

* *TB scaling field*

[Huawei] discusses that this field does not seem useful for MTCH. [Nokia] proposes a discussion on the potential inclusion of this field that could provide increased robustness for broadcast reception. However, most companies have included this field explicitly when listing the possible fields that are can be included in the DCI. Therefore, the starting point for the discussion is that TB scaling field is not included and **Proposal 2.1-7 (for conclusion)** is put forward to collect companies’ views.

* *MCCH change notification and TRS related fields*

The MCCH change notification was agreed at the last meeting as Working Assumption and has been included in the Draft CR of TS 38.212. The inclusion of TRS related fields depends on whether the respective functionality is supported pending the discussion other Issues in this summary.

***On first and second DCI format for broadcast and unified solution with multicast***

[Ericsson] proposes that in order to have an unified solution between multicast and broadcast, both can share the same DCI formats where broadcast-specific and multicast-specific-files are made optional. Building on this, they also propose to use a second DCI format for broadcast, which is the same as the second DCI for multicast where broadcast-specific and multicast-specific-files are made optional. Having a second DCI for broadcast would allow cross-polar MIMO and/or frequency diversity by resource allocation Type 0. On the other hand, [Lenovo] proposes that a second DCI format for broadcast is not supported arguing that a second DCI would not meet stringent coverage requirements required for broadcast reception.

Given that not many companies have discussed this aspect but has been first introduced in this meeting (for the second DCI aspect), Question 2.1-8 is included to collect companies’ views.

### **1st round FL proposals for Issue 1**

#### Proposal 2.1-1

For GC-PDSCH scheduled with DCI format 1\_0 for broadcast reception, the size of the FDRA field depends on the size of the CFR.

#### Proposal 2.1-2

For GC-PDSCH scheduled with DCI format 1\_0 for broadcast reception, RB numbering starts from the lowest RB of the CFR.

#### Proposal 2.1-3

For GC-PDSCH scheduled with DCI format 1\_0 for broadcast reception, the resource allocation granularity is single RB.

#### Proposal 2.1-4

**(for conclusion)**

for broadcast reception, the DCI 1\_0 format for GC-PDCCH scheduling a GC-PDSCH does not include the field HARQ Process Number.

#### Proposal 2.1-5

for broadcast reception, the DCI 1\_0 format for GC-PDCCH scheduling a GC-PDSCH includes the field New Data Indicator.

#### Question 2.1-6

for broadcast reception, which of the following options is supported for VRB-to-PRB mapping field in the DCI 1\_0 format for GC-PDCCH scheduling a GC-PDSCH?

* Opt-1: DCI includes the VRB-to-PRB mapping field with 1 bit according to Table 7.3.1.2.2-5 in TS 38.212
* Opt-2: VRB-to-PRB mapping is fixed to “interleaved” and no corresponding field is included in the DCI
* Opt-3: RRC signalling configures whether VRB-to-PRB mapping field in DCI is 0 bits or 1 bit according to Table 7.3.1.2.2-5 in TS 38.212

#### Proposal 2.1-7

**(for conclusion)**

for broadcast reception, the DCI 1\_0 format for GC-PDCCH scheduling a GC-PDSCH does not include the field TB scaling.

#### Question 2.1-8

Please provide your views on the following two bullets on the potential inclusion for broadcast reception

* Support a first DCI format for broadcast, which is the same as the first DCI format for multicast, with broadcast specific and multicast-specific fields made optional.
* Support a second DCI format for broadcast, which is the same as the second DCI format for multicast, with broadcast specific and multicast-specific fields made optional which would allow further functionality such as allow cross-polar MIMO and/or frequency diversity by resource allocation Type 0.

**Please provide your answers in the table below. Considering the FL assessment above:**

1. **do you agree with the Proposals 2.1-1, 2.1-2, 2.1-3, 2.1-4, 2.1-5 and 2.1-7? Please provide reasons and views in general.**
2. **Please provide your views on Questions 2.1-6 and 2.1-8.**

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| **company** | **Comments** |
| LG Electronics | Proposal 2.1-4 We prefer to support HARQ Process Number with NDI.Proposal 2.1-5 We prefer to support New Data Indicator for combining. |

## Issue 2: PDCCH: MCCH change notification

### **Background**

RAN2 discussed the details of broadcast session delivery and the following agreements were made during RAN2#113-e meeting:

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| * **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).**
 |

During RAN2#113bis-e meeting, RAN2 discussed further aspects of MCCH scheduling and MCCH change notification leading to the following agreements with RAN1 impacts:

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| * **The modification period is defined for NR MCCH and NR MCCH contents are only allowed to be modified at each modification period boundary.**
* **The updated MCCH message should be sent in the same MCCH modification period where the change notification is sent.**
* **It is up to RAN1 to decide about the RNTI and DCI format used for MCCH change notifications.**
* **RAN2 will discuss and down-select from the following two options for the UE to get aware of session stop/modification:**
	+ **Reading MCCH once per each MCCH modification period when receiving an ongoing broadcast session**
	+ **DCI used for MCCH notification indicates the change of an ongoing broadcast session**
 |

At RAN1#105-e, RAN2 requests RAN1 [R1-2104165] to investigate and provide feedback, considering agreements made by RAN2 as indicated in the LS (cf. Annex B) where the following request is relevant for the discussion:

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| * Details of the RNTI and DCI design for carrying MCCH change notifications.
	+ NOTE: RAN2 is still discussing some aspects that may have an impact on this issue, e.g. whether or not to support multiple MCCH or whether or not a notification about the modification/stop of an ongoing session is needed, as indicated above. RAN2 will update RAN1 as soon as further agreements are made on these items.
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RAN2 discussed further the aspects related to MCCH design and made the following agreements during RAN2#114-e meeting:

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| * Indication of an MCCH change due to modification of an ongoing session’s configuration (including session stop) is provided with an explicit notification from the network (provided that RAN1 confirms a separate bit for this purpose can be accommodated in the MCCH change notification DCI, in addition to a bit for session start notification). FFS on whether this notification can be reused for modification of other information carried by MCCH, if any.
* FFS whether the possibility of UE missing an MCCH change notification needs to be addressed or can be left to UE implementation.
* At least in case RAN1 decides to utilize RNTI other than MCCH-RNTI for MCCH change notification, MCCH change notification is sent in the first MCCH monitoring occasion of each MCCH repetition period.
 |

RAN2 discussed further the aspects related to MCCH design and made the following agreements during RAN2#115-e and RAN2#116-e meetings:

|  |
| --- |
| RAN2#115-e* **RAN2 waits for RAN1’s final decision on which RNTI/DCI (i.e. Alt1 and/or Alt 2 as identified by RAN1) for MCCH change notification to be adopted.**
* **Do not specify any mechanism to address the possibility of UE missing an MCCH change notification and it is left to UE implementation.**
* It is up to network implementation (e.g. paging repetitions) for addressing scenario of potential notification loss for UEs.

RAN2#116-e* **MCCH changes due to neighbouring cell information modification will be notified using the normal MCCH modification notification.**
 |

RAN1 discussed aspects related to RNTI and DCI design for carrying MCCH change notifications and made the following agreements during RAN1#105-e, RAN1#106-e and RAN1#106bis-e meetings:

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| --- |
| Agreement:For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, DCI format 1\_0 is used as baseline for GC-PDCCH of MCCH and MTCH.* FFS details of FDRA.

Agreement:For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, study the following alternatives for MCCH change notification indication due to session start:* Alt 1: Define a dedicated RNTI to scramble the CRC of a DCI indicating a MCCH change notification;
* Alt 2: Use of a field in a DCI format scheduling a MCCH without a dedicated RNTI for MCCH change notification;

Other solutions are not precluded and it is also not precluded whether to support both Alt1 and Alt2.Conclusion:It is up to RAN2 to decide the specific contents of the MCCH change notification, e.g, whether notification only informs about session start, whether or not notification also informs about session modification/stop or whether or not the notification informs about any other information.Agreement:Study and reach an agreement by RAN1#106b-e on whether Alt1 and Alt2 for MCCH change notification indication can accommodate at least 2 bits for the notification of MCCH configuration changes due to a session start and the notification of MCCH configuration changes of an ongoing session (including session stop).Working assumption:Alt 2 (from previous agreement) is supported for broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs for the notification of MCCH configuration changes.* Send an LS to RAN2 with the mechanism agreed in RAN1
 |

###  **Tdoc analysis**

* In [R1-2110779, Huawei]
	+ *Discuss*: As discussed in the last meeting, both alternatives can work. Since no fundamental problems have been discovered for Alt2 which was agreed as working assumption, this working assumption should be confirmed.
	+ Proposal 4: Confirm the working assumption that Alt 2 (from previous agreement) is supported for broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs for the notification of MCCH configuration changes.
* In [R1-2111551, Xiaomi]
	+ Proposal 7: Confirm the following working assumption and send an LS to RAN2 accordingly.
	Working assumption: Alt 2 (from previous agreement) is supported for broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs for the notification of MCCH configuration changes.
	Send an LS to RAN2 with the mechanism agreed in RAN1
* In [R1-2111629, CMCC]
	+ *Discuss*: During the discussion in last RAN1 meetings, all companies acknowledge that both Alt 1 and Alt 2 are workable and Alt 2 doesn’t need the introduction of new RNTI. Some companies commented the bit for MCCH change notification is limited, but as the analysis above and as the example in Table 1, the reserved bits in DCI format for MCCH is much larger than 2 bits and is enough to be used as MCCH change notification and can also provide forward compatibility. Therefore, Alt 2 can be supported which is a simple and sufficient way without defining a new RNTI for MCCH change notification.
	+ Proposal 7. Confirm the working assumption to support Alt 2 for broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs for the notification of MCCH configuration changes.
* In [R1-2111763, Samsung]
	+ Proposal 4. Confirm the Working assumption for MCCH change notification.
* In [R1-2111899, Apple]
	+ Proposal 2: Conform the following working assumption on MCCH change notification.
		- Alt 2 (from previous agreement) is supported for broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs for the notification of MCCH configuration changes.
* In [R1- 2112082, Asustek]
	+ Proposal 2: Confirm the working assumption: Alt 2 is supported for broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs for the notification of MCCH configuration changes.
* In [R1-2112314, MediaTek]
	+ Observation 1: UE needs more power consumption if Alt 2 is used for MCCH change notification.
	+ Observation 2: The system latency is increased if Alt 2 is used for MCCH change notification.
	+ Observation 3: The same DCI format used for MCCH/MTCH can be reused for MCCH change notification.
	+ Proposal 8: MBS DCI format 1\_0 used for MCCH and MTCH reception is reused for NR MBS MCCH change notification.
	+ Observation 4: The Alt 1 with DCI 1\_0 can keep the better decoding performance and backword compatibility.
	+ Proposal 9: The Alt 1 is supported for MCCH change notification.
	+ Proposal 10: MBS DCI format 1\_0 used for MCCH and MTCH reception is reused for NR MBS MCCH change notification.
	+ Proposal 11: A new RNTI (e.g., MCCH-N-RNTI) is defined for MCCH change notification.
* In [R1-2112348, Ericsson]
	+ *Discuss*: Bit toggling- The two bits will signal MBS session activation and change of MCCH signaling data. We propose that bit toggling is used, which means that the information of the change indication lies in the change of the bit value rather than the absolute value.

	The bit for MBS session activation is thus toggled each time a new MBS session is activated. If the initial value is e.g. ‘0’, this means that at the first MCCH PDCCH DCI in a Modification Period the UE will check whether the bit value has changed. If the UE detects that the value has changed to ‘1’ this implies that one MBS session is activated, and the UE will find out more by investigating the MCCH content. This bit value of ’1’ is retained in all MCCH PDCCH DCIs until there is a new MBS session activation to be notified to the UE, in which case the bit value changes back to ‘0’ and stays like that until a new change occurs etc.

	If the UE misses the first MCCH PDCCH carrying the toggled bit, this is not catastrophic, since the UE can have one or more new attempts on the following MCCH PDCCH Monitoring Occasion.

	The bit for change of MCCH content would work in the same way, i.e. the UE would check the first MCCH PDCCH DCI in each Modification Period whether the second bit has changed and, if so, would further investigate the MCCH content. If none of the bits are toggled, the UE can safely ignore the MCCH PDCCH until the start of the next Modification Period.
	+ Proposal 26: Confirm the Alt2 WA from RAN1#106b-e
		- For each of the bits indicating MBS session activation and MCCH content change: the bit value is toggled each time there is a change and the bit retains that value until the next change occurs.

### **FL Assessment**

[Huawei, Xiaomi, CMCC, Samsung, Apple, AsusTek] propose to confirm the working assumption made at RAN1#106bis-e on supporting Alt 2 for broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs for the notification of MCCH configuration changes. [Huawei] further clarifies that no fundamental issue has been found with Alt 2 and therefore this alternative works.

[MediaTek] proposes that Alt 1 is supported for MCCH change notification. They present drawbacks of Alt 2 and benefits of Alt 1. In particular, it is clarified that Alt 1 would not need a new DCI format and that the DCI 1\_0 format already agreed for broadcast can also be used for Alt 1 – this aspect was already clarified at the last meeting by proponents of Alt 1 and included in the FL summary discussions of RAN1#106bis-e. [MediaTek] also discusses that compared to Alt 1, Alt 2 needs more power consumption, it has increased latency, it has worse decoding performance and it has less forward compatibility in case more bits need to be added for notification changes.

Most companies propose to confirm the working assumption (i.e., Alt 2), while one company proposes to support Alt 1 based on better performance compared with the working assumption. It is worth pointing out that no fundamental issue has been reported in the submitted tdocs demonstrating that Alt 2 does not work. Therefore, the FL proposes to confirm the working assumption in **Proposal 2.2-1**.

Another aspect on bit toggling has been presented by [Ericsson], which can increase the robustness of Alt 2 as per tdoc analysis above. This approach was already reported for the last meeting, although there was no time for discussion. Therefore, **Proposal 2.2-2** to introduce this approach is put forward for discussion.

### **1st round FL proposals for Issue 2**

#### Proposal 2.2-1

Confirm the working assumption made at RAN1#106bis-e:

Working assumption:

Alt 2 (from previous agreement) is supported for broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs for the notification of MCCH configuration changes.

* Send an LS to RAN2 with the mechanism agreed in RAN1

#### Proposal 2.2-2

For the bits notifying MCCH configuration changes, each bit value is toggled each time there is a change and the bit retains that value until the next change occurs.

**Please provide your answers in the table below. Considering the FL assessment above: do you agree with Proposals 2.2-1 and 2.2-2? Please provide reasons and views in general if you do not agree.**

**FL note: based on the discussion a potential LS to RAN2 will also be discussed.**

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| --- | --- |
| **company** | **comments** |
|  |  |

## Issue 3: PDCCH: Details of CSS for MCCH/MTCH channels

### **Background**

The following agreement for RRC\_IDLE/RRC\_INACTIVE UEs at RAN1#103-e, RAN2#104-e, RAN1#105-e, RAN1#106-e and RAN1#106bis-e are relevant for this discussion:

|  |
| --- |
| Agreements: For RRC\_IDLE/RRC\_INACTIVE Ues, CSS is supported for group-common PDCCH.* FFS: reuse current CSS type, define a new CSS type, etc.
* FFS other details.

Agreement:For broadcast reception, the same group-common PDCCH and the corresponding scheduled group-common PDSCH can be received by both RRC\_IDLE/RRC\_INACTIVE Ues and RRC\_CONNECTED Ues when UE-specific active BWP of RRC\_CONNECTED UE contains the common frequency resource of RRC\_IDLE/INACTIVE Ues and the SCS and CP are the same.* FFS: the case when UE-specific active BWP of RRC\_CONNECTED UE does not contain the common frequency resource of RRC\_IDLE/INACTIVE Ues.

Agreement:For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, both searchSpace#0 and common search space other than searchSpace#0 can be configured for GC-PDCCH scheduling MCCH.Agreement:For broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs support the same CSS type for MCCH and MTCH.* FFS support of different CSS types for MCCH and MTCH channels for broadcast reception.

Conclusion:For broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs, there is no specification support in Rel-17 of different CSS types for GC-PDCCH scheduling MCCH and MTCH.Agreement:Study whether the Type-x CSS supported for multicast in RRC\_CONNECTED can be reused as baseline for broadcast in RRC\_IDLE/RRC\_INACTIVE for GC-PDCCH scheduling MCCH and MTCH.Agreement:For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, both searchSpace#0 and common search space other than searchSpace#0 can be configured for GC-PDCCH scheduling MTCH. |

The following agreements for RRC\_CONNECTED UEs at RAN1#105-e, RAN1#106-e and RAN1#106bis-e are also relevant for this discussion:

|  |
| --- |
| Agreement:For CSS of group-common PDCCH of PTM scheme 1 for multicast in RRC\_CONNECTED state, Alt 2 is supported:* Alt 2: support a Type-x CSS
	+ The monitoring priority of Type-x CSS is determined based on the search space set indexes of the Type-x CSS set and USS sets, regardless of which DCI format of group-common PDCCH is configured in the Type-x CSS.
* FFS: Whether the Type-x CSS is a Type-3 CSS

Conclusion:The specification impact of having a new Type-x CSS for GC-PDCCH in RRC\_CONNECTED state can be studied and discussed further.Agreement:The first and second DCI formats for multicast can be configured in the same or different search space sets belonging to type-x CSS. |

### **Tdoc analysis**

* In [R1-2110897, TD tech]
	+ Proposal 15: The CORESET/search spaces for GC-PDCCH carrying MCCH/MTCH can be configured as below.
		- If a CORESETs/search space not configured by *initialDownlinkBWP* is shared by MCCH and MBS sessions, configure the CORESETs/search space on the MCCH specific SIB with the type of the CORESET/search space set as “Shared”.
		- If a CORESETs/search space not configured by *initialDownlinkBWP* is only used by MCCH, configure the CORESETs/search space on the MCCH specific SIB with the type of the CORESET/search space set as “NOT Shared”.
		- If a CORESETs/search space not configured by *initialDownlinkBWP* is only used by MBS sessions, configure it on MCCH.
		- If at least one CORESET/search space configured by *initialDownlinkBWP* is used by MCCH, a CORESET/search space ID list is provided on the MCCH specific SIB to indicate which CORESETs/search spaces by *initialDownlinkBWP* are used by MCCH. For each CORESET/search space in the CORESET/search space ID list, if it’s shared by MBS sessions, its type is set as “Shared’. Otherwise its type is set as “NOT Shared”.
		- If at least one CORESET/search space configured by *initialDownlinkBWP* is used by MBS sessions but not used by MCCH, a CORESET/search space ID list is provided on MCCH to indicate which CORESETs/search spaces by *initialDownlinkBWP* are used by MBS sessions.
* In [R1- 2111041, vivo]
	+ Proposal 3: The same type of CSS supported for multicast in RRC\_CONNECTED can be reused for broadcast in RRC\_IDLE/RRC\_INACTIVE for GC-PDCCH scheduling MCCH and MTCH.
* In [R1-2111137, Nokia]
	+ Proposal-12: From signalling configuration perspective, the Type-x CSS defined in RRC\_CONNECTED cannot be directly reused, and there may need to define a new Type-y CSS specifically for RRC\_IDLE/INACTIVE UE with MBS operation.
* In [R1-2111305, OPPO]
	+ Proposal 5: One of the existing CSS types can be selected and reused for RRC\_IDLE/RRC\_CONNECTED UEs for broadcast reception.
	+ Proposal 6: The Type-x CSS for multicast in RRC\_CONNECTED is not reused for broadcast in RRC\_IDLE/RRC\_INACTIVE for GC-PDCCH scheduling MCCH and MTCH.
	+ Proposal 7: Type-x CSS for RRC\_IDLE is configured and the signaling is carried via SIB.
* In [R1-2111518, Intel]
	+ *Discuss*: The PDCCH which schedules the MCCH carrying the MBS configuration can be monitored in a Type0-PDCCH CSS set configured by *searchSpaceZero* in *PDCCH-ConfigBroadcast* and associated with a CORESET#0 for both RRC\_CONNECTED and IDLE mode UEs. Alternately it can be monitored in a new PDCCH CSS set e.g., *searchSpaceBroadcast* which is configured by the MBS specific *PDCCH-ConfigBroadcast*. The CSS set can be a Type-x CSS set similar to the case for RRC\_CONNECTED UEs
	+ Proposal 6: The PDCCH scheduling the MCCH can also be monitored in a Type-x CSS set configured by the MBS specific PDCCH-ConfigBroadcast
* In [R1-2111629, CMCC]
	+ *Discuss*: The first is that RRC\_CONNECTED UEs can both receive broadcast service and multicast service, and it is no sense to define different CSS types and different PDCCH monitoring priority rules between broadcast and multicast.
	The second is that new Type-x CSS for MTCH can reduce unnecessary BD/CCE counting for RRC\_CONNECTED UEs. For RRC\_CONNECTED UEs, all configured CSS PDCCHs are counted into the monitored BD/CCEs and the left BD/CCEs capability are used for USS in Rel-15/16. However, it’s up to UE’s implementation to receive Rel-17 broadcast services or not, that is UE may not receive some configured broadcast service MTCH GC-PDCCHs. If current CSS type is reused for broadcast MTCH GC-PDCCH and the same PDCCH overbooking rule is reused for RRC\_CONNECTED UEs, these non-received broadcast MTCH GC-PDCCHs will also be counted into monitored BD/CCEs, which causing the reduction of USS scheduling opportunity. If we take new Type-x CSS for MTCH, the monitoring priority is according to the search space index and the non-monitored broadcast MTCH GC-PDCCHs are not counted into the monitored BD/CCEs for RRC\_CONNECTED UEs in order to not decrease USS scheduling opportunity.
	During the discussion in last RAN1 meeting, some companies commented that the GC-PDCCH CSS configuration signalling is different from RRC\_CONNECTED UEs and RRC\_IDLE/INACTIVE UEs. From our point of view, the definition of CSS doesn’t have any relationship with the configuration signalling. For example, the paging search space can be configured in SIB for RRC\_IDLE/INACTIVE UEs and can also be configured within UE’s active BWP by dedicated RRC signalling for RRC\_CONNECTED UEs.
	+ Proposal 4. For CSS of GC-PDCCH for broadcast, the same CSS type as multicast is supported, i.e., Type-x CSS.
* In [R1-2111763, Samsung]
	+ *Discuss*: The suggested motivation for a new CSS is to avoid the default collision among PDCCH candidates that always start from CCE index 0. Therefore, whether or not there is any modification, is not applicable to that configuration of CSS sets (can remain as for Type-3 CSS sets with UE-common/SIB1 RRC instead of UE-specific RRC) but to the search space set equation where an initialization may not always be Y\_(p,-1)=0. Such collision avoidance (also with PDCCH candidates for non-Type-3 CSS in case of CORESET#0) is necessary and should also apply for multicast for RRC\_CONNECTED UEs (with respect to PDCCH monitoring, broadcast is only a particular realization of multicast and it has been agreed that the same GC-PDCCH can be received by both RRC\_IDLE/RRC\_INACTIVE UEs and RRC\_CONNECTED UEs). The mechanism to avoid the collisions can be further discussed.
	+ Observation 1: Configuration of SS sets for GC-PDCCH can be as for Type-3 PDCCH CSS sets in Rel-16 (via UE-common, instead of UE-specific, RRC signaling).
	+ Proposal 2. Support avoidance of permanent collisions for PDCCH candidates of search space sets for GC-PDCCH for broadcast and multicast.
* In [R1-2112065, LGE]
	+ Proposal 1: Idle/inactive UE monitors PDCCH for Type0A-PDCCH CSS set to detect a DCI with SI-RNTI and receive MBS specific SIB on the corresponding PDSCH on the initial DL BWP of a serving cell for broadcast.
* In [R1-2112130, NTT DOCOMO]
	+ Proposal 3: For CSS for broadcast for RRC\_IDLE/RRC\_INACTIVE UEs, use the same CSS type as multicast (i.e., type-x CSS).
* In [R1-2112163, Lenovo]
	+ *Discuss*: Correspondingly, an associated common search space is configured for the common CORESET, which can reuse current CSS type.
	+ Proposal 14: New type-x CSS is configured for RRC IDLE/RRC INACTIVE UEs.
* In [R1-2112241, Qualcomm]
	+ *Discuss*: If a CSS other than searchSpace#0 is configured in the broadcast CFR, RAN1 needs to discuss whether the *searchSpaceBroadcast* if configured in a *CFR-Config-Broadcast* is similar as legacy CSS or multicast Type-X CSS with configurable monitoring priority. If the broadcast DCI formats in the broadcast CSS is treated similar as SIB/paging in legacy CSS, it will always have higher monitoring priority than USS for unicast and CSS for multicast. Since a RRC\_CONNECTED UE may receive broadcast/unicast/multicast in a BWP, we prefer to reuse the design of multicast Type-X CSS with configurable monitoring priority for the broadcast CSS.
	+ Proposal 3: The *searchSpaceBroadcast* if configured in a CFR-Config-Broadcast is using same Type-X CSS as that of multicast CSS.
* In [R1-2112314, MediaTek]
	+ Proposal 6: The CSS type defined in AI 8.12.1 (e.g., a new Type-x CSS) for MBS group scheduling can be used for both *searchSpace#0* and search space other than *searchSpace#0* for GC-PDCCH scheduling MCCH and MTCH.
* In [R1-2112348, Ericsson]
	+ *Discuss*: It has been argued that broadcast cannot use the same CSS type as multicast, due to different way of configuration (RRC vs SIBx/MCCH), but how the configuration is conveyed is a totally different question from what is configured. There is nothing that prevents the same IEs to be conveyed via either RRC or SIBx/MCCH and be used for both multicast and broadcast. This means that the same CSS type can be used for both multicast and broadcast.
	+ Proposal 23: The CSS type for broadcast should be the same as the CSS type for multicast.

### **FL Assessment**

***On reusing Type-x CSS for multicast reception for broadcast reception in RRC idle/inactive UE states***

[vivo, Intel, CMCC, NTT DOCOMO, Qualcomm, MediaTek, Ericsson] propose that the same type of CSS supported for multicast in connected RRC state is reused for broadcast reception in idle/inactive RRC states.

On whether the CSS type being discussed for multicast can be reused for broadcast, [Nokia] discusses that the Type-x CSS defined for connected RRC state cannot be reused for idle/inactive RRC states, since the configuration is different, i.e., RRC dedicated signalling vs. SIB/MCCH signalling for connected and idle/inactive states, respectively. However, [Ericsson, OPPO, CMCC] discuss that what is relevant is first to discuss whether the parameters for the CSS for multicast and broadcast are the same/different and second the way it is configured is a separate aspect that would not preclude reusing the same CSS type for multicast and broadcast.

While [OPPO, Samsung] propose to reuse one the existing CSS types for broadcast reception in idle/inactive RRC states, [Nokia, Lenovo] proposes to use a new CSS type rather than reusing the CSS type from multicast.

Finally, [TD Tech] discuss configuration options for the CSS.

***On Draft CR TS 38.213 NR MBS [R1-2112445]***

It is important to highlight the discussions related to the Draft CR for TS 38.213 on NR MBS [R1-2112445]. The relevant text if the draft CR is copied below:

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|  |

Here, Type0-PDCCH CSS and Type0B-PDCCH CSS are configured for broadcast reception. On the other hand, for multicast Type3-PDCCH CSS is defined.

Regarding the CSS prioritization of CSS for broadcast in RRC connected state, the editor has the below note highlighting that RAN1 has not yet discussed this. Therefore, an agreement may be needed, but this may be better discussed at other AI on RRC connected UE state.

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| --- |
|  |

Based on the above, it seems that CSS types for broadcast reception in RRC idle/inactive states is concluded. However, to collect companies views on whether this is correct the FL puts forward for discussion **Question 2.3-1**.

Finally, as per the draft CR, Type3-PDCCH CSS is defined for multicast reception. Given [vivo, Intel, CMCC, NTT DOCOMO, Qualcomm, MediaTek, Ericsson] propose that the same type of CSS supported for multicast is reused for broadcast reception in idle/inactive RRC states, the FL puts forward **Question 2.3-2** to confirm whether given the current draft CR there is still need for this.

### **1st round FL proposals for Issue 3**

#### Question 2.3-1

Given the current draft CR on TS 38.213 [R1-2112445], are there any other critical aspect left for discussion on CSS types for broadcast reception with UEs in RRC idle/inactive states?

#### Question 2.3-2

Given the current draft CR on TS 38.213 [R1-2112445], should the multicast Type3-PDCCH CSS also be used for broadcast reception with UEs in RRC idle/inactive states?

**Please provide your answers in the table below. Considering the FL assessment above, please provide your views on Questions 2.3-1 and 2.3-2:**

|  |  |
| --- | --- |
| **company** | **comments** |
|  |  |

## Issue 4: Parameters and configuration of the CFR for MCCH/MTCH

### **Background**

The following agreements for RRC\_IDLE/RRC\_INACTIVE UEs at RAN1#103-e, RAN1#106-e, and RAN1#106bis-e are relevant for this discussion:

|  |
| --- |
| Agreements: For RRC\_IDLE/RRC\_INACTIVE UEs, define/configure common frequency resource(s) for group-common PDCCH/PDSCH.* the UE may assume the initial BWP as the default common frequency resource for group-common PDCCH/PDSCH, if a specific common frequency resource is not configured.
* FFS: the relation of the common frequency resource(s) (if configured) and initial BWP.
* FFS: whether to configure one/more common frequency resources
* FFS: configuration and definition details of the common frequency resource

Agreement:From RAN1 perspective, the CFR for broadcast reception of RRC\_IDLE/INACTIVE UEs, includes at least the following configurations:* One set of parameters configured for PDSCH for broadcast reception with GC-PDSCH
* One set of parameters configured for PDCCH for broadcast reception with GC-PDCCH
* FFS: whether some parameters configured for PDSCH/PDCCH are optional/needed for the supported cases of CFR.
* FFS: If necessary, depending on the cases supported, starting PRB and the number of PRBs
	+ The reference for starting PRB is Point A. (Following the same approach to determine reference for starting PRB as that defined in AI8.12.1.)

Agreement:For broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs can use the same bandwidth configurations for the CFR of GC-PDCCH/PDSCH carrying MCCH and the CFR of GC-PDCCH/PDSCH carrying MTCH.* FFS: use of different bandwidth configurations for the CFR of GC-PDCCH/PDSCH carrying MCCH and the CFR of GC-PDCCH/PDSCH carrying MTCH

Agreement:The PDCCH/PDSCH parameters for broadcast reception with GC-PDCCH/PDSCH, which are not configured, use as default the value of the PDCCH/PDSCH parameters for the configuration of the Rel-15/Rel-16 initial BWP for RRC\_IDLE/RRC\_INACTIVE UEs. |

### **Tdoc analysis**

***PDSCH TDRA table determination***

* In [R1-2110912, ZTE]
	+ Discuss: If search space 0 is used for MBS reception, it is viable to reuse the same default B table and C table for MBS PDSCH under the corresponding multiplexing patterns with the above restriction as shown in Figure-3. However, if search space other than 0 is used for MBS reception, the above restriction is invalid. And it will seriously affect the flexibility and capacity of MBS transmission, because most of the entities only have a length of 2 or 4 symbols for PDSCH allocation. This does not meet the requirement of mass data transmission, e.g., video service under MBS. The following approach is proposed to address this issue.
	+ Proposal 6: Adding the following PDSCH TDRA table determination rule for broadcast to Table 5.1.2.1.1-1 of TS38.214.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **RNTI** | **PDCCH search space** | **SS/PBCH block and CORESET multiplexing pattern** | **pdsch-ConfigCommon includes pdsch-TimeDomainAllocationList** | **pdsch-Config includes pdsch-TimeDomainAllocationList** | **pdsch-Config-broadcast includes pdsch-TimeDomainAllocationList** | **PDSCH time domain resource allocation to apply** |
| MCCH\_RNTI, G\_RNTI for broadcast | Type-x Common for broadcast | 1 | No | - | No | Default A(if SearchSpaceZero is configured) |
| 2 | No | - | No | Default B(if SearchSpaceZero is configured) |
| 3 | No | - | No | Default C(if SearchSpaceZero is configured) |
| 1,2,3 | No | - | No | Default A(if SearchSpaceZero is NOT configured) |
| 1,2,3 | Yes | - | No | pdsch-TimeDomainAllocationList provided in pdsch-ConfigCommon |
| 1,2,3 | No/Yes | - | Yes | pdsch-TimeDomainAllocationList provided in pdsch-Config-broadcast |

***Point A as reference for starting PRB***

* In [R1-2111137, Nokia]
	+ Proposal-5: To align the outcome agreement with RRC\_CONNECTED, the Point A as reference point of starting PRB for CFR configuration of RRC\_IDLE/INACTIVE UEs for all Case C, Case D and Case E.
* In [R1-2111232, CATT]
	+ *Discuss*: Since CFR has the same size as the initial BWP (configured by SIB1) in Case C, so it is reasonable that the *locationAndBandwidth* of Case C is optional and can reuse the *locationAndBandwidth* of initial BWP. Regarding Case D and Case E, to configure the CFR, the indication of the MBS common frequency includes starting PRB and length of PRBs. Following the same approach to determine reference for starting PRB as that defined in AI8.12.1 for RRC-CONNECTED UEs, the Point A can be applied as the reference for starting PRB for RRC\_IDLE/INACTIVE UEs. The indication method of starting point and length of PRBs can reuse the current RIV (resource indicator value) mechanism in Rel-15.
	+ Proposal 3: The *locationAndBandwidth* parameter for PDSCH/PDCCH can be optional for Case C.
	+ Proposal 4: For Case D (if supported) and Case E (if supported), the starting PRB is referenced to Point A. The current RIV mechanism can be applied for indicating the starting PRB and the length of PRB of CFR.
* In [R1-2112348, Ericsson]
	+ Proposal 11: To define the broadcast BWP/CFR frequency resources, reuse the legacy definition of BWP frequency resources for unicast using the combination of Point A, offsetToCarrier and locationAndBandwidth to indicate the exact location of the BWP/CFR with respect to the carrier starting RB.
		- Note: With Case A, the frequency resources of BWP/CFR are – by definition – equal to CORESET#0 initial BWP, which is already defined by legacy, so no dedicated configuration of the frequency resources are required for the CFR.

***Different BW configurations for MCCH and MTCH***

* In [R1-2110779, Huawei]
	+ Discuss: MTCH may require larger frequency resources than MCCH, so the CFR for MTCH can be configured in MCCH.

When CFR for at least MTCH can be configured with the same size as SIB1 configured initial BWP, the CORESET for MTCH scheduling can be configured to be larger than the bandwidth of CORESET#0. Hence, the CORESET for MTCH scheduling can be configured in MCCH which could be part of configuration of CFR but can be up to RAN2 for signaling design.

* + Proposal 3: The CFR, CORESET, and search space for MCCH and MTCH can be configured separately.
* In [R1-2110912, ZTE]
	+ *Discuss*: MCCH only transmits some control information for MBS. However, MTCH needs to transmit MBS traffic, which may require large bandwidth. Considering the different requirements of MCCH and MTCH, it is worthwhile for network to have the flexibility of configuring different CFRs for MCCH and MTCH.
	+ Proposal 3: Network supports configuring different CFRs for MCCH and MTCH.
* In [R1-2111137, Nokia]
	+ *Discuss*: Practically the traffic payload size for MCCH and MTCH can be different a lot, where the control configuration payload carried via MCCH can be much smaller than the MBS traffic data payload carried via MTCH. Thus, the CFR for MCCH and MTCH can be also configured differently and controlled by network gNB based on traffic needs. An example is shown in Figure-1 with CFR Case C-1, where the MCCH CFR can be configured in CORESET#0 region and the MTCH CFR can be configured differently with larger CFR identical to initial BWP.
	+ Proposal-2: CFR for MCCH and MTCH can be configured differently.
* In [R1-2111232, CATT]
	+ Proposal 5: For RRC\_IDLE/RRC\_INACTIVE UEs, different bandwidth configurations for the CFR of GC-PDCCH/PDSCH carrying MCCH and the CFR of GC-PDCCH/PDSCH carrying MTCH are not supported.
* In [R1-2112348, Ericsson]
	+ *Discuss*: For the reception of MCCH data, the bandwidth is probably not that important, since the MCCH is cyclic, and the UE only needs to receive one cycle and can then monitor for changes. It is then more important that the monitoring of change notifications of the MCCH can be done in a power efficient way, which is possible with TDM due to the sparse way the change notifications are transmitted.
	+ *Discuss*: Even with a single CFR, most part of the power saving is expected to come from the time domain DRX and change notification mechanism, which allows the UE to receive MCCH change notification using a very small percentage of all slots, once the cyclic MCCH as such as has been captured.
	+ Proposal 9: Only a single common CFR for both MCCH and MTCH is supported in Rel-17.
* In [R1-2111305, OPPO]
	+ Proposal 3: For broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs can use the same bandwidth configuration by SIB for the CFR of GC-PDCCH/PDSCH carrying MCCH and the CFR of GC-PDCCH/PDSCH carrying MTCH.
* In [R1-2111551, Xiaomi]
	+ Proposal 4: For broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs can use the same bandwidth configuration for the CFR of GC-PDCCH/PDSCH carrying MCCH and the CFR of GC-PDCCH/PDSCH carrying MTCH.
* In [R1-2112163, Lenovo]
	+ Discuss: In RAN1#106bis meeting, regarding CFR configuration for RRC connected mode UEs, RAN1 has agreed that no more than one CFR is configured per dedicated unicast BWP in Rel-17. Following this agreement, it is straightforward to extend it to RRC\_IDLE/RRC\_INACTIVE UEs. Since only one CFR is configured for RRC\_IDLE/RRC\_INACTIVE UEs, same CFR is used for receiving MCCH and MTCH.
	+ Proposal 3: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, only same CFR for MCCH and MTCH is supported.
* In [R1-2112314, MediaTek]
	+ Proposal 1: The unified CFR is defined/configured for GC-PDCCH/PDSCH carrying MCCH and GC-PDCCH/PDSCH carrying MTCH.

***Different PDCCH-Config and PDSCH-Config for MCCH and MTCH***

* In [R1-2110779, Huawei]
	+ *Discuss*: As for the PDSCH configurations of MCCH and MTCH, some of them can be different. Similar to SIB, the GC-PDSCH carrying MCCH could fixed as QPSK and MCS Table 5.1.3.1-1 in TS38.214, and one layer is sufficient. While for GC-PDSCH carrying MTCH which may be with high data rate, the MCS for MTCH should be flexible, i.e., qam256 or qam64LowSE can be configured by high layer. In addition, due to only DCI format 1\_0 was agreed for GC-PDCCH of MCCH and MTCH, there is no Antenna port(s) information can be configured. In order to minimize specification impact, GC-PDSCH carrying MTCH can also use one layer.
	+ Proposal 6: GC-PDSCH carrying MCCH can be fixed as QPSK and single layer.
	+ Proposal 7: GC-PDSCH carrying MTCH can be fixed as single layer and mcs-Table can be configured as qam256 or qam64LowSE by high layer.
* In [R1- 2112082, AsusTek]
	+ Proposal 1: Only the basic parameters in the current PDSCH-Config are necessary for broadcast reception for RRC\_IDLE/ INACTIVE UEs, e.g. *pdsch-TimeDomainAllocationList*, *resourceAllocation*, and *rbg-Size*, to simplify the implementation.
* In [R1-2112241, Qualcomm]
	+ Proposal 4:
		- GC-PDSCH for broadcast MCCH can use QPSK and single layer.
		- GC-PDSCH for broadcast MTCH can be configured by MCCH to use flexible MCS.
* In [R1-2111629, CMCC]
	+ *Discuss*: As the discussion above, we think the same CFR is used for MCCH and MTCH and the CFR is configured in SIBx. We also agreed that separate PDCCH-config/PDSCH-config can be configured for GC-PDCCH/PDSCH for MCCH/MTCH in CFR, but one issue is if the PDCCH-config/PDSCH-config for MCCH and MTCH are the same or not. From our point of view, considering the MCCH is similar to system information PDSCH and MTCH is similar to data PDSCH, and different broadcast service can also have different traffic parameters, the PDCCH/PDSCH configuration can be different. Thus, the PDCCH-config/PDSCH-config for MCCH is configured by SIB, and the PDCCH-config/PDSCH-config for MTCH is configured by MCCH.
	+ Proposal 3. For broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs:
		- The CFR used for MCCH and MTCH is configured by SIBx;
		- PDCCH-config/PDSCH-config for broadcast reception with GC-PDCCH/PDSCH carrying MCCH is configured by SIBx;
		- PDCCH-config/PDSCH-config for broadcast reception with GC-PDCCH/PDSCH carrying MTCH is configured by MCCH. If the PDCCH-config/PDSCH-config for MTCH is not configured, the PDCCH-config/PDSCH-config for GC-PDCCH/PDSCH carrying MCCH configured by SIBx is reused for GC-PDCCH/PDSCH carrying MTCH.
* In [R1-2112348, Ericsson]
	+ Proposal x: For broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs:
		- the set of parameters configured for PDCCH/PDSCH for broadcast reception with GC-PDCCH/PDSCH carrying MCCH can be configured by SIBx
		- the set of parameters configured for PDCCH/PDSCH for broadcast reception with GC-PDCCH/PDSCH carrying MTCH can be configured by MCCH
	+ At RAN1#106b-e it was also discussed whether different configurations for MCCH and MTCH could be used on the same CFR. This could e.g. be different PDCCH-config, allowing for different Monitoring Occasions for MCCH and MTCH. We think such functionality could be useful to have, since the requirements to receive MCCH and MTCH are expected to be quite different.
	+ Proposal 10: For UEs receiving broadcast in RRC IDLE/INACTIVE, support different configurations of PDCCH and PDSCH for MCCH and MTCH within a broadcast CFR.
* In [R1-2112241, Qualcomm]
	+ Discuss: Even if using same BW size for MCCH and MTCH, it is also possible to use different pdsch-config, and/or pdcch-config. For example, the MCCH can use TDRA in the pdsch-Config-Common and SS#0 similar as SIB; while the MTCH can use flexible MCS, RM patterns, and CORESET/SS for broadcast data services. More detailed discussion is in Sect. 2.3 and 2.4.
	+ Proposal 2: Different CFR-Config-Broadcast can be configured for MCCH and for MTCH.
* In [R1-2112314, MediaTek]
	+ Proposal 2: The CFR for MCCH and MTCH is configured via MBS specific SIB (e.g., SIB-x).
* In [R1-2111899, Apple]
	+ *Discuss*: According to RAN2 incoming LS in [4], MCCH related configurations will be carried by MSB specific SIB, it should include the CFR configuration to enable the reception of GC-PDCCH/PDSCH carrying the MCCH. The scheduling information for MTCH is included in MCCH contents, it’s natural CFR configurations for MTCH is delivered via the MCCH.
	+ Proposal 3: For broadcast reception by RRC\_IDLE/RRC\_INACTIVE UEs,
		- the CFR of GC-PDCCH/PDSCH carrying MCCH is configured by MBS specific SIB
		- the CFR of GC-PDCCH/PDSCH carrying MTCH is configured by MCCH

***RateMatchPattern***

* In [R1-2111232, CATT]
	+ Proposal 2: If RAN1 wants to configure *RateMatchPattern*/ *RateMatchPatternLTE-CRS*, the following issues should be discussed.
		- Issue1: Whether both *RateMatchPattern* and *RateMatchPatternLTE-CRS* are needed configured by SIBx/MCCH.
		- Issue2: The relationship between unicast and broadcast rate matching parameters when UE receiving both unicast and broadcast services.

### **FL Assessment**

***PDSCH TDRA table determination***

[ZTE] discusses limitations of the current PDSCH TDRA table determination for broadcast. The determination of the resource allocation table to be used for PDSCH has also been discussed as part of the draft CR to TS 38.214 [R1-2112485]. This issue has not been discussed yet for broadcast reception in idle/inactive UEs, therefore **Proposal 2.4-1** uses table from ZTE as starting point for the discussion.

***Point A as reference for starting PRB***

[Nokia, Ericsson] propose to use The Point A as reference of the starting PRB for the CFR configuration of RRC idle/inactive UEs as it has been agreed for multicast. [CATT] proposes that for case C, this configuration can be optional.

This discussion is related to Issue 6 on definition of CFR and down-selection of case D/E. For Case A/C they may reuse the configuration from CORESET#0/SIB-1 initial BWP and may not require a dedicated configuration to indicate the frequency resources within the carrier. **Proposal 2.4-2** is put for discussion and collect company views.

***Different BW configurations for MCCH and MTCH***

[Huawei, ZTE, Nokia] propose that MCCH and MTCH can have different bandwidth configurations between MCCH and MTCH, where the frequency resources of the MTCH can be larger and contain the frequency resources of MCCH.

[CATT, Ericsson, OPPO, Xiaomi, Lenovo, MediaTek] only support that both MCCH and MTCH have the same frequency resources for the CFR. [Ericsson] argues that if power saving is the criteria for configuring a frequency resource smaller for MCCH than for MTCH, power saving is better achieved by time domain DRX operation.

This aspect has been discussed at previous meetings without reaching a conclusion after various rounds of discussion. Based on the submitted tdocs, companies have not changed their position. Based on this, the FL proposes not to discuss this aspect and focus on other aspects that may require more discussion. Companies are welcome to provide their views in the table below.

***Different PDCCH-Config and PDSCH-Config for MCCH and MTCH***

[Huawei, Qualcomm, CMCC, Apple] discuss that the some of the PDSCH configurations of MCCH and MTCH can be different, for example the MCS Table. [Huawei] discusses that for PDSCH carrying MCCH table 5.1.3.1-1 in TS 38.214 could be used while for PDSCH carrying MTCH MCS should be more flexible, i.e., qam256 or qam64LowSE can be configured by higher layers. [Ericsson] also argues that the PDCCH-Config could also be different between MCCH and MTCH where different Monitoring Occasions are configured for MCCH and MTCH. [Apple] notes that MCCH related configurations will be carried by MSB specific SIB, it should include the CFR configuration to enable the reception of GC-PDCCH/PDSCH carrying the MCCH. The scheduling information for MTCH is included in MCCH contents, it’s natural CFR configurations for MTCH is delivered via the MCCH. [Asustek] discusses that only basic parameters should be configured.

[MediTek] proposes that both MCCH and MTCH are both configured via MBS specific SIB.

There is stronger support for having different PDCCH/PDSCH-Config parameters between MCCH and MTCH and justification on why some parameters could be different has been provide for this meeting. Based on this **Proposal 2.4-3** puts forward an agreement to enable this.

***RateMatchPattern***

[CATT] proposes further discussion on *RateMatchPattern* / *RateMatchPatternLTE-CRS*. Given that this aspect was discussed at the past meeting without reaching an agreement and the limited time to close critical aspects in this meeting, the FL proposes to focus on the other aspects first. Companies are welcome to provide inputs in table below.

***On the determination of modulation and target code-rate & TBS***

The following agreements have been made in AI 8.12.1 for RRC connected UEs:

|  |
| --- |
| Agreement:For LBRM and TBS determination for GC-PDSCH:* The maximum number of layers can be provided by *maxMIMO-Layers* in *PDSCH-Config* for MBS in CFR; if not provided, a default value is defined.
	+ FFS the default value.
* The maximum modulation order can be determined from *mcs-Table* in PDSCH-Config for MBS in CFR;
	+ FFS: if *mcs-Table* in *PDSCH-Config* for MBS is not configured in CFR, a value determined from *mcs-Table* in *PDSCH-Config* for unicast in the active DL BWP is used; if the *mcs-Table* in *PDSCH-Config* for unicast is not configured, Table 5.1.3.1-1 in TS38.214 is used (similar as the default value in R16).
* xOverhead can be provided in PDSCH-Config for MBS in CFR; if not provided, a default value of zero is used.
* The number of PRBs is determined based on the size of CFR.

Agreement:For LBRM and TBS determination for GC-PDSCH, the default value of the maximum number of layers is 1 if *maxMIMO-Layers* in *PDSCH-Config* for MBS in CFR is not configured.Agreement:For determination of maximum modulation order for LBRM and TBS determination for GC-PDSCH,* if *mcs-Table* in *PDSCH-Config* for MBS is not configured in CFR, Table 5.1.3.1-1 in TS38.214 is used (similar as the default value in R16).
 |

However, these have not been discussed for broadcast reception in idle/inactive UEs. It is not clear whether this agreement do also apply for broadcast reception. However, as per the draft CR on TS 38.214 [R1-2112485] below, the above agreements have only been implemented for multicast.

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Therefore, the FL includes **Proposal 2.4-4** to confirm whether these agreements can also be confirmed for broadcast reception with UEs in idle/inactive RRC states.

### **1st round FL proposals for Issue 4**

#### Proposal 2.4-1

Adding the following PDSCH TDRA table determination rule for broadcast to Table 5.1.2.1.1-1 of TS38.214.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **RNTI** | **PDCCH search space** | **SS/PBCH block and CORESET multiplexing pattern** | **pdsch-ConfigCommon includes pdsch-TimeDomainAllocationList** | **pdsch-Config includes pdsch-TimeDomainAllocationList** | **pdsch-Config-broadcast includes pdsch-TimeDomainAllocationList** | **PDSCH time domain resource allocation to apply** |
| MCCH\_RNTI, G\_RNTI for broadcast | Type-x Common for broadcast | 1 | No | - | No | Default A(if SearchSpaceZero is configured) |
| 2 | No | - | No | Default B(if SearchSpaceZero is configured) |
| 3 | No | - | No | Default C(if SearchSpaceZero is configured) |
| 1,2,3 | No | - | No | Default A(if SearchSpaceZero is NOT configured) |
| 1,2,3 | Yes | - | No | pdsch-TimeDomainAllocationList provided in pdsch-ConfigCommon |
| 1,2,3 | No/Yes | - | Yes | pdsch-TimeDomainAllocationList provided in pdsch-Config-broadcast |

#### Proposal 2.4-2

For Case D/E (if supported), the definition of the broadcast BWP/CFR frequency resources reuses the legacy definition of BWP frequency resources for unicast using the combination of Point A, *offsetToCarrier* and *locationAndBandwidth* to indicate the exact location of the BWP/CFR with respect to the carrier starting RB.

#### Proposal 2.4-3

For broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs:

* The CFR frequency resources used for MCCH and MTCH are configured by SIBx;
* PDCCH-config/PDSCH-config for broadcast reception with GC-PDCCH/PDSCH carrying MCCH is configured by SIBx
* PDCCH-config/PDSCH-config for broadcast reception with GC-PDCCH/PDSCH carrying MTCH is configured by MCCH. If the PDCCH-config/PDSCH-config for MTCH is not configured, the PDCCH-config/PDSCH-config for GC-PDCCH/PDSCH carrying MCCH configured by SIBx is reused for GC-PDCCH/PDSCH carrying MTCH.

#### Proposal 2.4-4

The following agreements for RRC\_CONECTED UEs also apply for broadcast reception with UEs in RRC\_IDLE/ RRC\_INACTIVE states:

Agreement:

For LBRM and TBS determination for GC-PDSCH:

* The maximum number of layers can be provided by *maxMIMO-Layers* in *PDSCH-Config* for MBS in CFR; if not provided, a default value is defined.
	+ FFS the default value.
* The maximum modulation order can be determined from *mcs-Table* in PDSCH-Config for MBS in CFR;
	+ FFS: if *mcs-Table* in *PDSCH-Config* for MBS is not configured in CFR, a value determined from *mcs-Table* in *PDSCH-Config* for unicast in the active DL BWP is used; if the *mcs-Table* in *PDSCH-Config* for unicast is not configured, Table 5.1.3.1-1 in TS38.214 is used (similar as the default value in R16).
* xOverhead can be provided in PDSCH-Config for MBS in CFR; if not provided, a default value of zero is used.
* The number of PRBs is determined based on the size of CFR.

Agreement:

For LBRM and TBS determination for GC-PDSCH, the default value of the maximum number of layers is 1 if *maxMIMO-Layers* in *PDSCH-Config* for MBS in CFR is not configured.

Agreement:

For determination of maximum modulation order for LBRM and TBS determination for GC-PDSCH,

* if *mcs-Table* in *PDSCH-Config* for MBS is not configured in CFR, Table 5.1.3.1-1 in TS38.214 is used (similar as the default value in R16).

**Please provide your answers in the table below. Considering the FL assessment above, do you support proposals above? Please provide reasons and views in general. Please provide any alternate proposals in case you don’t support the proposals.**

|  |  |
| --- | --- |
| **company** | **comments** |
| LG Electronics | Proposal 2.4-3: We are fine with this proposal.  |

## Issue 5: Beam Sweeping for MCCH and MTCH channels

### **Background**

The following agreement for RRC\_IDLE/RRC\_INACTIVE UEs at RAN1#103-e, RAN2#104-e, RAN1#105-e, RAN1#106-e and RAN1#106bis-e are relevant for this discussion:

|  |
| --- |
| Agreements:* For RRC\_IDLE/RRC\_INACTIVE Ues, beam sweeping is supported for group-common PDCCH/PDSCH.
	+ FFS: Details for support of beam sweeping for group-common PDCCH/PDSCH.

Agreement:For RRC\_IDLE/RRC\_INACTIVE Ues, for broadcast reception, the UE may assume that group-common PDCCH/PDSCH is QCL’d with SSB.* It is up to UE implementation whether UE monitors monitoring occasions corresponding to all SSB indexes or monitoring occasions corresponding to a subset of all SSB indexes.
* FFS: association rules between SSB indexes and UE monitoring occasions.
* FFS: group-common PDCCH/PDSCH is QCl’d with TRS if configured

Agreement:For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, RAN1 confirms the following assumptions made by RAN2* RAN2 assumes, in case searchSpace#0 is configured for MCCH (if allowed, pending RAN1 decision), the mapping between PDCCH occasions and SSBs is the same as for SIB1.
* RAN2 assumes that if common search space other than searchSpace#0 is configured for MCCH (if allowed, pending RAN1 decision), the PDCCH monitoring occasions for MCCH message which are not overlapping with UL symbols are sequentially numbered from one in the MCCH transmission window and mapped to SSBs using the similar rule as defined for OSI in TS 38.331.

Agreement:For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, the same beam can be used for group-common PDCCH and the corresponding scheduled group-common PDSCH for carrying MCCH or MTCH.* UE may assume that DMRS ports of the group-common PDCCH/PDSCH for MCCH is QCL’d with SSB.
* UE may assume that DMRS ports of the group-common PDCCH/PDSCH for MTCH is QCL’d with SSB.
* FFS: group-common PDCCH/PDSCH for MTCH is QCL’d with periodic TRS if configured

Agreement:For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, both searchSpace#0 and common search space other than searchSpace#0 can be configured for GC-PDCCH scheduling MCCH.Agreement:For broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs support the same CSS type for MCCH and MTCH.* FFS support of different CSS types for MCCH and MTCH channels for broadcast reception.

Agreement:For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, if searchSpace#0 is configured for MTCH, the mapping between PDCCH occasions and SSBs is the same as for SIB1.Agreement:For RRC\_IDLE/RRC\_INACTIVE UEs with broadcast reception, if common search space other than searchSpace#0 is configured for MTCH, the mapping of PDCCH monitoring occasions to SSBs can be configured with a rule.* The existing rule defined for OSI in TS 38.331 is used as starting point to define the above rule.

Agreement:For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, both searchSpace#0 and common search space other than searchSpace#0 can be configured for GC-PDCCH scheduling MTCH.Agreement:For RRC\_IDLE/RRC\_INACTIVE UEs for broadcast reception, MTCH scheduling is associated with a window defined by the MTCH monitoring periodicity and the starting of the periodicity* FFS: the window is associated to one or multiple or all G-RNTI.

Agreement:For RRC\_IDLE/RRC\_INACTIVE UEs for broadcast reception, at least support that within the MTCH scheduling window, the association between the PDCCH monitoring occasions and SSB is defined as:* the [*x*×*N*+*K*]th PDCCH monitoring occasion(s) for MTCH in the scheduling window corresponds to the *K*th transmitted SSB, where *x* = 0, 1, ...*X*-1, *K* = 1, 2, …*N*, *N* is the number of actual transmitted SSBs determined according to *ssb-PositionsInBurst* in SIB1 and *X* is equal to CEIL(*number of PDCCH monitoring occasions in MTCH transmission window*/*N*).
* For the purpose of associating PDCCH monitoring occasion for MTCH and SSB,the UE assumes that, in the MTCH scheduling window, PDCCH for an MTCH scrambled by G-RNTI is transmitted in at least one PDCCH monitoring occasion corresponding to each transmitted SSB.
 |

The following agreements form RAN2#113bis-e meeting are relevant for this discussion:

|  |
| --- |
| * **The concept of MCCH transmission window, similar to the one used for LTE SC-PTM, is used for NR MCCH scheduling. The exact parameters to define the window are FFS (discussed in the following proposals).**
* **The MCCH transmission window is defined by MCCH repetition period, MCCH window duration and radio frame/slot offset.**
* **R2 assumes PDCCH occasions for MCCH search space are associated with SSBs in a pre-defined manner so that the UE can receive MCCH scheduling on PDCCH occasions according to its detected SSB.**
* **R2 assumes, In case searchSpace#0 is configured for MCCH (if allowed, pending RAN1 decision), the mapping between PDCCH occasions and SSBs is the same as for SIB1.**
* **R2 assumes that If common search space other than searchSpace#0 is configured for MCCH (if allowed, pending RAN1 decision), the PDCCH monitoring occasions for MCCH message which are not overlapping with UL symbols are sequentially numbered from one in the MCCH transmission window and mapped to SSBs using the similar rule as defined for OSI in TS 38.331.**
 |

The following agreements form RAN2#115-e meeting are relevant for this discussion:

|  |
| --- |
| * **If Data Inactivity timer is configured, data monitoring is applied both for unicast and MBS multicast (i.e. both PTM and PTP data) (but not MBS broadcast)**
* **The Multicast Long DRX operation has to support the following parameters which are similar to the UE-specific DRX for unicast, where the last two parameters are needed if the HARQ- feedback is enabled:**
	+ **drx-onDurationTimerPTM**
	+ **drx-InactivityTimerPTM**
	+ **drx-LongCycleStartOffsetPTM**
	+ **drx-SlotOffsetPTM**
	+ **drx-HARQ-RTT-TimerDLPTM**
	+ **drx-RetransmissionTimerDLPTM**
* **For NR Broadcast, the DRX pattern is configured per G-RNTI.**
* **For NR Broadcast, DRX configuration includes: drx-onDurationTimerPTM, drx-SlotOffsetPTM, drx-InactivityTimerPTM, drx-CycleStartOffsetPTM.**
 |

### **Tdoc analysis**

* In [R1-2110779, Huawei]
	+ *Discuss*: In addition, an offset should be defined to determine the starting of the window, and it should not be replaced by the parameters defined for DRX because of the offset for beam sweeping window should be independent from DRX configurations.
	+ *Discuss*: In our opinion, since the SSB is associated with the PDCCH monitoring occasions in search space, and the GC-PDCCHs scrambled by different G-RNTI may use different search spaces, the window should be associated to one G-RNTI.
	+ Proposal 8: The MTCH transmission window is associated to one G-RNTI.
	+ Proposal 9: An offset to the starting of the MTCH transmission window should be defined, e.g., $O\_{G-RNTI}$:
		- the PDCCH monitoring occasion(s) in slot $n\_{slot}$ in the frame $SFN$ is given by $\left(SFN∙N\_{slot}+n\_{slot}-O\_{G-RNTI}\right)mod K\_{G-RNTI}=0$, where $N\_{slot}$ is the number of slots in a radio frame.
* In [R1-2110897, TD Tech]
	+ Proposal 12: For a CSS for MCCH other than search space 0, the mapping between GC-PDCCH occasions and SSB beams within each transmission window of MCCH is defined as:
		- The GC-PDCCH occasions within each transmission window are numbered in sequence with index 0 for the first GC-PDCCH occasion.
		- The GC-PDCCH occasion with index k=(N\*x+n) is associated with SSB beam n, where n=0,…,N-1, N is the number of the SSB beams, SSB beam n is for SSB index n, x=0,…,INT[L/N]-1, and L is the number of the GC-PDCCH occasions in each transmission window.
	+ Proposal 13: For a CSS for MTCH other than search space 0, the mapping between GC-PDCCH occasions and SSB beams within each monitoring period of the CSS is defined as:
		- The GC-PDCCH occasions within each monitoring period are numbered in sequence with index 0 for the first GC-PDCCH occasion.
		- The GC-PDCCH occasion with index k=(N\*x+n) is associated with SSB beam n, where n=0,…,N-1, N is the number of the SSB beams, SSB beam n is for SSB index n, x=0,…,INT[L1/N]-1, and L1 is the number of the GC-PDCCH occasions in each monitoring period.
* In [R1-2111137, Nokia]
	+ Proposal-22: It is preferred to keep the robust SSB-based beam sweeping operation as SIB for RRC\_IDLE/INACTIVE UEs for both MCCH and MTCH in Rel17 MBS.
	+ *Discuss*: To our understanding, the configured MTCH scheduling window corresponds to the broadcast DRX pattern, where the corresponding parameters, i.e. *onDuration* (periodicity) and *SlotOffset* (starting of the periodicity) have already been agreed and defined in RAN2-115-e meeting, as shown in below. And correspondingly, the MTCH scheduling window is configured per G-RNTI, and practically a MTCH scheduling window can be configured by gNB to be associated with multiple G-RNTI.
	+ Proposal-23: The configured MTCH scheduling window corresponds to the broadcast DRX pattern, as already been agreed in RAN2.
	+ Proposal-24: The MTCH scheduling window is configured per G-RNTI, and practically a MTCH scheduling window can be configured by gNB to be associated with multiple G-RNTI.
	+ Proposal-25: It is proposed to consider additional association rules between SSB indexes and UE monitoring occasions other than the rule defined for OSI in TS 38.331.
	+ Proposal-26: Consider the SSB index to PDCCH MO mapping across the MBS window can be “disabled” by network. Thus, the mapped number of mapped SSB beams can be evenly distributed among each MCCH window duration.
	+ Proposal-27: Allow the network to control the number of repetition transmission for each SSB beam within the on-duration window.
* In [R1-2111232, CATT]
	+ Proposal 7: In NR MBS system, PDCCH MOs in one MBS-window length are allocated to one SSB with consecutive MO should be considered.
	+ Proposal 8: The MTCH scheduling window can be associated with one or multiple or all G-RNTI.
* In [R1-2111305, OPPO]
	+ *Discuss*: First, whether multiple MTCH windows can be overlapped in time domain should be discussed. If multiple MTCH windows can be overlapped, and each window is associated with one G-RNTI, then it may work normally, but it increases the complexity. Within a MTCH window, if different G-RNTIs are associated with different MTCH TDM, it technically works. However, it still needs discussion that whether G-RNTI should be associated with MTCH window or they are two independent scheduling components. From the perspective of system and simple scheduling mechanism, a MTCH window associated with one G-RNTI is preferred for broadcast MBS services in this release.
	+ Proposal 11: One MTCH window is associated with one G-RNTI.
* In [R1-2111551, Xiaomi]
	+ Proposal 10: The association between the PDCCH monitoring occasions and SSB within the MCCH scheduling window is same as that of MTCH scheduling window.
	+ *Discuss*: One open issue is how to define the association between the scheduling window and G-RNTI, considering more than one G-RNTI can be configured for a MBS UE. From UE complexity point of view, there is no additional burden for a UE tries to decode a DCI with different RNTI assumptions. On the other hand, gNB can configure multiple search spaces in a single monitoring occasion if different services may collide in time domain. Hence we have the following proposal:
	+ Proposal 11: A MTCH scheduling window is associated with all G-RNTIs configured by gNB.
* In [R1-2112065, LGE]
	+ *Discuss*: For scheduling of OSI in NR, different SI messages can be scheduled in different SI windows with different scheduling parameters e.g. different SI periodicities. Multiple SIBs having a same SI periodicity can be scheduled in a same SI message while different SIBs having different SI periodicities can be separately scheduled in different SI messages. With such basic principle of scheduling OSI, we think that group common transmissions for different G-RNTIs with different traffic patterns can be scheduled in different transmission windows, while Group common transmissions for different G-RNTIs with similar traffic pattern can be scheduled in same transmission windows.
	+ Observation 3: Different SI messages can be scheduled in different SI windows with different scheduling parameters e.g. different SI periodicities.
	+ Proposal 3A: Group common transmissions for different G-RNTIs with different traffic patterns or even for different SFN areas can be scheduled in different transmission windows. Different transmission windows can be configured with different window lengths as well as different periodicities of transmission windows, depending on MTCH traffic characteristics.
	+ Proposal 3B: Group common transmissions for different G-RNTIs with similar traffic pattern can be scheduled in same transmission windows. If SFN is used, group common transmissions for different G-RNTIs in the same cell group i.e. the same SFN area can be scheduled in same transmission windows.
	+ Observation 4: A certain broadcast service may be available only at a specific local service area within a cell. Besides, if a cell is at the boundary of SFN area, only a limited number of SSBs could participate in the SFN area for one or more services in the cell group in SFN.
	+ Proposal 4: For a certain broadcast service, the number of actual transmitted SSBs used to determine PDCCH monitoring occasions within certain transmission windows can be smaller than the number of SSBs determined in SIB1. Different transmission windows can be configured with different number of actual transmitted SSBs, depending on actual broadcast service area.
	+ Observation 5: RAN2 agreed that MCCH contents should include information about broadcast sessions such as G-RNTI, MBS session ID as well as scheduling information for MTCH (e.g. search space, DRX).
	+ Proposal 5: PDCCH monitoring occasions are determined in DRX on-durations for MTCH of a broadcast service for idle/inactive UEs.
* In [R1-2112130, NTT DOCOMO]
	+ *Discuss*: An MTCH scheduling window will be useful to limit the duration of the MTCH reception processing. Regarding the association between the scheduling window and G-RNTI, one window for all G-RNTI would be sufficient. Because RAN2 has already agreed that the DRX pattern for broadcast is configured per G-RNTI [5]. Even if there is only one MTCH scheduling window, the ‘on duration’ for each G-RNTI can be configured within the window. We don’t see a clear benefit in defining a different window for each G-RNTI.
	+ Proposal 7: An MTCH scheduling window is associated with all G-RNTI.
* In [R1-2112348, Ericsson]
	+ *Discuss*: We seek clarification how the MTCH scheduling window is related to the DRX for Multicast MBS that is part of the running CR 38.321 (R2-2108926). The DRX parameters are contained in the MCCH, therefore we assume it is relevant for reception of broadcast in RRC idle/inactive, not only for multicast in RRC connected. MTCH scheduling for broadcast must be done in accordance with the PTM-DRX scheme, which is inherited from the unicast scheme, i.e. using parameters like *onDurationTimer*, *InactivityTimer* and *drx-LongCycle* and *drx-StartOffset*. Any MTCH transmission window would have to coincide with the onDuration of the DRX cycle. We therefore think that parameters like a MTCH transmission window offset and periodicity are not needed.
	We believe that different MBS services can have different latency requirements and different typical packet interarrival time. In order to avoid that UEs interested in a service with relaxed latency and long interarrivals has to monitor PDCCH as frequently as that may be necessary for other services, we propose the window can be different for different G-RNTI.
	+ Proposal 14: The MTCH scheduling is associated with one G-RNTI.
	+ Proposal 15: For the purpose of associating PDCCH monitoring occasion for MTCH and SSB, the UE assumes that, in the MTCH scheduling window, if any PDCCH for an MTCH scrambled by G-RNTI is transmitted, then such a PDCCH is transmitted in at least one PDCCH monitoring occasion corresponding to each transmitted SSB.

### **FL Assessment**

***i) On configuration of MTCH transmission window***

* *Monitoring periodicity and the starting of the periodicity*

[Huawei] discusses that the configuration of the parameters of the MTCH scheduling window (monitoring periodicity and the starting of the periodicity) should not be determined by the DRX parameters and further provide details on the definition of the parameters. On the other hand, [Nokia, Ericsson, LGE, NTT DOCOMO] discuss/question whether the MTCH scheduling window parameters directly correspond to the DRX parameters defined in RAN2.

This question, whether window parameters are already determined by DRX parameters, was presented for discussion at the last meeting in the FL summary in one of the rounds of discussion for this issue. However, not many companies commented on this aspect. **Question 2.4-1** is put for discussion to collect company comments.

* *Association of window & G-RNTI(s)*

While [Huawei, Nokia, CATT, OPPO, LGE, Ericsson] propose that the window should be associated to one G-RNTI, [CATT, Xiaomi, NTT DOCOMO] proposes that the window should be associated all G-RNTI. [LGE] also proposes that transmissions with different G-RNTIs can be transmitted in the same window.

Based on majority view, **Proposal 2.4-2** tries to agree that the window should be associated with one G-RNTI.

***ii) On clarifications of mapping of PDCCH monitoring occasions to SSBs for MTCH***

[Ericsson] proposes to clarify one of the sub-bullets in one of the previous agreements to avoid forcing the network to transmit PDCCH even if there is no MTCH traffic in a window. **Question 2.4-3** seeks feedback from companies on this proposal.

***iii) Other aspects***

* *On additional association rules between SSB indexes and UE monitoring occasions*

[Nokia, CATT, LGE] proposes that additional association rules between SSB indexes and UE MO other than those defined for OSI are considered. These aspects have been discussed as well in previous meeting. In previous meetings multiple companies did not support such approaches as they were not considered essential for this release. The FL therefore proposes to first focus on finishing critical aspects open for beam sweeping. Companies are welcome to provide their views in the table below.

* *Same association between PDCCH MO and SSBs for MCCH and MTCH*

[Xiaomi] proposes that the association between the PDCCH monitoring occasions and SSB within the MCCH scheduling window is same as that of MTCH scheduling window. As per the comment above, the FL proposes to first focus on finishing the critical issues open for beam sweeping. Companies are welcome to provide their views in the table below.

### **1st round FL proposals for Issue 5**

#### Question 2.5-1

regarding the parameters of MTCH scheduling window, i.e., monitoring periodicity and the starting of the periodicity.

* Option-1: there is no need to define these parameters since they are already determined by the RAN2 parameters agreed for DRX for NR broadcast.
* Option-2: the configuration of the DRX and the MTCH scheduling window are independent and therefore these parameters need to be defined.

#### Proposal 2.5-2

For broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs, the MTCH scheduling window is associated to one G-RNTI.

#### Question 2.5-3

Provide your views on whether the second sub-bullet of the following agreement made at RAN1#106bis-e:

Agreement:

For RRC\_IDLE/RRC\_INACTIVE UEs for broadcast reception, at least support that within the MTCH scheduling window, the association between the PDCCH monitoring occasions and SSB is defined as:

* the [*x*×*N*+*K*]th PDCCH monitoring occasion(s) for MTCH in the scheduling window corresponds to the *K*th transmitted SSB, where *x* = 0, 1, ...*X*-1, *K* = 1, 2, …*N*, *N* is the number of actual transmitted SSBs determined according to *ssb-PositionsInBurst* in SIB1 and *X* is equal to CEIL(*number of PDCCH monitoring occasions in MTCH transmission window*/*N*).
* For the purpose of associating PDCCH monitoring occasion for MTCH and SSB,the UE assumes that, in the MTCH scheduling window, PDCCH for an MTCH scrambled by G-RNTI is transmitted in at least one PDCCH monitoring occasion corresponding to each transmitted SSB.

should be updates as follows:

* For the purpose of associating PDCCH monitoring occasion for MTCH and SSB, the UE assumes that, in the MTCH scheduling window, if any PDCCH for an MTCH scrambled by G-RNTI is transmitted, then such a PDCCH is transmitted in at least one PDCCH monitoring occasion corresponding to each transmitted SSB.

**Please provide your comments in the table below. Considering the FL assessment above:**

1. **please provide your views on Questions 2.5-1 and 2.5-3.**
2. **do you agree with Proposal 2.5-2? please provide your views and reasons.**

|  |  |
| --- | --- |
| **company** | **comments** |
| LG Electronics | Question 2.5-1RAN2 recently made agreements as follows: * *Confirm that the same PTM DRX configuration parameters can be applied to multiple G-RNTIs.*
* *Allow RRC signalling to configure the same DRX configuration instance to multiple G-RNTIs.*
* *In case mtch-schedulingInfo is absent for a G-RNTI (i.e. no PTM DRX), the UE should monitor for PDCCH scrambled with G-RNTI in any slot according to the search space configured for MTCH.*

Meanwhile, RAN1 agreed that MTCH scheduling is associated with a window defined by the MTCH monitoring periodicity and the starting of the periodicity. RAN1 also agreed to support the association between the PDCCH monitoring occasions and SSB within the MTCH scheduling window. FFS: the window is associated to one or multiple or all G-RNTI.In our view, the MTCH window is mainly determined for the association between the PDCCH monitoring occasions and SSB. Thus, we would still need the MTCH window defined by the periodicity and the starting of the periodicity. Note that the MTCH scheduling window could be simply changed to ‘MTCH window’, like the existing term SI-window.Accordingly, both the configuration of the DRX and the MTCH window can be ‘separately’ configured and used for a UE to determine when UE actually receive MTCH. Considering RAN2 agreements, we think that one or more G-RNTIs can be scheduled in a same MTCH window according to DRX configuration(s) of the G-RNTI(s), and if DRX is not configured (i.e. no PTM DRX), UE monitors PDCCH monitoring occasions only based on the MTCH windows for interested G-RNTI(s).Proposal 2.5-2: We think that this proposal is not aligned with what RAN2 recently agreed.* *Confirm that the same PTM DRX configuration parameters can be applied to multiple G-RNTIs.*
* *Allow RRC signalling to configure the same DRX configuration instance to multiple G-RNTIs.*

So, this proposal can be changed to:***Proposal 2.5-2:****For broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs, the MTCH scheduling window is associated to one or more G-RNTIs based on DRX configuration.*Question 2.5-3: We are OK with this update “if any PDCCH for an MTCH scrambled by G-RNTI is transmitted, then such’ in order to avoid forcing the network to transmit PDCCH even if there is no MTCH traffic in a window. |

## Issue 6: Definition and down-selection for CFR of MCCH/MTCH

### **Background**

During RAN2#113bis-e meeting, RAN2 discussed further aspects of MCCH scheduling with RAN1 impacts. Here, we reproduce relevant RAN2 agreements relevant to the discussion on the CFR:

|  |
| --- |
| * **Request RAN1 to discuss the details of the configuration of the bandwidth for MCCH reception.**
* **UE in RRC IDLE/INACTIVE should be able to monitor/read both MCCH channel and SI/Paging without BWP switch. It is up to RAN1 to decide how this is ensured.**
 |

RAN2 in [R1-2104165] requests RAN1 to investigate and provide feedback, considering agreements made by RAN2 as indicated in the LS where the following request is relevant for the discussion on CFR:

|  |
| --- |
| * Details of the allowed transmission bandwidth/BWP configurations for MCCH transmission.
 |

RAN2 discussed further the aspects related to MCCH design and made the following agreements during RAN2#114 meeting relevant to the discussion on CFR for MCCH/MTCH:

|  |
| --- |
| * MBS specific SIB is defined to carry MCCH configuration.
* Postpone the discussion on whether dedicated MCCH configuration is required until RAN1 makes progress on BWP/CFR for MCCH.
* We support single MCCH (in this release)
 |

The following agreements for RRC\_IDLE/RRC\_INACTIVE UEs at RAN1#103-e, RAN1#104-e, RAN1#105-e, RAN1#106-e and RAN#93-e are relevant for this discussion:

|  |
| --- |
| Agreements: For RRC\_IDLE/RRC\_INACTIVE UEs, define/configure common frequency resource(s) for group-common PDCCH/PDSCH.* the UE may assume the initial BWP as the default common frequency resource for group-common PDCCH/PDSCH, if a specific common frequency resource is not configured.
* FFS: the relation of the common frequency resource(s) (if configured) and initial BWP.
* FFS: whether to configure one/more common frequency resources
* FFS: configuration and definition details of the common frequency resource

Agreement:For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, further study the following cases of a configured/defined specific common frequency resource (CFR) for group-common PDCCH/PDSCH, and identify which case(s) will be supported:* [Case E] the case where a CFR is defined based on a configured BWP.
	+ In particular, study the following:
		- whether a configured BWP for MBS is needed or not.
		- whether BWP switching is needed or not.
	+ In this study, the configured BWP has the following properties:
		- The configured BWP is different than the initial BWP where the frequency resources of this initial BWP are configured smaller than the full carrier bandwidth.
		- The CFR has the frequency resources identical to the configured BWP.
		- The configured BWP needs to fully contain the initial BWP in frequency domain and has the same SCS and CP as the initial BWP.
	+ Note: The configured BWP is not larger than the carrier bandwidth
* the case where the initial BWP fully contains the CFR in the frequency domain.
	+ In this study the following sub-cases are considered:
		- [Case B] A CFR with smaller size than the initial BWP, where the initial BWP has the same frequency resources as CORESET0. In this case the CFR has the frequency resources confined within the initial BWP and have the same SCS and CP as the initial BWP.
		- [Case D] A CFR with smaller size than the initial BWP, where the initial BWP has the frequency resources configured by SIB1. In this case the CFR has the frequency resources confined within the initial BWP and have the same SCS and CP as the initial BWP.
	+ In particular, study the following:
		- Whether the considered two options with a CFR with smaller size than the initial BWP are needed or not for MBS.
* the case where the initial BWP has same size as the CFR in the frequency domain.
	+ In this study the following two sub-cases are considered:
		- [Case A] A CFR with the same size as the initial BWP, where the initial BWP has the same frequency resources as CORESET0. In this case the CFR has the same frequency resources and same SCS and CP as the initial BWP.
		- [Case C] A CFR with same size as the initial BWP, where the initial BWP has the frequency resources configured by SIB1. In this case the CFR has the same frequency resources and same SCS and CP as the initial BWP.
	+ In particular, study the following:
		- Whether the considered two options with a CFR with the same size as the initial BWP are needed or not for MBS.

Agreement:For broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs can use a configured/defined CFR with the same size as the initial BWP, where the initial BWP has the same frequency resources as CORESET0 (i.e., Case A), to receive GC-PDCCH/PDSCH carrying MCCH.* Note: GC-PDCCH/PDSCH transmission within a narrower portion of the Initial BWP (where the initial BWP has the same frequency resources as CORESET0) is possible by implementation via appropriate scheduling.

Agreement:For broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs can use a configured/defined CFR with the same size as the initial BWP, where the initial BWP has the same frequency resources as CORESET0 (i.e., Case A), to receive GC-PDCCH/PDSCH carrying MTCH.* Note: GC-PDCCH/PDSCH transmission within a narrower portion of the Initial BWP (where the initial BWP has the same frequency resources as CORESET0) is possible by implementation via appropriate scheduling.

Conclusion:There is no specification support in Rel-17 for broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs with configured/defined CFRs for group-common PDCCH/PDSCH with smaller size than the initial BWP, where the initial BWP has the same frequency resources as CORESET0 (i.e., Case B).Agreement (Updated proposal from RAN1#106e):For a configured/defined CFR for GC-PDCCH/PDSCH carrying MCCH and MTCH for broadcast reception with UEs in RRC IDLE/INACTIVE state.* Support Case-C
* Support at least one of Case D and Case E.
	+ Down-selection to be made at RAN1#106b-e
* Note: Case C, D and E are defined in previous agreements
 |

At RAN1#106bis-e the was no agreement on the down-selection of Case D/E and the following was reported in the Chair’s notes:

|  |
| --- |
| Proposal:For a configured/defined CFR for GC-PDCCH/PDSCH carrying MCCH and MTCH for broadcast reception with UEs in RRC IDLE/INACTIVE state.* Support Case D
* Working assumption: Support Case E
* Note: Case D and E are defined in previous agreements

Objection sustained by: Lenovo, CMCC, Xiaomi, Spreadtrum, OppoProposal:For a configured/defined CFR for GC-PDCCH/PDSCH carrying MCCH and MTCH for broadcast reception with UEs in RRC IDLE/INACTIVE state.* Support Case D
* FFS: Support Case E
* Note: Case D and E are defined in previous agreements

Objection sustained by: NSB, ZTE, vivo, LG, Qualcomm |

### **Tdoc analysis**

* In [R1-2110891, Futurewei]
	+ Proposal 1: For Idle/Inactive UEs broadcast reception, the common frequency resource (CFR) for group-common PDCCH/PDSCH is fully contained within the initial BWP and is configured by SIB. Furthermore, the frequency resources for the CFR does not need to be equal to CORESET0 (Case D).
* In [R1-2110897, TD Tech]
	+ Proposal 1: The CFR for MCCH is the initial DL BWP.
	+ Proposal 4: The CFR for MTCH for broadcast mode can be larger than the initial DL BWP, which means the CFR for MTCH can contain the initial DL BWP and has the same numerology as the initial DL BWP.
* In [R1-2110912, ZTE]
	+ Proposal 1: For a configured/defined CFR for GC-PDCCH/PDSCH carrying MCCH and MTCH for broadcast reception with UEs in RRC\_IDLE/INACTIVE states, support both Case D and Case E.
* In [R1- 2111041, vivo]
	+ *Discuss*: During transition from RRC CONNECTED before RRC (re)-configuration to RRC CONNECTED after RRC (re)-configuration, it is observed that service continuity is kept for case C and D when *firstActiveDownlinkBWP-Id* is not configured, but not kept when *firstActiveDownlinkBWP-Id* is configured to indicate the first active downlink BWP. And for case E, service continuity is kept when *firstActiveDownlinkBWP-Id* is configured to indicate the first active downlink BWP to the broadcast CFR. but not kept when firstActiveDownlinkBWP-Id is not configured. Consequently, depending on conditions, whether service continuity could be kept or not is quite similar for the three cases.
	+ *Discuss*: Another issue is how network identifies UEs having interest or not in broadcast services. One possible approach is via MBS interest indicator, even though it maybe optional from UE side, it helps network to ensure the broadcast performance of the UEs reporting their MBS interest. For the UEs not reporting, network may not have information for their interest and broadcast performance doesn’t have to be guaranteed in this case. When UE reports its MBS interest, network can configure it with first active DL BWP including the broadcast CFR, otherwise, network can configure it with first active DL BWP by considering unicast and multicast only. The network operation on this issue is common in case-C, -D, and -E.
	+ *Discuss*: It is not wise to consider case E as an optimized solution over case C, on the contrary, case E is complementary to case C and is essential to be supported in Rel-17.
	+ Proposal 1: For a configured/defined CFR for GC-PDCCH/PDSCH carrying MCCH and MTCH for broadcast reception with UEs in RRC IDLE/INACTIVE state:
		- Support Case-C
		- Support Case-E.
		- Note: Case C and E are defined in previous agreements.
* In [R1-2111115, Spreadtrum]
	+ *Discuss*: Regarding Case E, firstly, we have not seen the specfic use cases, which must be delivered in idle sate, and are high data volume. In NR Rel-15/Rel-16, only small data, or even no traffice data is allowed to be transmitted in idle state. High traffic volume is always transmitted in connected state. One reason is that it is higher efficiency and reliablity in connected state. The necesarity of introducing CFR with large bandwidth.e g., case E in idle state, is not clear to us.
	+ Discuss: In idle state, no matter case C or case E, there is no impact on legacy UE. This is because that SIB1 configured initial DL BWP can be active only in RRC connnected state, and legacy UE only camp in the bandwidth of CORESET#0.
	+ In RRC connnected state, assuming all MBS UEs report MBS interest indication to gNB, then for case C, gNB can configure first active BWP and default BWP by UE RRC signalling to make SIB1 configured initial DL BWP invalid. There is no impact on legacy UE even if in the case where SIB1 configured inital DL BWP is enlarged due to MBS as the proponent of case E claimed.
	+ In RRC connnected state, assuming MBS UEs not report MBS interest indication to gNB, then for both case C and case E, it is completely up to gNB’s implementation to configure unicast BWP by RRC signalling for each UE, which may be larger than the bandwidth of BWP configured by case E/ SIB1 configured initial DL BWP, or equal to the bandwidth of BWP configured by case E/ SIB1 configured initial DL BWP, or smaller than the bandwidth of BWP configured by case E/ SIB1 configured initial DL BWP. For this case, there is no difference between case C and case E.
	+ In RRC connnected state, assuming MBS UEs not report MBS interest indication to gNB, and first active BWP is not configured by gNB for each UE, some companies of proponent E claim that for case E, legacy UE use SIB1 configured intial BWP as the first active BWP, and MBS UE uses the BWP configured by case E as the first active BWP by default. So, there will be no impact on legacy UEs for case E. While for case C, due to the enlarged SIB1 configured inital DL BWP as the proponent of case E claimed, there will be additional power cost on legacy UEs. But for this, we have different understanding.
		- For case E, it measn two initial DL BWPs are being maintained in the system.
		- For case E, in this case, gNB doesn’t know who is MBS UE, who is legacy UE. There is no common understanding between gNB and UE. There will be too much impact. For example, if gNB mistake one legacy UE as MBS UE, and scheudle it in the frequency resource not overlapping with SIB1 configured initial DL BWP, obviously the performance of legecy UE will be deteriorated, i.e., case E brought negative impact to legacy UEs.
		- For case C, there is no discrepancy between gNB and UE. There is no legacy bahivor change for legacy UE.
	+ Proposal 1: For CFR configuration for RRC\_IDLE/RRC\_INACTIVE UEs, Case E is not supported.
* In [R1-2111137, Nokia]
	+ To our view, the support of Case C, Case D, and Case E can be achieved in the same manner with a common signaling design approach, and all three cases should be treated with the same design priority. The difference among the Case D, Case E, as well as previously agreed Case C, is just the matter of configured value of CFR size, and the Case C and Case D can be seen as a subset of Case E.
	+ Proposal-1: Support of CFR Case D and Case E.
* In [R1-2111232, CATT]
	+ Discuss: When low data rate is required, Case D can be supported for power saving. When high data rate is required, both Case C and E can be generally supported. However, Case C will affect legacy UE due to initial BWP with increased bandwidth. Case E can solve the issue. For Case E, the first active BWP should contain the CFR, so that the MBS UEs can receive broadcast and SIB/paging/unicast without BWP switching. All in all, Case D and Case E can be supported for gNB scheduling flexibility.
	+ Proposal 1: Support Case D and E for gNB scheduling flexibility.
* In [R1-2111305, OPPO]
	+ *Discuss*: In order to keep the MBS reception continuous, the bandwidth of CFR should be maintained for unicast and MBS service reception even UE has transferred from RRC\_IDLE to RRC\_CONN state. This larger bandwidth is considered as the applicable “initial DL BWP” rather than the initial DL BWP which is configured by SIB1. UEs may have different initial DL BWPs because some of the UEs may use initial DL BWP configured by SIB1 while some other UEs are using a larger bandwidth equal to CFR.
	+ Proposal 1: For a configured/defined CFR for GC-PDCCH/PDSCH carrying MCCH and MTCH for broadcast reception with UEs in RRC IDLE/INACTIVE state, Case D is selected.
	+ Proposal 2: For a configured/defined CFR for GC-PDCCH/PDSCH carrying MCCH and MTCH for broadcast reception with UEs in RRC IDLE/INACTIVE state, Case E is not supported.
* In [R1-2111408, SONY]
	+ Proposal 1: Support Case E.
* In [R1-2111518, Intel]
	+ Discuss: This method of coupling the CFR with the initial BWP also means that the related configurations can then be re-used for the CFR which does not need an independent reference point, starting PRB and length in PRBs to be additionally configured.

For Case D, it assumes that CFR is smaller than the SIB1 configured initial BWP but potentially larger than and containing the resources of CORESET#0. In our understanding, this case can be resolved using FDRA within Case C. Case D should not provide any added advantage in terms of UE power consumption since the UE will move the wider SIB1 configured initial BWP when it transitions to CONNECTED mode.

* + Proposal 1: Case D can be implemented under Case C using appropriate FDRA since the resources required for broadcast reception under Case D are already included in Case C. Additional support for Case D is not required.
	+ Discuss: . To our understanding, a configured BWP can be anything which is different from the legacy SIB1 configured initial BWP or CORESET#0. However, we also need to ensure that that configured BWP contains CORESET#0. Assuming that CFR in Case E is different (wider) from the initial BWP, there is an issue that the UE will need to transition to the smaller initial BWP when entering CONNECTED mode and in this case the CFR lies outside of the initial active BWP. Therefore, in this implementation of Case E, for CONNECTED mode UEs to continue receiving broadcast transmission within the broadcast CFR, the gNB needs to switch the relevant UEs to wider active BWP as part of the initial access procedure.
	+ Observation 1: For Case E when the configured BWP is wider than legacy SIB1 configured initial BWP, when the UE transitions to CONNECTED mode, the CFR will be outside the initial active BWP, requiring the switching of the UE to a wider BWP (containing CFR) for continuous broadcast reception.
	+ *Discuss*: On the other hand, if we define the “configured BWP” as another SIB-x configured initial BWP only for MBS UEs which supersedes the legacy initial BWP configuration, then the issue of CFR outside of initial active BWP for UEs transitioning to CONNECTED mode does not exist. In fact, it is reasonable also to assume that the UE which required a wider CFR would also require a wider initial BWP to continue receiving broadcast and it does not have any additional power consumption issues. The main difference here is that the configured BWP is now a new wider initial BWP for the MBS UEs while the legacy UEs still use the legacy initial BWP.
	+ Proposal 2: Case E can be supported where the “configured BWP” is defined as a SIB-x configured wider initial BWP for MBS capable UEs which supersedes the legacy SIB1 configured initial BWP.
* In [R1-2111551, Xiaomi]
	+ *Discuss*: Case C would be a possible solution to resolve the capacity issues for MBS. However, gNB still needs to consider the multiplexing issues between MBS and legacy broadcast channels. Case D can provide more tools for network to handle MBS scheduling and consequently the system can benefit from flexibility harvested via case D. Furthermore, as case D only requires a CFR which fully contained by the initial DL BWP, gNB can use the CFR seamlessly when it enters RRC CONNECTED state. It is pretty aligned with the spirit of ‘the aim of keeping maximum commonality between RRC\_CONNECTED state and RRC\_IDLE/RRC\_INACTIVE state for the configuration of PTM reception’.
	+ Proposal 1: For a configured/defined CFR for GC-PDCCH/PDSCH carrying MCCH and MTCH for broadcast reception with UEs in RRC IDLE/INACTIVE state, support case D.
	+ *Discuss*: One concern on case C is that the larger initial DL BWP increase the power consumption for legacy UE. We don’t think this argument is reasonable as nothing new is introduced for the legacy UE in terms of initial DL BWP. Power saving is never the factor needs to be taken into account when gNB configure initial DL BWP. For a legacy UE, it can be configured with a first active DL BWP other than initial DL BWP. The first active DL BWP can be much smaller than the initial DL BWP as it doesn’t need to receive MBS.
	+ *Discuss*: If a larger MBS-specific BWP is configured for MBS UE, additional BWP switching is required when it transfers to RRC CONNECTED state as it is larger than the initial DL BWP. It would also complicate the scheduling at gNB side as it has to maintain two ‘initial DL BWPs’ if the intention is to make legacy UE and MBS UE associate with separate initial DL BWP, i.e. SIB1-configured initial DL BWP and MBS-specific DL BWP.
	+ Proposal 2: For a configured/defined CFR for GC-PDCCH/PDSCH carrying MCCH and MTCH for broadcast reception with UEs in RRC IDLE/INACTIVE state, do not support case E.
	+ Proposal 3: The SIB-1 configured initial BWP for legacy Rel-15/Rel-16 UEs in RRC\_CONNECTED state is applied as initial BWP for Rel-17 MBS capable UEs.
* In [R1-2111629, CMCC]
	+ *Discuss*: Case D: RRC\_IDLE/INACTIVE UE first receives SIB-1 and then receives the CFR configuration (Case D) in SIBx. If this UE wants to receive the broadcast service, it is UE’s implementation whether to always keep RF bandwidth same as Case D CFR to receive broadcast service and receive legacy behaviour, e.g., paging in the bandwidth of CORESET#0 or switch between CORESET#0 and Case D CFR according to the search space monitoring occasion.
	And when UE transits into RRC\_CONNECTED state, the SIB-1 configured initial DL BWP is used as first active BWP regardless UE whether sends MBS interest indication or not. There is no BWP switching/service interruption between the RRC state transition because UE can always set the RF bandwidth equals to Case D CFR or timely switch to Case D CFR before the complement of RRC connection establishment or re-establishment or resume.

*Discuss*: Case E: When in RRC\_IDLE/INACTIVE states, the UE behaviour is similar as Case D, which it is UE’s implementation whether to always keep RF bandwidth same as Case E CFR or switch between CORESET#0 and Case E CFR.
But when UE transits into RRC\_CONNECTED mode, UE will either take the SIB-1 configured initial DL BWP as the first active BWP when an active BWP is not configured or the configured new active BWP as first active BWP. In the first method which SIB-1 configured initial DL BWP used as the first active BWP, UE cannot receive the broadcast service considering the SIB1-configured initial DL BWP is smaller than Case E CFR.
In the second method, gNB can configure an active BWP to cover the frequency resources of Case E CFR, but the critical issue is that how gNB knows which UEs receive the broadcast service since the MBS interest indication is an optional feature. In addition, the broadcast service is interrupted during BWP re-configuration. There are two potential ways proposed by companies to relieve this problem, which the first one is all MBS-capable UE taking Case E MBS BWP as the first active BWP (there is additional RAN2 spec impact to define new first active BWP) or UE will not receive broadcast service if not report MBS interest indication (cannot guarantee all UEs’ broadcast reception).
Compared with Case D, Case E has these natural drawbacks and may introduce more spec impact. In addition, as the previous agreement, Case E is an MBS specific BWP, whether can or how to support two BWPs simultaneously by UE have never been widely discussed. Considering these, we don’t support Case E but Case D as the CFR for MCCH/MTCH.

* + Proposal 1. For RRC\_IDLE/RRC\_INACTIVE UEs, Case D can be supported as configured/defined specific CFR for MTCH/MCCH
* In [R1-2111763, Samsung]
	+ *Discuss*: However, considering that RAN1#107-e is the last meeting for Rel-17, in order to complete this WI, supporting only Case D could be done because Case E needs many details related to BWP such as BWP switching and restrictions.
	+ Proposal 1: Support Case D.
* In [R1-2111899, Apple]
	+ Proposal 2: For MBS UE in RRC\_IDLE/RRC\_INACTIVE mode, the Case E is supported for broadcast reception.
* In [R1-2112065, LGE]
	+ Proposal 2: PDCCH/PDSCH for MTCH transmission can be transmitted on a CFR defined based on a configured BW or a CFR with the same size as the initial BWP, depending on MCCH information.
* In [R1-2112130, NTT DOCOMO]
	+ Discuss: The problem is that a UE receiving broadcast in RRC\_IDLE/RRC\_INACTIVE state may not be able to continue receiving the broadcast services after transitioning to RRC\_CONNECTED state since the initial BWP applied after receiving Msg4 cannot include the CFR for broadcast in Case E. However, if gNB indicates a BWP that contains the CFR for broadcast as the first active downlink BWP, the UE will be able to continue receiving broadcast services without interruption. Also, broadcast services do not require high QoS, so interrupted reception may not be a problem. Both cases should be supported in the specification, and it should be up to network to choose which case to use.
	+ Proposal 1: For a CFR for GC-PDCCH/PDSCH for broadcast, support both Case D and E.
* In [R1-2112163, Lenovo]
	+ Observation 1: The motivation to support Case E is not justified.
	+ Observation 2: Those UEs with small bandwidth capabilities can’t be supported in Case E.
	+ Observation 3: Frequent BWP switching happens in Case E.
	+ *Discuss*: RAN2 has already agreed that transmitting MBS interest indication to gNB for Idle/Inactive mode UE is not supported. Furthermore, the Idle/Inactive mode UE can’t transmit MBS interest indication to gNB due to lack of TA. Without such indication, gNB can’t know which Idle/Inactive mode UE is interested in the MBS with larger CFR and will not configure the first active BWP same as the MBS-specific BWP in Case E to the interested Idle/Inactive mode UE.
	+ Observation 4: Idle/Inactive mode UE can’t send MBS interest indication to gNB.
	+ *Discuss*: To support MBS-specific BWP with large CFR in Case E, standards should support Idle/Inactive mode UE to transmit MBS interest indication to gNB and support configuring first active BWP as MBS-specific BWP via SIBx or MCCH for Idle/Inactive mode UE.

In addition, how to configure the CFR with larger size than SIB-1 configured initial DL BWP is unknown and whether different parameters for CFR in Case E are configured for Case A or Case C has not been discussed.

Regarding group-common DCI format design for support of Case E, since CFR is larger than CORESET 0/SIB-1 configured initial DL BWP, solution is needed to determine the FDRA field size in case of Case E so as to align the DCI payload size of the group-common DCI with size of DCI format 1-0 with CRC scrambled by C-RNTI in CSS.

* + Observation 5: Significant standard impact is caused in Case E.
	+ Observation 6: Case E is an optimization on top of Case C.
	+ Proposal 1: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, for CFR configuration for group-common PDCCH/PDSCH, Case E is not supported.
* In [R1-2112241, Qualcomm]
	+ *Discuss*: For RRC\_IDLE/INACTIVE UEs, the CORESET#0 is still the “initial BWP to receive SIB/paging” but the broadcast CFR with bandwidth size of “SIB-indicated initial BWP” larger than CORESET#0 can be regarded as a new BWP, differentiated from the “initial BWP to receive SIB/paging”.
	+ *Discuss*: If network does not configure SIB1-configured initial BWP, we should allow the network to configure a broadcast CFR/BWP larger than CORESET#0 for MBS UEs and it would be pointless to down-select Case C, D or Case E. The unified solution is preferred no matter whether it is Case E or Case C, and no matter whether there is SIB1-configured initial BWP or not. If Case C or Case E is configured, Case D can be implemented by using CORESET for GC-PDCCH and FDRA for GC-PDSCH by implementation. We don’t see the point to support the option of Case D only.
	+ Proposal 1: Support Case E for a CFR-Config-Broadcast.
* In [R1-2112314, MediaTek]
	+ Discuss: If the bandwidth of initial BWP is changed due to introducing the MBS services, it also will affect the legacy UEs’s capability. Therefore, we suggest to discuss the CFR configuration independently.
	+ Proposal 3: CFR can be configured with any size as long as it covers CORESET#0.
* In [R1-2112348, Ericsson]
	+ Observation 1: In NR, all data channels and reference signals used for transmission/reception between the UE and network occur in a DL/UL Bandwidth Part (BWP).
	+ Observation 2: For Case A, this BWP is the CORESERT#0 initial BWP, which is configured for all UEs in RRC IDLE/INACTIVE and does therefore not need to be specifically configured for broadcast.
	+ Observation 3: For Case C, D and E, since the CFR exceeds the CORESET#0 frequency resources, a specific BWP for broadcast needs to be configured.
	+ Proposal 1: For UEs receiving broadcast in RRC IDLE/INACTIVE, the CFR is configured within a BWP.
		- Note1: For Case A this BWP is the CORESET#0 initial BWP (already agreed)
		- Note: Specific naming and configuration of the BWP is up to RAN2.
	+ Proposal 2: For UEs receiving broadcast in RRC IDLE/INACTIVE according to other Cases than Case A, a specific BWP for broadcast, different from CORESET#0 initial BWP, is configured: “BWP-B”.
	+ Proposal 3: The legacy CORESET#0 initial BWP is used to receive System Information and paging and for Random Access also for UEs receiving broadcast in RRC IDLE/INACTIVE.
	+ Observation 4: UEs is RRC IDLE/INACTIVE receiving broadcast will need to receive in parallel legacy type of data, such as System Information, paging and RA signaling in the CORESET#0 initial BWP and broadcast data. For Case C, D and E, the broadcast is received in a specific broadcast BWP, wider than CORESET#0 initial BWP, but containing this.
	+ Observation 5: With Case C, the configured broadcast BWP-B can naturally have identical frequency resources to the SIB1 initial BWP.
	+ Observation 6: With Case D, the configured broadcast BWP-B can naturally have identical frequency resources to the configured CFR.
	+ Observation 7: With Case E, the configured broadcast BWP-B can naturally have identical frequency resources to the configured CFR.
	+ Observation 7: For all cases C, D and E, the configured broadcast BWP-B can naturally have identical frequency resources to the configured CFR
	+ Proposal 4: For all cases, other than Case A, the configured broadcast CFR and BWP-B have identical frequency resources.
	+ *Discuss*: With Case E as a starting point, it supports any CFR/BWP-B size within the carrier, independently of SIB1 initial BWP, Case D adds a constraint in that the CFR/BWP-B is required to be contained within the SIB1 initial BWP frequency resources. Case C adds a further constraint in that the CFR/BWP-B needs to have identical frequency resources to SIB1 initial BWP.

It is not clear what gains there could be of introducing such Case C/D constraints, when the solution could just as well be fully flexible with Case E.

* + Observation 9: When SIB1 does not configure the initial BWP, Case C and D are not applicable. Broadcast would then be limited to Case A, unless Case E is supported.
	+ Proposal 5: Broadcast in a wider CFR/BWP than CORESET#0 initial BWP is supported when SIB1 does not configure the initial BWP.
	+ Specification complexity: Case C allows for a simplification of the configuration of frequency resources for the CFR/BWP-B, in that the SIB1 initial BWP configuration can be reused for both CFR and BWP-B.

For both Case D and E there is a need to separately configure a CFR/BWP-B, which is different from the SIB1 initial BWP. This will require the same type of additional configuration in both cases, which is likely to be a *locationAndBandwidth* parameter in SIBx that will define the frequency resources of the CFR/BWP.

* + Observation 10: There is no significant difference in specification complexity between Case D and Case E.
	+ Observation: There is no significant difference in UE complexity between Case D and Case E.
	+ *Discuss*: In all cases C, D and E, without further information about whether the UE receives broadcast, the gNB would need to decide depending on what it finds most important, but there is no difference between the cases regarding the impact of this.
	+ Observation 11: For UEs supporting broadcast, without additional RRC signaling support, the network cannot know whether a UE entering RRC Connected state is receiving broadcast or not, so cannot make an informed choice on which active BWP is optimum to use. It can either select an optimum active BWP, without broadcast considerations, or it can let the UE keep its current BW to allow for seamless transition of the broadcast service. This issue is however identical for all Cases C, D and E.
	+ Observation 12: There are no significant differences in operational issues between Case D and Case E.
	+ Proposal 6: For UEs in RRC INACTIVE/IDLE, broadcast can be received according to Case E.
		- Note: CFRs according to Case C and D can be supported by Case E.The BWP (”BWP-B”) to receive the broadcast CFR in RRC IDLE/INACTIVE has the same frequency resources as the CFR.
	+ Proposal 7: When the UE state is changed from RRC INACTIVE/IDLE to RRC CONNECTED, the UE formally keeps its BWP-B used to receive Case E broadcast in RRC INACTIVE/IDLE until completion of RRC configuration. After RRC configuration, the UE releases the BWP-B but keeps the CFR, which is inherited by all configured BWPs in RRC CONNECTED, provided the CFR is contained within the respective BWP.
	+ *Discuss*: Note: Only using a CFR (i.e. without a BWP) in RRC INACTIVE/IDLE is not possible since a BWP always needs to be used to receive data, for consistency with legacy NR. Only using a BWP is not possible either since the BWP needs to be released after completion of RRC configuration and UEs in all RRC states need to have something in common to receive the broadcast, which is the CFR. The CFR thus stays the same when a UE moves from RRC INACTIVE/IDLE to RRC CONNECTED, but the BWP changes.
	+ The BWP\_ID numbering used by UEs in RRC INACTIVE/IDLE is independent from the numbering used by RRC CONNECTED UEs. For UEs in RRC INACTIVE/IDLE, CORSESET#0 initial BWP is used by all UEs and BWP-B is used for UEs receiving broadcast with Case C, D or E. For UEs in RRC CONNECTED, the legacy numbering is unaffected.
	+ Proposal 8: When the frequency range and numerology of the BWP to receive broadcast does not change with a change of RRC state, the UE is expected to receive the broadcast data without disruption.

### **FL Assessment**

***On configuration of a BWP for the CFR (including agreed Case A/C)***

In parallel to the discussion on down-selection of Case D/E, it is proposed to focus on critical aspects that may be open even for the already agreed Cases of CFR, i.e., Case A and Case C. The discussion should also consider the other two open cases if possible.

As per the background section, Cases A, C and D are defined as a CFR. However, whether the relationship of these cases within a BWP has not been concluded yet.

The contributions in [Ericsson, Qualcomm] detail, for Cases other than D/E, the relationship of the CFR and a BWP and proposes that the CFR is configured as a BWP. [Intel] also discusses potential implementation of Case E as an BWP, however, in this case as a specific initial BWP only MBS UEs. [Xiaomi] similarly proposes that for Case C, MBS UEs apply as initial BWP the one configured in the SIB-1 configured initial BWP. In previous meetings, some companies also proposed to leave this decision to RAN2. However, this was directly discussed at the last meeting and multiple companies expressed that it should be RAN1 that decides at least basic functionality such as whether it is based on BWP or not.

The common point in all the contributions above in this aspect is that the CFR is configured within a BWP since this is the basic operational mode to receive signals in NR. Therefore, **Proposal 2.6-1** for discussion tries to agree this for all cases other than Case A. The proposal further details that the frequency resources of the CFR and the BWP are identical. The formulation is general to potentially accommodate Case D/E after down-selection. However, this agreement should also cover Case C that has already been agreed.

***Down selection of Case D/E***

This issue was debated at length at the past meetings without reaching a conclusion.

Multiple companies have contributed to this aspect of the discussion. Although some contributions have provided more detailed analysis based on the technical discussion from the last meeting, most companies provide similar arguments to support/not support the different Cases. Compared to the last meeting, most companies have not changed their views on the support Case D/E.

Please see FL summary#5 [R1-2110595] from RAN1#106bis-e for detailed discussions on this issue on down-selection.

* *Support of Cases D/E*
* Support of Case D
	+ [Futurewei, Spreadtrum, Xiaomi, CMCC, Samsung] (5)
* Support of Case E
	+ [TD Tech, vivo, SONY, Intel\*, Apple, LGE, Qualcomm, Ericsson] (8)
		- Intel proposes Case E implemented as a new MBS initial BWP.
* Support of Case D/E
	+ [ZTE, Nokia, CATT, NTT DOCOMO, MediaTek,] (5)
* Not support of Case E
	+ [Spreadtrum, OPPO, Xiaomi, CMCC, Lenovo] (5)
* *Technical issues*

Based on the technical discussion on potential interruption due to UEs frequency range change and service continuity from previous meetings and tdocs to this meeting the following observations are done:

* potential interruption situations where were identified for Case C/D/E when the UE changes the frequency range from RRC idle/inactive to RRC connected. Some examples below:
	+ for Case C this can happen for example when active BWP in RRC connected has a frequency resource larger than the frequency resources of Case C.
	+ For Case D this can happen for example when UE has to change to the frequency resources to the frequency resources of the SIB-1 configured initial BWP (which are larger)
	+ For Case E this can happen for example when active BWP in RRC connected has a frequency resource larger than the frequency resources of Case E
	+ Note: it was also recognised that the potential interruption in all cases may be acceptable for broadcast reception.
* regarding service continuity when UE changes from RRC idle/inactive to RRC connected: situations were identified where service continuity cannot be guaranteed for cases C/D/E.
	+ Since the gNB does not have any knowledge whether UEs are receiving the broadcast service or not, the gNB could configure an active BWP in RRC connected with frequency resources smaller than those of Case C/D/E, causing service loss.
		- For case C/D, in the case that gNB uses default active BWP (i.e., SIB-1 conf initial BWP) service continuity would be maintained but if the gNB configures an active BWP with frequency resources smaller than those of Case C/D service loss would occur.
	+ To solve this potential service loss for all Cases, UE interest notification could be sent from UEs to gNB, however, this is a functionality that is not mandated in the current specifications.
* *Motivation*

Regarding motivation for Case E, there were multiple discussions.

Companies supporting Case E argue that using only Case D (and Case C) has an impact on legacy non-MBS UEs since configuring Case D and Case C both rely on changing the configuration of the SIB-1 configured initial BWP. These companies consider not having an impact on legacy UEs while being able to schedule broadcast services a basic function.

Companies that do not want Case E argue that they do not see the argument above as a limitation. Legacy UEs can use the SIB-1 configured initial BWP, therefore, nothing is broken. Case C already provides sufficient flexibility and therefore Case E is an optimisation, not a basic function and therefore should not be discussed/included.

After multiple exchanges of discussion, not consensus was reached.

* *Specification Impact*

One aspect that has been discussed in less detail is the potential specification impact of standardising case D and Case E and whether there is more/less/same specification impact for both cases. Contribution in [Ericsson] argues that specification impact of case D/E is similar, while [Lenovo] discusses aspects presenting significant more specification impact for Case E.

The proposal from the FL is that we also discuss potential specification impact of both case D/E. If there is a common understanding that the specification impact to introduce Case D and Case E are the same/similar both cases could be considered to be agreed. However, if there is a Case that has significant more impact than the other this would help the group reach a decision to down-select one Case over the other. **Question 2.6-2** will be used to collect companies’ views on this.

### **1st round FL proposals for Issue 6**

#### Proposal 2.6-1

For UEs receiving broadcast in RRC IDLE/INACTIVE, the CFR is configured within a BWP.

* for Case A (already agreed) this BWP is the CORESET#0 initial BWP
* for other Case(s) than Case A, a specific BWP for broadcast, different from CORESET#0 initial BWP, is configured
* the CFR and the specific BWP have identical frequency resources
* Specific naming and configuration of the specific BWP is up to RAN2.

#### Question 2.6-2

Regarding potential specification impact of Case D and E, please provide your views on whether the specification impact of Case D is the same/larger/smaller than the specification impact of case E.

**Please provide your answers in the table below. Considering the FL assessment above:**

1. **Do you support Proposal 2.6-1? If you don’t, please provide additional proposals or modifications to work towards a compromise.**
2. **Please provide your views on Question 2.6-2.**
3. **Please provide your views, if any, on the FL assessment above.**

**FL note: based on the discussion from these questions further proposals will be included for discussion and agreement.**

|  |  |
| --- | --- |
| **company** | **comments** |
|  |  |

## Issue 7: PDSCH repetition/HARQ combining

### **Background**

The following agreements at RAN1#102-e, RAN1#103-e, RAN1#104-e and RAN1#106bis-e for UEs in RRC\_CONNECTED and RRC\_IDLE/INACTIVE states are relevant for the discussion:

|  |
| --- |
| Agreements: For RRC\_CONNECTED UEs, at least support slot-level repetition for group-common PDSCH.* FFS: whether enhancement is needed

Agreements:For slot-level repetition for group-common PDSCH of RRC\_CONNECTED UEs, for indicating the repetition number, further down-select among:* Opt 1: by DCI
* Opt 2: by RRC
* Opt 3: by RRC+DCI
* FFS: Opt 4: by MAC-CE
* FFS: Opt 5: by RRC+MAC-CE
* FFS details for each option.
* FFS further enhancements for configuration of slot-level repetition

Agreement:For slot-level repetition for group-common PDSCH for RRC\_CONNECTED UEs receiving multicast,* (Config A) UE can be optionally configured with *pdsch-AggregationFactor*.
* (Config B) UE can be optionally configured with TDRA table with *repetitionNumber* as part of the TDRA table.
* If UE is configured with Config B, UE does not expect to be configured with Config A for the same group-common PDSCH.

Conclusion:The maximum number of HARQ processes per cell, currently supported for unicast, is kept unchanged for UE to support multicast reception.* How to allocate HARQ processes between unicast and multicast is up to gNB.

Agreement:* If configured, the *pdsch-AggregationFactor* for multicast dynamic scheduling is configured per G-RNTI.
* If configured, the *pdsch-AggregationFactor* for multicast SPS is configured per *SPS-Config-Multicast*.

Agreement:For slot-level repetition for SPS GC-PDSCH for multicast RRC\_CONNECTED UEs.* + Config A or Config B can be configured to UE:
		1. (Config A) UE can be optionally configured with *pdsch-AggregationFactor* per *SPS-Config-Multicast*.
		2. (Config B) UE can be optionally configured with TDRA table with *repetitionNumber* as part of the TDRA table in *PDSCH-Config-Multicast*. If UE is configured with Config B, UE does not expect to be configured with Config A for the same SPS group-common PDSCH.
	+ For Config A, if *pdsch-AggregationFactor* in *SPS-Config-Multicast* is not configured, default value is
		1. Alt1: equal to 1.

Agreement:For broadcast reception with UEs in RRC\_IDLE/INACTIVE states, support slot-level repetition for MTCH. |

### **Tdoc analysis**

* In [R1-2110779, R1-2111917**,** Huawei]
	+ *Discuss*: It was agreed in the last meeting to support slot-level repetition for MTCH for broadcast reception with UEs in RRC\_IDLE/INACTIVE states. However, based on the discussion, it is unclear such configuration should be semi-static as aggregation as supported in Rel-15 or it is part of TDRA set configuration and can be dynamically changed by TDRA indication in DCI as supported in Rel-16. It is an open issue that can be discussed. Considering it is for broadcast scheduling and DCI format 1\_0 with G-RNTI is the only format agreed to be supported, configured as slot aggregation for broadcast seems sufficient.
	+ Proposal 10: Slot-level repetition is configured per G-RNTI as slot aggregation for broadcast.
	+ Proposal 4: *repetitionNumber-Broadcast* is configured per G-RNTI and included in *pdsch-Config-Broadcast* for broadcast.
* In [R1-2110897**,** TD Tech]
	+ Proposal 3: Support slot level repetition for MCCH
* In [R1-2110912, ZTE]
	+ Discuss: The same mechanism as slot aggregation can be reused for broadcast repetition. The only remaining issue is how to configure the repetition number. The repetition number can be configured per G-RNTI via MCCH.
	+ Proposal 4: For broadcast reception with UEs in RRC\_IDLE/INACTIVE states, the repetition number of slot-level repetition for MTCH is configured per G-RNTI via MCCH.
* In [R1-2111137, Nokia]
	+ *Discuss*: Proposal-7: For broadcast reception with UEs in RRC\_IDLE/INACTIVE states, support slot-level repetition for GC-PDCCH/PDSCH carrying MCCH/MTCH.
	+ Proposal-8: Further discussion on whether both Config A and Config B could be supported for broadcast reception, and whether it can be applied for both dynamic and semi-persistent scheduling.
	+ Proposal-9: It is proposed that “when receiving group-common PDSCH scheduled by DCI format 1\_0 in group-common PDCCH with CRC scrambled by G-RNTI or G-CS-CRNTI for broadcast reception, with NDI=1, if the UE is configured with *pdsch-AggregationFactor* in *pdsch-config*, the same symbol allocation is applied across the *pdsch-AggregationFactor* consecutive slots”.
* In [R1-2112065, LGE]
	+ Proposal 6: For slot-level repetition for group-common PDSCH for RRC\_IDLE/INACTIVE UEs receiving broadcast,
		- (Config A) UE can be optionally configured with *pdsch-AggregationFactor*.
		- (Config B) UE can be optionally configured with TDRA table with *repetitionNumber* as part of the TDRA table.
		- If UE is configured with Config B, UE does not expect to be configured with Config A for the same group-common PDSCH.
* In [R1-2112163, Lenovo]
	+ *Discuss*: Regarding slot level repetition, there are two types specified in standard in Rel-15 and Rel-16: Type A and Type B. Since both types have been supported for RRC\_connected UEs, it is straightforward to extend both to RRC IDLE/RRC INACTIVE UEs. To support Type B, RRC configured TDRA table with number of repetitions in one or multiple entries should be supported.
	+ Proposal 16: For RRC\_IDLE/RRC\_INACTIVE UEs, PDSCH repetition Type B is supported for MCCH and MTCH.
* In [R1-2112241, Qualcomm]
	+ Proposal 5: For RRC\_IDLE/INACTIVE UEs,
		- Support slot-level repetition for MCCH, using
			* (Config A) UE can be configured with *pdsch-AggregationFactor*, applied to DCI format 1\_0 with MCCH-RNTI.
		- For slot-level repetition for MTCH, support
			* (Config A) UE can be configured with *pdsch-AggregationFactor* per G-RNTI, applied to DCI format 1\_0 with the G-RNTI.
			* (Config B) UE can be configured with TDRA table with *repetitionNumber* as part of the TDRA table in *PDSCH-Config-Broadcast*
			* If UE is configured with Config B, UE does not expect to be configured with Config A for the same GC-PDSCH.
* In [R1-2112348, Ericsson]
	+ *Discuss*: Obviously, with broadcast the UE would not send any feedback to trigger HARQ retransmissions, so these would need to be scheduled by the network without such feedback. We may call this gNB-triggered HARQ retransmission to contrast with legacy HARQ retransmission, where the UE triggers the retransmission via NACK feedback.
	+ *Discuss*: The main purpose of gNB-triggered HARQ retransmission would be to provide increased time diversity, similar to that provided by time interleaving in some legacy broadcast systems.
	+ *Discuss*: The time diversity offered by slot-level repetition is very limited. With a maximum of 16 slots in a “repetition burst” the total duration would only be 16 ms with SCS 15 kHz and half of this with SCS 30 kHz. With a more realistic repetition over e.g. four slots the duration would be only 4 ms (15 kHz SCS) or 2 ms (30 kHz SCS), which is too small values to provide any significant time diversity gain in most scenarios.
	+ Observation 16: With gNB-triggered HARQ retransmission for broadcast, the time diversity may be very significantly extended, and be significant also for low speeds such as walking speed.
	+ *Discuss*: To increase time diversity, one could alternatively use HARQ retransmission, where the total time duration of a Transport Block (TB), considering all (gNB-triggered) HARQ retransmission may be much longer, which could allow for better time diversity also with low overhead. If the repetitions are e.g. spread over 100 ms, which may be feasible with broadcast applications that are not very sensitive to latency, significant time diversity gain could be gained also at walking speed.

	It appears thus that both the required DCI signaling fields and the UE soft-combining capability will anyway be available for broadcast, so supporting also HARQ combining, based on gNB-triggered HARQ retransmissions, would not require any significant additional complexity, neither specification-wise, nor UE complexity-wise. Since such functionality could also provide significant gains in certain scenarios, we think this functionality should be supported in Rel-17, which can be done with almost no additional specification work.
	+ Proposal 14: Support gNB-triggered (not feedback based) HARQ retransmissions for broadcast
		- Note: UE behavior is the same as with UEs receiving multicast, but with no feedback from the UE. The UE would soft-combine successive HARQ transmissions of the same G-RNTI and HARQ process. The total number of transmissions is pre-determined by the gNB.

### **FL Assessment**

While for the support of slot-level repetition for MTCH, [Huawei, ZTE, Lenovo] propose to use Config B, [Nokia, LGE, Qualcomm] propose/discuss to use both Config A and Config B. [TD Tec, Qualcomm, Nokia] also propose to support slot-level repetition for MCCH, but for this case only semi-static configuration (Config A) would be supported.

Based on this input, **Proposal 2.7-1** is to agree for the support for slot-level repetition for MCCH and Config A, and **Proposal 2.7-2** extends the agreements on RRC connected UEs to RRC idle/inactive UEs for broadcast reception.

In [Ericsson] it is also proposed to support for broadcast reception with idle/inactive UEs the reception of the HARQ retransmissions (initiated by the gNB only and not by direct request from idle/inactive UEs using UL feedback) to significantly increase the time interleaving depth (to hundreds of ms) compared to the time interleaving depth of slot level repetition (of only a few ms). It is discussed that to support such an approach, very limited specification impact should be expected since the required fields in DCI are already included as part of the support of slot-level repetition.

**Question 2.7-3** collects companies’ views on this proposal that could be further extended for agreement based on company comments.

### **1st round FL proposals for Issue 7**

#### Proposal 2.7-1

Proposal 5: For RRC\_IDLE/INACTIVE UEs, support slot-level repetition for MCCH, using:

* (Config A) UE can be configured with *pdsch-AggregationFactor*, applied to DCI format 1\_0 with MCCH-RNTI.

#### Proposal 2.7-2

For RRC\_IDLE/INACTIVE UEs, for slot-level repetition for MTCH, support:

* (Config A) UE can be configured with *pdsch-AggregationFactor* per G-RNTI, applied to DCI format 1\_0 with the G-RNTI.
* (Config B) UE can be configured with TDRA table with *repetitionNumber* as part of the TDRA table in *PDSCH-Config-Broadcast*
* If UE is configured with Config B, UE does not expect to be configured with Config A for the same GC-PDSCH.

#### Question 2.7-3

Provide your views on the support of gNB-triggered (not feedback based) HARQ retransmissions for broadcast

* Note: UE behavior is the same as with UEs receiving multicast, but with no feedback from the UE. The UE would soft-combine successive HARQ transmissions of the same G-RNTI and HARQ process. The total number of transmissions is pre-determined by the gNB.

**Please provide your answers in the table below. Considering the FL assessment above:**

1. **do you agree with the proposals 2.7-1 and 2.7-2? Please provide reasons and views in general.**
2. **Please provide your views on Question 2.7-3.**

|  |  |
| --- | --- |
| **company** | **comments** |
| LG Electronics | Proposal 2.7-1: This proposal seems not needed.MCCH is periodically transmitted anyway like system information. Thus, slot-level repetition for MCCH seems not needed.Proposal 2.7-2: We support this proposal.Question 2.7-3: We support blind HARQ retransmissions for broadcast.We think that blind HARQ retransmissions can be same as HARQ retransmissions with disabling HARQ-ACK for multicast. The total number of transmissions can be pre-determined by the gNB. |

## Issue 8: TRS as QLC source

### **Background**

The following agreement for RRC\_IDLE/RRC\_INACTIVE UEs at RAN1#103-e, RAN2#104-e, RAN1#105-e and RAN1#106-e are relevant for this discussion:

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| --- |
| Agreements:* For RRC\_IDLE/RRC\_INACTIVE Ues, beam sweeping is supported for group-common PDCCH/PDSCH.
	+ FFS: Details for support of beam sweeping for group-common PDCCH/PDSCH.

Agreement:For RRC\_IDLE/RRC\_INACTIVE Ues, for broadcast reception, the UE may assume that group-common PDCCH/PDSCH is QCL’d with SSB.* It is up to UE implementation whether UE monitors monitoring occasions corresponding to all SSB indexes or monitoring occasions corresponding to a subset of all SSB indexes.
* FFS: association rules between SSB indexes and UE monitoring occasions.
* FFS: group-common PDCCH/PDSCH is QCl’d with TRS if configured

Agreement:For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, the same beam can be used for group-common PDCCH and the corresponding scheduled group-common PDSCH for carrying MCCH or MTCH.* UE may assume that DMRS ports of the group-common PDCCH/PDSCH for MCCH is QCL’d with SSB.
* UE may assume that DMRS ports of the group-common PDCCH/PDSCH for MTCH is QCL’d with SSB.
* FFS: group-common PDCCH/PDSCH for MTCH is QCL’d with periodic TRS if configured
 |

The following agreement at RAN#93-e is also relevant for this discussion:

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| Agreement:* The following aspects can be considered to be within the scope of the Rel-17 MBS WID and can be further discussed in the WGs with the aim of minimizing specification impacts:
	+ Configurable scrambling sequence initialization for PDCCH/PDSCH and DMRS sequence generator initialization for PDCCH/PDSCH for broadcast transmission (as supported for RRC\_CONNECTED UE).
	+ Configuring TRS as QCL sources for broadcast transmission (as supported for RRC\_CONNECTED UE).
* Note: For broadcast transmission, the presence of TRS would be optional from a network perspective.
* Note: Any SFN operation is transparent to the UE
 |

### **Tdoc analysis**

* In [R1-2110779, Huawei]
	+ *Discuss:* Depending on the expected SFN operation performance and the SFN area to be implemented, form network perspective, either SSB or TRS is configured as QCL source for broadcast transmission. Hence, the presence of TRS will be optional as agreed in RAN#93-e.
	The UE assumes that the DM-RS ports of PDSCH of a serving cell are quasi co-located with the SS/PBCH block determined in the initial access procedure with respect to qcl-Type set to 'typeA' for Doppler shift, Doppler spread, average delay and delay spread. For intra-DU SFN operation, the delay spread of multiple SFN cells may be quite different, so SSB cannot be associated with for the delay spread.
	As agreed in Rel-17 UE Power Saving Enhancements WI, for a RS resource configured for TRS/CSI-RS occasion(s) for idle/inactive UEs, a quasi co-location type can be determined as ‘typeC’ with an SS/PBCH block and, when applicable, ‘typeD’ with the same SS/PBCH block and the QCL information of TRS/CSI-RS occasion(s) for idle/inactive UEs is indicated as a SSB index in range of 0 to 63. The broadcast deployment will dominate in low frequency range, e.g., 600MHz/700MHz, there is no beam selection problems in FR2. Hence, the UE can obtain cell timing and Doppler shift with “typeC” QCLed with SSB. Owing to the delay spread is not associated with SSB, the UE can have a more precise channel estimation for intra-DU SFN cells from period TRS.
	In Rel-17 UE Power Saving Enhancements WI, configuration for TRS occasion(s) for idle/inactive UEs is based on periodic TRS only. For frequency range 1, the UE may be configured with one or more TRS resource set(s), where each TRS resource set configured by a high layer parameter consists of four periodic NZP CSI-RS resources in two consecutive slots with two periodic NZP CSI-RS resources in each slot. On top of it, the additional specification impact for configuring TRS for broadcast is including such configurations into SIBx/MCCH for MTCH.
	+ Proposal 1: Periodic TRS can be configured as QCL source for MTCH transmission especially for RRC\_IDLE/INACTIVE UE. The configuration is included in SIBx/MCCH.
* In [R1-2111137, Nokia]
	+ Observation-1: Scheme based on SSB with lower modulation scheme could be a better solution in practice from robustness perspective for RRC\_IDLE/INACTIVE UE with broadcast transmission.
	+ Proposal-20: For further discussion and supporting of TRS with higher modulation scheme, it is preferred having performance evaluation and justification from the proponents before the detailed specification work.
	+ Observation-2: Based on the outcome of RAN#93e, there is no update of Rel17 MBS WID, meaning that there is no standardized support specifically for SFN is provided in Rel17 MBS WI. Any SFN operation should be transparent to the UE.
	+ Observation-3: There is ongoing work on support of TRS for RRC\_IDLE/INATIVE UEs in Rel17 UE power saving WI. How to align the two Rel17 Wis need to be carefully considered, so as to parallel duplicated work in Rel17 on supporting of TRS for RRC\_IDLE/INATIVE UEs.
	+ Proposal-21: If there is not enough time for specifying TRS for RRC\_IDLE/INACTIVE UEs in Rel17 MBS, it can be further considered as a candidate in upcoming Rel18 MBS work.
* In [R1-2112065, LGE]
	+ Observation 7: Assuming that low MCS is usually used for broadcast transmission, it is not clear how much we achieve better performance with TRS.
	+ Proposal 7: If TRS is agreed to be supported, RAN1 is requested to agree the following proposals:
		- Proposal 7A: a list of NZP CSI-RS resource sets for TRS can be configured for the same cell group serving one or more G-RNTIs.
		- Proposal 7B: QCL-Info is associated with a NZP CSI-RS resource set for TRS and configured to be Type C QCLed with SSB (i.e. Doppler shift, average delay) via SIBx or MCCH.
		- Proposal 7C: The number of NZP CSI-RS resource sets in the list of NZP CSI-RS resource sets for TRS can be configurable for each cell group, similarly as specified in NZP-CSI-RS-ResourceSetList.
	+ Proposal 8: For broadcast GC-PDCCH, UE assumes that a PDCCH Monitoring Occasion (MO) is associated with one *NZP-CSI-RS-ResourceSet* for TRS which is QCLed with the SSB-index mapped to the MO.
		- UE uses the TRS associated with the MO where GC-DCI scheduling GC-PDSCH is received for determining GC-PDSCH antenna port quasi co-location.
	+ Proposal 9: If a same SSB index can be associated with more than one NZP CSI-RS resource sets for TRS e.g. in *NZP-CSI-RS-ResourceSetPerSSB*,
		- for the [x×N+K]th PDCCH monitoring occasion(s) for MTCH in the scheduling window, the number of PDCCH monitoring occasions in MTCH transmission window is greater than N i.e. the number of actual transmitted SSBs; and
		- the same SSB index can be mapped to multiple MOs of which each is associated with one NZP CSI-RS resource set for TRS e.g. in *NZP-CSI-RS-ResourceSetPerSSB*.
* In [R1-2112241, Qualcomm]
	+ If broadcast is transmitted from SFNed multiple cells, GC-PDCCH/PDSCH should be QCL’d with periodic TRS with the multiple cells. The time delay spread of multi-cell transmission is different from that of serving cell’s SSB. The TRS can be configured in a broadcast CFR with transmission no larger than that of the CFR. The TRS can still be QCL-ed with SSB at least in terms of timing, doppler shift.
	+ Even if the broadcast is transmission from single cell, the GC-PDSCH for MTCH may use high modulation and TRS is beneficial to link budget.
	+ Proposal 7: TRS can be configured in a CFR-Config-Broadcast for RRC\_IDLE/INACTIVE UEs.
		- UE may assume that the GC-PDCCH/PDSCH is QCL’d with periodic TRS if configured for broadcast.
		- The TRS can be QCL-ed with SSB at least in terms of timing, doppler.
* In [R1-2111552, Xiaomi]
	+ Proposal: Introduce group-specific TRS for MBS capable UE in order to improve the accuracy of T/F synchronization.
		- MBS UE receives the group-specific TRS only when it is in Idle/Inactive state.

### **FL Assessment**

[Huawei, Qualcomm, Xiaomi] support the introduction of TRS for broadcast reception with UEs in idle/inactive RRC state. [Huawei, Qualcomm] clarify that TRS would be optional and transparent to the UEs. For intra-DU SFN the combined delay spread of the multi cell transmission would be different to that of a single cell and SSB cannot be associated in terms of delay spread while SSB can be used to obtain cell timing and Doppler shift. They clarify that since the broadcast deployment would dominate in the 600MHz/700MHz frequency range, beam selection problems are not in the scope.

[Nokia] discuss that the WID has not been updated so no standardised support of SFN is provided and highlight that ongoing work on TRS for power saving WI should be considered. They acknowledge that if there is not time in this release, it could be considered for Rel-18.

[LGE] although also prefers to delay the introduction to future releases, provides further proposals for the introduction of TRS. Two sets of proposals are made in [LGE], the first set address definition and configuration of NZP CSI-RS for TRS, secondly, it also proposes additional configurations targeted for beam sweeping operation. Since, the proposal to introduce TRS is targeting lower frequency bands, the first set of proposals will be put forward for discussion.

**Proposal 2.8-1** addresses the potential agreement of introducing TRS for broadcast reception while **Question 2.8-2** discusses aspects proposed on the configuration of NZP CSI-RS.

### **1st round FL proposals for Issue 8**

#### Proposal 2.8-1

TRS can be configured in a CFR-Config-MCCH-MTCH for RRC\_IDLE/INACTIVE UEs.

* UE may assume that the GC-PDCCH/PDSCH is QCL’d with periodic TRS if configured for broadcast.
* The TRS can be QCL-ed with SSB at least in terms of timing, doppler.
* The configuration is included in SIBx/MCCH

#### Question 2.8-2

Provide your views on the following items on configuration of TRS:

* a list of NZP CSI-RS resource sets for TRS can be configured for the same cell group serving one or more G-RNTIs.
* QCL-Info is associated with a NZP CSI-RS resource set for TRS and configured to be Type C QCLed with SSB (i.e. Doppler shift, average delay) via SIBx or MCCH.
* The number of NZP CSI-RS resource sets in the list of NZP CSI-RS resource sets for TRS can be configurable for each cell group, similarly as specified in *NZP-CSI-RS-ResourceSetList*.

**Please provide your answers in the table below. Considering the FL assessment above,**

1. **do you agree with the proposal 2.8-1? Please provide reasons, views in general if you do not agree.**
2. **Please provide your views on Question 2.8-2.**

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| --- | --- |
| **company** | **comments** |
| LG Electronics | Proposal 2.8-1: We prefer to defer TRS to a later release.Question 2.8-2:If TRS is supported, the TRS can be configured as listed in this question. |

## Issue 9: Multiplexing MCCH/MTCH and other PDCCH/PDSCH

### **Background**

As part of the discussion for the Draft CR on TS 38.202 [R1-2112515], companies discussed multiplexing of MCCH/MTCH and other PDCCH/PDSCH for RRC idle/inactive UE states. In the two figures below show the changes made to Table 6.2.1 on Downlink “Reception Types” where D5 and D6 corresponds to MCCH and MTCH, respectively.

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Table 6.2-2 on Downlink “Reception Type” combinations of the Draft CR on TS 38.202 [R1-2112515] shows the comment from the Editor highlighting that more discussion is needed for the scenarios for which D5 and D6 are applicable.

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|  |

### **Tdoc analysis**

* [R1-2112241, Qualcomm]
	+ *Discuss*: For LTE SC-PTM
		- RRC\_IDLE UEs are not required to receive FDMed SC-PTM and PBCH/SIB/Paging in PCell.
	+ For NR broadcast MCCH/MTCH, RAN1 needs to discuss
		- For RRC\_IDLE/INACTIVE UEs, whether the UE is required to support FDMed MCCH/MTCH and PBCH/SIB/Paging in PCell.
	+ In our view, NR broadcast MCCH/MTCH can be treated similar as LTE SC-PTM, but in addition, we need to consider the multicast case for RRC\_CONNECTED UEs.

RRC\_IDLE/INACTIVE UEs are not required to support FDMed MCCH/MTCH and PBCH/SIB/Paging in PCell.

* + Proposal 8: For NR broadcast MCCH/MTCH
		- RRC\_IDLE/INACTIVE UEs are not required to support FDMed MCCH/MTCH and PBCH/SIB/Paging in PCell.
		- RRC\_CONNECTED UEs,
			* Shall be able to support FDMed one PDSCH (for MCCH/MTCH, multicast, or unicast) and PBCH/SIB in a DL CC.
			* Whether to support FDMed one PDSCH (for MCCH/MTCH) and one PDSCH for unicast in a DL CC is subject to UE capability
			* Whether to support FDMed one PDSCH (for MCCH/MTCH), one PDSCH for multicast and unicast in a DL CC is subject to UE capability.

### **FL Assessment**

Only the contribution in [Qualcomm] address the issue of multiplexing MCCH/MTCH and other PDCCH/PDSCH. However, given the discussions with the CRs to TS 38.202 this issue is included for discussion in this meeting. [Qualcomm] presents that for LTE SC-PTM, RRC idle UEs are not required to receive FDMed SC-PTM and PBCH/SIB/Paging in PCell and consider that this “Reception Type” combination should be applied to NR broadcast. They also discuss the case for RRC connected UEs, but in this AI we initially would only need to focus on RRC idle/inactive UEs.

**Question 2.9-1** is put forward to collect company views. Based on rounds of discussion a further proposal for agreement could be included.

### **1st round FL proposals for Issue 9**

#### Question 2.9-1

Are RRC\_IDLE/INACTIVE UEs required to support FDMed MCCH/MTCH and PBCH/SIB/Paging in PCell?

**Considering the FL assessment above, please provide your views on Question 2.9-1 in the table below.**

|  |  |
| --- | --- |
| **company** | **comments** |
|  |  |

## Other Issues proposed for lower priority

The proposal for the Issues below is that are considered with lower priority to focus on the other issues above in this summary. If companies think that any of the issues below address a critical functionality that is missing for this AI, please provide also these comments to the table below to evaluate the situation based on comments.

### **Other Issue 1: Number of CFRs for MTCH**

This issue has been discussed at past meetings without reaching a conclusion. Although some companies did support specifying more than one CFR for MTCH, multiple companies did not support it. The motivation to introduce multiple CFRs for MTCH is to provide higher flexibility to the network to deploy services with different requirements. To this meeting contributions from [ZTE, vivo, Nokia] supported more than one CFR for MTCH, while [OPPO, Intel, Xiaomi, CMCC, NTT DOCMO, Lenovo, MediaTek, Ericsson] explicitly mentioned that only supported one CFR for MTCH.

The FL initial proposal is not to discuss further this Issue for this meeting.

### **Other Issue 2: PDSCH: Semi Persistent Scheduling**

This issue has been discussed at multiple meetings including the last one. There are companies that want to introduce SPS for broadcast reception with idle/inactive UEs with the motivation to reduce PDCCH overhead for services that have periodic transmissions. However, there were companies that had concerns with the complexity of such functionality at such at such late stage of the release, or concerns were raised on SPS without activation/deactivation mechanisms.

Contributions to this meeting from [ZTE, vivo, Nokia, Xiaomi, NTT DOCOMO, LGE, Ericsson] propose to support/discuss SPS for broadcast reception in idle/inactive UEs. On the other hand, [OPPO, Apple] propose to not to support or to consider for next releases.

The FL initial proposal is not to discuss further this Issue for this meeting.

### **Other Issue 3: PDCCH: CORESET for MCCH and MTCH**

There have been multiple agreements on the configuration of CORESET in past meetings. Based on the agreements so far, FL understands that the basic functionality is in place. Please comment in the table below if this understanding is not correct.

Aspects that were proposed at the last meeting were the possibility to configure separately different CORESET for MCCH and MTCH to provide higher flexibility on the configuration of services. However, there was no conclusion on the discussion.

Contributions to this meeting discussing configuration of CORESET are [Huawei, TD Tech, Nokia, OPPO, Xiaomi, Lenovo, Ericsson]. While [Huawei, Nokia] discusses different configuration for MCCH and MTCH, [OPPO, Xiaomi, Lenovo] propose to use the same coreset for both channels.

A note is that Issue 4 in this summary is discussing separate PDCCH/PDSCH-Configs for MCCH and MTCH.

The FL initial proposal is not to discuss further this Issue for this meeting.

### **Other Issue 4: HARQ feedback for RRC\_IDLE/RRC\_INACTIVE UE states**

This issue has been discussed at previous meetings but not the last one. Most companies did not support introducing such a functionality for idle/inactive UEs. To this meeting contributions form [vivo, Xiaomi, Samsung, Lenovo] propose that HARQ feedback is not supported, while [OPPO] proposes to support.

The FL’s proposal is not to discuss further this Issue for this meeting.

### **Other Issue 5: Broadcast services supported for both RRC\_CONNECTED and RRC\_IDLE/RRC\_INACTIVE UEs**

This aspect was discussed at initial meetings of this release but has not been discussed at the last meetings. Inputs to this meeting [CATT, Intel, MediaTek, Ericsson] discuss aspects on this issue. However, most of the discussions and proposals are to clarify that network implementation makes sure that UEs in RRC connected state use a BWP that contains the CFR.

The FL’s proposal is not to discuss further this Issue for this meeting.

### **Other Issue 6: Discontinuous Reception (DRX) and Wakeup Signals (WUS)**

This issue has only been discussed at [CATT].

The FL’s proposal is not to discuss this Issue for this meeting.

### **Other Issue 6: UE feedback for MBS Interest Indication for partial beam sweeping or MCS determination**

This issue has been discussed at [Nokia, Sony].

The FL’s proposal is not to discuss this Issue for this meeting.

**Provide your comments/vies if any in the following table.**

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| --- | --- |
| **company** | **comments** |
|  |  |

# Proposals for Discussion at GTW sessions

This section will include proposals for potential discussion at the different GTW scheduled for NR MBS at RAN1#107-e.

## GTW on 11 Nov

#### Proposal 2.2-1

Confirm the working assumption made at RAN1#106bis-e:

Working assumption:

Alt 2 (from previous agreement) is supported for broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs for the notification of MCCH configuration changes.

* Send an LS to RAN2 with the mechanism agreed in RAN1

#### Proposal 2.1-1

For GC-PDSCH scheduled with DCI format 1\_0 for broadcast reception, the size of the FDRA field depends on the size of the CFR.

#### Proposal 2.1-2

For GC-PDSCH scheduled with DCI format 1\_0 for broadcast reception, RB numbering starts from the lowest RB of the CFR.

#### Proposal 2.1-3

For GC-PDSCH scheduled with DCI format 1\_0 for broadcast reception, the resource allocation granularity is single RB.

# Stable Proposals

# Summary of Agreements

This section includes the agreements for RAN1#107-e.

# References

1. RP-201038 Revised Work Item on NR Multicast and Broadcast Services, Huawei, HiSilicon

**Relevant tdoc from RAN#93-e**

1. RP-212559 Moderator's summary for email discussion [93e-19-MBS-WI] 3GPP RAN1 WG Vice-Chair

**Relevant tdoc from AI 5**

1. R1-2112311 Discussion on RAN2 LS on broadcast session delivery about MCCH design MediaTek Inc.

**Relevant tdocs from AI 8.12.3**

1. R1-2110779 Discussion on UE receiving broadcast in RRC IDLE/INACTIVE state Huawei, HiSilicon, CBN
2. R1-2110891 MBS Support for RRC IDLE/INACTIVE UEs FUTUREWEI
3. R1-2110897 Discussion on basic functions for broadcast mode TD Tech, Chengdu TD Tech
4. R1-2110912 Discussion on basic Functions for Broadcast or Multicast for RRC\_IDLE or RRC\_INACTIVE UEs ZTE
5. R1-2111041 Remaining issues on basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE Ues vivo
6. R1-2111115 Basic Functions for Broadcast or Multicast for RRC\_IDLE or RRC\_INACTIVE UEs Spreadtrum Communications
7. R1-2111137 Basic Functions for Broadcast / Multicast for RRC\_IDLE / RRC\_INACTIVE Ues Nokia, Nokia Shanghai Bell
8. R1-2111232 Discussion on basic functions for broadcast multicast for RRC\_IDLE RRC\_INACTIVE UEs CATT
9. R1-2111305 Discussion on basic functions for RRC\_IDLE/RRC\_INACTIVE UEs OPPO
10. R1-2111408 Considerations on MBS functions for RRC\_IDLE/INACTIVE UEs Sony
11. R1-2111518 NR-MBS for RRC\_IDLE/INACTIVE UEs Intel Corporation
12. R1-2111551 Discussion on basic functions for broadcastmulticast for RRC\_IDLERRC\_INACTIVE UEs Xiaomi
13. R1-2111629 Discussion on NR MBS in RRC\_IDLE/ RRC\_INACTIVE states CMCC
14. R1-2111763 On basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs Samsung
15. R1-2111899 Discussion on MBS for RRC\_IDLE and RRC\_INACTIVE UEs Apple
16. R1-2112065 Basic function for broadcast/multicast LG Electronics
17. R1-2112082 Discussion on basic functions for broadcast or multicast for RRC\_IDLE and RRC\_INACTIVE UEs ASUSTeK
18. R1-2112130 Discussion on basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs NTT DOCOMO, INC.
19. R1-2112163 Basic functions for broadcast/multicast in idle/inactive states Lenovo, Motorola Mobility
20. R1-2112241 Views on group scheduling for Broadcast RRC\_IDLE/INACTIVE UEs Qualcomm Incorporated
21. R1-2112314 Discussion on MBS for RRC\_IDLE and INACTIVE UEs MediaTek Inc.
22. R1-2112348 Support for NR multicast reception in RRC Inactive/Idle Ericsson

**Relevant tdocs from AI 8.12.4**

1. R1-2111552 Discussion on remaining issues for idle and inactive UE Xiaomi
2. R1-2111917 Discussion on RRC parameters for NR MBS Huawei, HiSilicon, CBN

# Annex A: Agreements in previous RAN1 meetings

## RAN1#103-e agreements

Agreements: For RRC\_IDLE/RRC\_INACTIVE UEs, support group-common PDCCH with CRC scrambled by a common RNTI to schedule a group-common PDSCH, where the scrambling of the group-common PDSCH is based on the same common RNTI.

* FFS details

Agreements:

* For RRC\_IDLE/RRC\_INACTIVE Ues, beam sweeping is supported for group-common PDCCH/PDSCH.
	+ FFS: Details for support of beam sweeping for group-common PDCCH/PDSCH.

Agreements: For RRC\_IDLE/RRC\_INACTIVE UEs, define/configure common frequency resource(s) for group-common PDCCH/PDSCH.

* the UE may assume the initial BWP as the default common frequency resource for group-common PDCCH/PDSCH, if a specific common frequency resource is not configured.
* FFS: the relation of the common frequency resource(s) (if configured) and initial BWP.
* FFS: whether to configure one/more common frequency resources
* FFS: configuration and definition details of the common frequency resource

Agreements: From physical layer perspective, for broadcast reception, the same group-common PDCCH and the corresponding scheduled group-common PDSCH can be received by both RRC\_IDLE/RRC\_INACTIVE UEs and RRC\_CONNECTED UEs.

* FFS details.

Agreements: For RRC\_IDLE/RRC\_INACTIVE UEs, CSS is supported for group-common PDCCH.

* FFS: reuse current CSS type, define a new CSS type, etc.
* FFS other details.

Agreements: For RRC\_IDLE/RRC\_INACTIVE UEs, a CORESET can be configured within the common frequency resource for group-common PDCCH/PDSCH. CORESET0 is used by default if the common frequency resource for group-common PDCCH/PDSCH is the initial BWP and the CORESET is not configured.

* FFS: configuration details of the CORESET for group-common PDCCH/PDSCH

## RAN1#104-e agreements

Agreement:

For RRC\_IDLE/RRC\_INACTIVE UEs, one common frequency resource for group-common PDCCH/PDSCH can be defined/configured.

* FFS: whether to define/configure more than one common frequency resources

Agreement:

For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, the UE may assume that group-common PDCCH/PDSCH is QCL’d with SSB.

* It is up to UE implementation whether UE monitors monitoring occasions corresponding to all SSB indexes or monitoring occasions corresponding to a subset of all SSB indexes.
* FFS: association rules between SSB indexes and UE monitoring occasions.
* FFS: group-common PDCCH/PDSCH is QCl’d with TRS if configured

Agreement:

For broadcast reception, the same group-common PDCCH and the corresponding scheduled group-common PDSCH can be received by both RRC\_IDLE/RRC\_INACTIVE UEs and RRC\_CONNECTED UEs when UE-specific active BWP of RRC\_CONNECTED UE contains the common frequency resource of RRC\_IDLE/INACTIVE UEs and the SCS and CP are the same.

* FFS: the case when UE-specific active BWP of RRC\_CONNECTED UE does not contain the common frequency resource of RRC\_IDLE/INACTIVE UEs.

Agreement:

For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, further study the following cases of a configured/defined specific common frequency resource (CFR) for group-common PDCCH/PDSCH, and identify which case(s) will be supported:

* [Case E] the case where a CFR is defined based on a configured BWP.
	+ In particular, study the following:
		- whether a configured BWP for MBS is needed or not.
		- whether BWP switching is needed or not.
	+ In this study, the configured BWP has the following properties:
		- The configured BWP is different than the initial BWP where the frequency resources of this initial BWP are configured smaller than the full carrier bandwidth.
		- The CFR has the frequency resources identical to the configured BWP.
		- The configured BWP needs to fully contain the initial BWP in frequency domain and has the same SCS and CP as the initial BWP.
	+ Note: The configured BWP is not larger than the carrier bandwidth
* the case where the initial BWP fully contains the CFR in the frequency domain.
	+ In this study the following sub-cases are considered:
		- [Case B] A CFR with smaller size than the initial BWP, where the initial BWP has the same frequency resources as CORESET0. In this case the CFR has the frequency resources confined within the initial BWP and have the same SCS and CP as the initial BWP.
		- [Case D] A CFR with smaller size than the initial BWP, where the initial BWP has the frequency resources configured by SIB1. In this case the CFR has the frequency resources confined within the initial BWP and have the same SCS and CP as the initial BWP.
	+ In particular, study the following:
		- Whether the considered two options with a CFR with smaller size than the initial BWP are needed or not for MBS.
* the case where the initial BWP has same size as the CFR in the frequency domain.
	+ In this study the following two sub-cases are considered:
		- [Case A] A CFR with the same size as the initial BWP, where the initial BWP has the same frequency resources as CORESET0. In this case the CFR has the same frequency resources and same SCS and CP as the initial BWP.
		- [Case C] A CFR with same size as the initial BWP, where the initial BWP has the frequency resources configured by SIB1. In this case the CFR has the same frequency resources and same SCS and CP as the initial BWP.
	+ In particular, study the following:
		- Whether the considered two options with a CFR with the same size as the initial BWP are needed or not for MBS.

## RAN1#105-e agreements

Agreement:

For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, both searchSpace#0 and common search space other than searchSpace#0 can be configured for GC-PDCCH scheduling MCCH.

Agreement:

For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, DCI format 1\_0 is used as baseline for GC-PDCCH of MCCH and MTCH.

* FFS details of FDRA.

Agreement:

For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, RAN1 confirms the following assumptions made by RAN2

* RAN2 assumes, in case searchSpace#0 is configured for MCCH (if allowed, pending RAN1 decision), the mapping between PDCCH occasions and SSBs is the same as for SIB1.
* RAN2 assumes that if common search space other than searchSpace#0 is configured for MCCH (if allowed, pending RAN1 decision), the PDCCH monitoring occasions for MCCH message which are not overlapping with UL symbols are sequentially numbered from one in the MCCH transmission window and mapped to SSBs using the similar rule as defined for OSI in TS 38.331.

Agreement:

For broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs support the same CSS type for MCCH and MTCH.

* FFS support of different CSS types for MCCH and MTCH channels for broadcast reception.

Agreement:

For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, study the following alternatives for MCCH change notification indication due to session start:

* Alt 1: Define a dedicated RNTI to scramble the CRC of a DCI indicating a MCCH change notification;
* Alt 2: Use of a field in a DCI format scheduling a MCCH without a dedicated RNTI for MCCH change notification;

Other solutions are not precluded and it is also not precluded whether to support both Alt1 and Alt2.

Conclusion:

It is up to RAN2 to decide the specific contents of the MCCH change notification, e.g, whether notification only informs about session start, whether or not notification also informs about session modification/stop or whether or not the notification informs about any other information.

Agreement:

For broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs can use a configured/defined CFR with the same size as the initial BWP, where the initial BWP has the same frequency resources as CORESET0 (i.e., Case A), to receive GC-PDCCH/PDSCH carrying MCCH.

* Note: GC-PDCCH/PDSCH transmission within a narrower portion of the Initial BWP (where the initial BWP has the same frequency resources as CORESET0) is possible by implementation via appropriate scheduling.

Agreement:

For broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs can use a configured/defined CFR with the same size as the initial BWP, where the initial BWP has the same frequency resources as CORESET0 (i.e., Case A), to receive GC-PDCCH/PDSCH carrying MTCH.

* Note: GC-PDCCH/PDSCH transmission within a narrower portion of the Initial BWP (where the initial BWP has the same frequency resources as CORESET0) is possible by implementation via appropriate scheduling.

Agreement:

For RRC\_IDLE/RRC\_INACTIVE UEs, the CORESET index can be the same for GC-PDCCH of MCCH and MTCH.

Agreement:

For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, the same beam can be used for group-common PDCCH and the corresponding scheduled group-common PDSCH for carrying MCCH or MTCH.

* UE may assume that DMRS ports of the group-common PDCCH/PDSCH for MCCH is QCL’d with SSB.
* UE may assume that DMRS ports of the group-common PDCCH/PDSCH for MTCH is QCL’d with SSB.
* FFS: group-common PDCCH/PDSCH for MTCH is QCL’d with periodic TRS if configured

Agreement:

For Rel-17, for broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs do not exceed the maximum number of CORESETs mandatorily (in the minimum capability) supported for Rel-15/Rel-16 UEs, i.e., 2 CORESETs.

* If the CFR has the same frequency range as the initial BWP, where the initial BWP has the same frequency resources as CORESET0 or where the initial BWP has the frequency resources configured by SIB1, RRC\_IDLE/RRC\_INACTIVE UEs can be configured with the following options:
	+ CORESET#0 (default option if CFR is the initial BWP and CORESET is not configured); or
	+ CORESET configured by *commonControlResourceSet;* or
	+ CORESET#0 and CORESET configured by *commonControlResourceSet*.

## RAN1#106-e agreements

Agreement:

From RAN1 perspective, the CFR for broadcast reception of RRC\_IDLE/INACTIVE UEs, includes at least the following configurations:

* One set of parameters configured for PDSCH for broadcast reception with GC-PDSCH
* One set of parameters configured for PDCCH for broadcast reception with GC-PDCCH
* FFS: whether some parameters configured for PDSCH/PDCCH are optional/needed for the supported cases of CFR.
* FFS: If necessary, depending on the cases supported, starting PRB and the number of PRBs
	+ The reference for starting PRB is Point A. (Following the same approach to determine reference for starting PRB as that defined in AI8.12.1.)

Conclusion:

There is no specification support in Rel-17 for broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs with configured/defined CFRs for group-common PDCCH/PDSCH with smaller size than the initial BWP, where the initial BWP has the same frequency resources as CORESET0 (i.e., Case B).

Agreement:

For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, if searchSpace#0 is configured for MTCH, the mapping between PDCCH occasions and SSBs is the same as for SIB1.

Agreement:

Study and reach an agreement by RAN1#106b-e on whether Alt1 and Alt2 for MCCH change notification indication can accommodate at least 2 bits for the notification of MCCH configuration changes due to a session start and the notification of MCCH configuration changes of an ongoing session (including session stop).

Agreement:

The DCI format for GC-PDCCH scheduling a GC-PDSCH carrying MCCH/MTCH at least includes the following fields for broadcast reception with UEs in RRC\_IDLE/INACTIVE state:

* FDRA field
* TDRA field
* Modulation and coding scheme
* Redundancy version
* FFS:
	+ MCCH change notification (if supported and only for MCCH),
	+ RB numbering starts from the lowest RB of the CFR and support of resource allocation with granularity of single or multiple RBs.
	+ HARQ process number and New data indicator
	+ VRB-to-PRB mapping
	+ other fields if needed.

Agreement:

Only one CFR can be configured for group-common PDCCH/PDSCH carrying MCCH for broadcast reception with UEs in RRC\_IDLE/INACTIVE state.

Agreement:

For broadcast reception with UEs in RRC\_IDLE/INACTIVE state, the DCI size of GC-PDCCH scheduling a GC-PDSCH carrying MCCH/MTCH is aligned with DCI format 1\_0 with CRC scrambled by C-RNTI in the CSS.

Agreement:

For broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs can use the same bandwidth configurations for the CFR of GC-PDCCH/PDSCH carrying MCCH and the CFR of GC-PDCCH/PDSCH carrying MTCH.

* FFS: use of different bandwidth configurations for the CFR of GC-PDCCH/PDSCH carrying MCCH and the CFR of GC-PDCCH/PDSCH carrying MTCH

Conclusion:

For broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs, there is no specification support in Rel-17 of different CSS types for GC-PDCCH scheduling MCCH and MTCH.

Agreement:

Study whether the Type-x CSS supported for multicast in RRC\_CONNECTED can be reused as baseline for broadcast in RRC\_IDLE/RRC\_INACTIVE for GC-PDCCH scheduling MCCH and MTCH.

Agreement:

For RRC\_IDLE/RRC\_INACTIVE UEs with broadcast reception, if common search space other than searchSpace#0 is configured for MTCH, the mapping of PDCCH monitoring occasions to SSBs can be configured with a rule.

* The existing rule defined for OSI in TS 38.331 is used as starting point to define the above rule.

## RAN#93-e agreements

Agreement:

* The following aspects can be considered to be within the scope of the Rel-17 MBS WID and can be further discussed in the WGs with the aim of minimizing specification impacts:
	+ Configurable scrambling sequence initialization for PDCCH/PDSCH and DMRS sequence generator initialization for PDCCH/PDSCH for broadcast transmission (as supported for RRC\_CONNECTED UE).
	+ Configuring TRS as QCL sources for broadcast transmission (as supported for RRC\_CONNECTED UE).
* Note: For broadcast transmission, the presence of TRS would be optional from a network perspective.
* Note: Any SFN operation is transparent to the UE

Agreement (Updated proposal from RAN1#106e):

For a configured/defined CFR for GC-PDCCH/PDSCH carrying MCCH and MTCH for broadcast reception with UEs in RRC IDLE/INACTIVE state.

* Support Case-C
* Support at least one of Case D and Case E.
	+ Down-selection to be made at RAN1#106b-e
* Note: Case C, D and E are defined in previous agreements

## RAN1#106bis-e agreements

Agreement:

For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, both searchSpace#0 and common search space other than searchSpace#0 can be configured for GC-PDCCH scheduling MTCH.

Agreement:

The PDCCH/PDSCH parameters for broadcast reception with GC-PDCCH/PDSCH, which are not configured, use as default the value of the PDCCH/PDSCH parameters for the configuration of the Rel-15/Rel-16 initial BWP for RRC\_IDLE/RRC\_INACTIVE UEs.

Agreement:

For initializing scrambling sequence generator for GC-PDCCH for MCCH/MTCH for broadcast,

* $n\_{ID}$ equals the higher layer parameter *pdcch-DMRS-ScramblingID* if it is configured in a CFR used for the GC-PDCCH for MCCH/MTCH;$n\_{ID}=N\_{ID}^{cell}$ otherwise.
* $n\_{RNTI}=0$.

Agreement:

For broadcast reception with UEs in RRC\_IDLE/INACTIVE states, support slot-level repetition for MTCH.

Agreement:

For initializing scrambling sequence generator for GC-PDSCH for MCCH/MTCH for broadcast,

* $n\_{ID}$ equals the higher layer parameter *dataScramblingIdentityPDSCH* if it is configured in a CFR used for GC-PDSCH for MCCH/MTCH and the RNTI equals the G-RNTI or MCCH-RNTI;$n\_{ID}=N\_{ID}^{cell}$ otherwise.
* $n\_{RNTI}$ corresponds to the RNTI associated with the GC-PDSCH transmission.

Agreement:

For initializing sequence generator for DMRS of GC-PDCCH for MCCH/MTCH for broadcast,

* $N\_{ID}$ equals the higher layer parameter *pdcch-DMRS-ScramblingID* if it is configured in a CFR used for the GC-PDCCH for MCCH/MTCH; $N\_{ID}=N\_{ID}^{cell}$ otherwise.

Agreement:

For initializing sequence generator for DMRS of GC-PDSCH for MCCH/MTCH for broadcast,

* $N\_{ID}^{0} $equals the higher-layer parameters *scramblingID0* if it is configured in the *DMRS-DownlinkConfig*IE in a CFR used for GC-PDSCH for MCCH/MTCH; $N\_{ID}^{\overbar{n}\_{SCID}^{\overbar{λ}}}=N\_{ID}^{cell} $ otherwise.

Working assumption:

Alt 2 (from previous agreement) is supported for broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs for the notification of MCCH configuration changes.

* Send an LS to RAN2 with the mechanism agreed in RAN1

Agreement:

For RRC\_IDLE/RRC\_INACTIVE UEs for broadcast reception, MTCH scheduling is associated with a window defined by the MTCH monitoring periodicity and the starting of the periodicity

* FFS: the window is associated to one or multiple or all G-RNTI.

Agreement:

For RRC\_IDLE/RRC\_INACTIVE UEs for broadcast reception, at least support that within the MTCH scheduling window, the association between the PDCCH monitoring occasions and SSB is defined as:

* the [*x*×*N*+*K*]th PDCCH monitoring occasion(s) for MTCH in the scheduling window corresponds to the *K*th transmitted SSB, where *x* = 0, 1, ...*X*-1, *K* = 1, 2, …*N*, *N* is the number of actual transmitted SSBs determined according to *ssb-PositionsInBurst* in SIB1 and *X* is equal to CEIL(*number of PDCCH monitoring occasions in MTCH transmission window*/*N*).
* For the purpose of associating PDCCH monitoring occasion for MTCH and SSB,the UE assumes that, in the MTCH scheduling window, PDCCH for an MTCH scrambled by G-RNTI is transmitted in at least one PDCCH monitoring occasion corresponding to each transmitted SSB.

# Annex B: [R1-2104165] RAN2 LS on broadcast session delivery and MCCH design

R1-2104165 submitted to RAN1#105-e reproduced here for convenience:

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| **3GPP TSG RAN WG1 #105-e R1-2104165****e-Meeting, May 10th – 27th, 2021****3GPP TSG-RAN WG2 Meeting #113bis-e R2-2104639****E-meeting, 12th – 20th April 2021****Title: LS on broadcast session delivery and MCCH design****Response to:** **Release: Release 17****Work Item: NR\_MBS-Core****Source: RAN2****To: RAN1****Contact person: Dawid Koziol** **dawid.koziol@huawei.com****Send any reply LS to: 3GPP Liaisons Coordinator,** **mailto:3GPPLiaison@etsi.org****Attachments:** **N/A**1 Overall descriptionRAN2 discussed the details of broadcast session delivery and the following agreements were made during RAN2#113-e meeting:

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| --- |
| * **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).**
 |

For RAN1 to better understand the above agreements, RAN2 would like to clarify that RAN2 is working on two MBS delivery modes (DM1 and DM2), summarized as follows:* DM1 is used for multicast session delivery and is applicable to UEs in RRC Connected state (FFS UEs in RRC Inactive, but this scenario is down-prioritized). The UE is provided with MBS configuration e.g. G-RNTI using dedicated RRC signalling when the UE is in RRC Connected state. DM1 can use both Point-to-Point and Point-to-Multipoint transmissions and can take advantage of UL UE feedback (e.g. HARQ) when the UE is in RRC Connected.
* DM2 is used for broadcast session (FFS for multicast session for UEs in RRC Inactive, but this scenario is down-prioritized) delivery and is applicable to UEs in all RRC states. The UE is provided with MBS configuration using common RRC signalling in a two-step based approach, i.e. SIB will be used to provide the transmission configuration of MCCH. Based on the MCCH configuration received via SIB, UE reads MCCH, which carries transmission configuration of MTCH(s), e.g. G-RNTI. The MTCH configuration acquired from MCCH is applied by the UE for MTCH reception regardless of UE’s RRC state (for RRC\_CONNECTED state, the possibility to receive MTCH can be further subject to UE’s configuration and capabilities).

It was also agreed that RAN2 will prioritize multicast session reception in RRC Connected mode in Rel-17. If time permits multicast support for RRC Inactive can be considered later, once connected mode Multicast solution and Broadcast solution become more mature.Furthermore, RAN2 defines two types of logical channels used at least for broadcast session delivery using DM2:* MTCH: A point-to-multipoint downlink channel for transmitting traffic data from the network to the UE.
* MCCH: A point-to-multipoint downlink channel used for transmitting MBS control information from the network to the UE, for one or several MTCH(s).
	+ In RAN2, some companies think it should be allowed to configure multiple MCCH(s) for different services, but other companies disagree with the need for multiple MCCH and RAN2 has not made a decision on this issue yet.

During RAN2#113bis-e meeting, RAN2 discussed further aspects of MCCH scheduling and MCCH change notification leading to the following agreements with RAN1 impacts:

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

The agreements made by RAN2 require further discussions in RAN1. In particular, RAN2 would like to request RAN1 to investigate and provide feedback on the following aspects, considering the above agreements made by RAN2:1. Details of Common Search Space design for MCCH channel, e.g. is SS#0 allowed to be configured as a search space for MCCH, is search space other than SS#0 allowed to be configured as a search space for MCCH.
2. Details of the allowed transmission bandwidth/BWP configurations for MCCH transmission.
3. Details of the RNTI and DCI design for carrying MCCH change notifications.
	* NOTE: RAN2 is still discussing some aspects that may have an impact on this issue, e.g. whether or not to support multiple MCCH or whether or not a notification about the modification/stop of an ongoing session is needed, as indicated above. RAN2 will update RAN1 as soon as further agreements are made on these items.

2 Actions**To RAN1 group:****ACTION:** RAN2 respectfully asks RAN1 to take RAN2 agreements into account in their work on MBS and discuss RAN1 aspects of MCCH as requested above.3 Dates of next RAN2 meetingsTSG-RAN2 Meeting #114-e May 19 – May 27, 2021 E-Meeting |
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# Annex C: [R1-2106410] RAN2 LS on update for MCCH design

R1-2106410 submitted to RAN1#106-e reproduced here for convenience.

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| **3GPP TSG RAN WG1 #106-e R1-2106410****e-Meeting, August 16th – 27th, 2021****3GPP TSG-RAN WG2 Meeting #114-e R2-2106544****E-meeting, 19th – 27th May 2021****Title: LS on update for MCCH design****Response to:** **Release: Release 17****Work Item: NR\_MBS-Core****Source: RAN2****To: RAN1****Contact person: Dawid Koziol** **dawid.koziol@huawei.com****Send any reply LS to: 3GPP Liaisons Coordinator,** **mailto:3GPPLiaison@etsi.org****Attachments:** **N/A**1 Overall descriptionRAN2 discussed further the aspects related to MCCH design and made the following agreements during RAN2#114 meeting:

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| * MBS specific SIB is defined to carry MCCH configuration.
* MCCH contents should include information about broadcast sessions such as G-RNTI, MBS session ID as well as scheduling information for MTCH (e.g. search space, DRX). L1 parameters that need to be included in MCCH are pending further RAN1 progress and input.
* Postpone the discussion on whether dedicated MCCH configuration is required until RAN1 makes progress on BWP/CFR for MCCH.
* Indication of an MCCH change due to modification of an ongoing session’s configuration (including session stop) is provided with an explicit notification from the network (provided that RAN1 confirms a separate bit for this purpose can be accommodated in the MCCH change notification DCI, in addition to a bit for session start notification). FFS on whether this notification can be reused for modification of other information carried by MCCH, if any.
* FFS whether the possibility of UE missing an MCCH change notification needs to be addressed or can be left to UE implementation.
* At least in case RAN1 decides to utilize RNTI other than MCCH-RNTI for MCCH change notification, MCCH change notification is sent in the first MCCH monitoring occasion of each MCCH repetition period.
* We support single MCCH (in this release)
* MCCH is mapped to the DL-SCH for NR MBS delivery mode 2.
 |

RAN2 would like RAN1 to take these agreements into account when discussing PHY layer aspects of MCCH design (in particular for RNTI and DCI design for carrying the MCCH change notifications), in addition to the agreements RAN2 informed earlier in R2-2104639.2 Actions**To RAN1 group:****ACTION:** RAN2 respectfully asks RAN1 to take RAN2 agreements into account when discussing PHY layer aspects of MCCH.3 Dates of next RAN2 meetingsTSG-RAN2 Meeting #115-e August 16 – August 27, 2021 OnlineTSG-RAN2 Meeting #116-e November 01 – November 12, 2021 Online |