**3GPP TSG RAN WG1 #105-e R1-210XXXX**

**e-Meeting, May 10th – 27th, 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 meetings are listed in the Annex A of this document.

In R1-2104165, RAN2 respectfully asks RAN1 to take RAN2 agreements, as detailed in R1-2104165, into account in their work on MBS and discuss RAN1 aspects of MCCH as requested in the LS. The LS is reproduced in Annex B of this document for convenience. In particular RAN2 requests:

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

[105-e-NR-MBS-03] Email discussion/approval on basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs with checkpoints for agreements on May 24, May 27 – David (BBC)

In this document the Feature Lead (FL) provides a summary of the technical documents (tdocs) submitted to RAN1#105-e to the. This document also presents proposals for discussion at RAN1#105e.

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

# Issues

One of the key issues to discuss at this meeting is MBS Common Frequency Resource (CFR). At RAN1#104-e five cases (Case A-E) of configured/defined specific common frequency resource (CFR) for group-common PDCCH/PDSCH were identified for further study. Figure 1&2below from [R1-2104552, Nokia] and [R1-210433, ZTE] are copied below to facilitate the discussions of the issues identified for this RAN1#105-e meeting.



*Figure 1: configured/defined specific common frequency resource (CFR) for group-common PDCCH/PDSCH were identified for further study at RAN1#104-e. From [R1-2104552, Nokia].*



*Figure 2: Options for Case D of configured/defined specific common frequency resource (CFR) for group-common PDCCH/PDSCH. From [R1-2104338 ZTE].*

## Issue 1: MBS Common Frequency Resource for MCCH channel

### **Background**

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

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| * **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.**
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RAN2 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:

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| * Details of the allowed transmission bandwidth/BWP configurations for MCCH transmission.
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The following agreements for RRC\_IDLE/RRC\_INACTIVE UEs at RAN1#103-e and RAN1#104-e are relevant for this discussion:

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| 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.
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###  **Tdoc analysis**

* In [R1-2104250, Huawei et al.]
	+ Proposal 1: Separate CFR configurations for MCCH and MTCH(s) can be supported.
* In [R1-2105927, Huawei]
	+ Proposal 1: One common frequency resource can be configured for MCCH that is with the same size or smaller bandwidth than the SIB1 configured initial BWP. If the CFR is not configured, UE may assume the initial BWP as the default CFR.
	+ Proposal 2: The CFR if configured for MCCH contains CORESET#0.
* In [R1-2104338, ZTE]
	+ Observation 1: Case C requires UE to activate the initial BWP configured by SIB1 in RRC\_IDLE state, which is conflicting with the Rel-15/Rel-16 legacy mechanism. Furthermore, Case C requires the same frequency bandwidth range for MBS and unicast, which is too restrictive.
	+ Observation 2: Case B can be implemented through FDRA under case A.
	+ Proposal 12: MCCH transmission is contained within the frequency range of CORESET#0.
* In [R1-2104493, CATT]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Proposal 1: The case where a CFR is defined based on a configured BWP (Case E) is not supported due to the BWP switching.
	+ Proposal 2 Both the case where the initial BWP fully contains the CFR in the frequency domain (i.e. Case B and D) and the case where the initial BWP has same size as the CFR in the frequency domain (i.e. Case A and C) are supported.
	+ Proposal 3: For the case where the initial BWP fully contains the CFR in the frequency domain, the indication of the starting PRB can be based on the starting point of the initial BWP or the starting point of the carrier.
	+ Proposal 4: The current SLIV indication mechanism can be reused for common frequency resource of starting PRB and length of PRBs.
* In [R1-2104552, Nokia]
	+ Proposal-1: Support CFR [Case-A/C/D/E], but do not support CFR [Case-B].
	+ Proposal-2: Support the same or different CFR configuration for MCCH and MTCH.
* In [R1-2104634, CMCC]
	+ Proposal 1. Initial BWP with the same frequency resources as CORESET0 is used for MCCH transmission, including PDCCH used for scheduling MCCH and MCCH message.
* In [R1-2104697, Qualcomm]
	+ Proposal 1: Separate CFR configuration for MCCH/MTCH.
		- For MCCH, the CFR can be configured with the frequency size same as CORESET#0 or initial BWP.
* In [R1-2104761, OPPO]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Proposal 1: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, Case B and Case D are NOT supported.
	+ Proposal 2: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, Case C is used if initial DL BWP is configured in SIB1, and Case E is used otherwise.
* In [R1-2104867, Lenovo]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Proposal 1: If a specific common frequency resource is configured for RRC\_IDLE/RRC\_INACTIVE UEs, it should be confined within the initial DL BWP and share same numerology.
	+ Proposal 2: The starting PRB index and the number of contiguous PRBs of the specific common frequency resource are configured within the initial DL BWP via RRC signaling.
	+ Proposal 4: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, for CFR configuration for group-common PDCCH/PDSCH, both Case A and Case C are supported.
	+ Proposal 5: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, for CFR configuration for group-common PDCCH/PDSCH, none of Case B, Case D and Case E is supported.
* In [R1-2104930, Intel]
	+ Proposal 1: For CFR configuration only Case A and C can be supported for both configuration and data reception. Case E can be supported only for data reception but not for configuration reception via MCCH if BWP switch is assumed to be required for Case E. If CFR is wider than initial BWP, CFR should fully contain the initial BWP or CORESET#0 such that common control and paging signals can be received.
* In [R1-2105130, Apple]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Proposal 2: For MBS UE in RRC\_IDLE/RRC\_INACTIVE mode, if CFR is configured for group-common PDCCH/PDSCH, the CFR size should be larger than SIB1 configured initial BWP, or equal to initial BWP configured by MIB or SIB1.
* In [R1-2105338, Samsung]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Proposal 1. SIBx can configure a frequency region for MBS. If that configuration for MBS CFR is not provided, the frequency region is the initial DL BWP (as configured by SIB1 or, if SIB1 does not configure an initial DL BWP, the BWP of CORESET#0).
* In [R1-2105383, MediaTek]
	+ Proposal 3: For RRC\_IDLE/RRC\_INACTIVE UEs, a configured CFR for group-common PDCCH/PDSCH can be smaller or equal to the initial BWP based on network configuration.
	+ Proposal 6: The configured CFR for group-common PDCCH/PDSCH in RRC\_IDLE/RRC\_INACTIVE states can be reused to NR MBS MCCH transmission.
* In [R1-2105916, Ericsson]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Observation 1: If the Initial BWP is contained within the unicast BWP and the Common Frequency Resource, then a UE that is moved from RRC Connected to RRC Inactive/Idle may continue to use the same BWP to receive the multicast in RRC Inactive/Idle and to monitor the Initial BWP in a seamless way, without involving any BWP switching.
	+ Proposal 6: The initial BWP should be contained within the Common Frequency Resource/the configured BWP, for the use case when UEs continue to receive a multicast/broadcast after having been moved from RRC Connected to RRC Inactive/Idle.
* In [R1-2105439, LG]
	+ Proposal 3: For idle/inactive UEs receiving broadcast, CFR associated to initial DL BWP can be configured with a wider bandwidth than the initial DL BWP or a bandwidth equal to or smaller than the initial DL BWP.
		- If configured as a wider bandwidth, the initial DL BWP should be confined within the MBS specific BWP.
	+ Proposal 7: Idle/inactive UE monitors PDCCH for a PDCCH CSS set on the initial DL BWP or the CFR associated to the initial DL BWP to detect a DCI with SC-RNTI.
		- It is up to gNB whether PDCCH/PDSCH for MCCH is transmitted on the initial DL BWP or the CFR associated to the initial DL BWP.
* In [R1-2105602, Convida Wireless]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Proposal 2: Define the CFR that can be configured with wider frequency range than the initial BWP should be supported and should be prioritized than other cases.
	+ Proposal 3: Support Case E for the CFR design for the RRC\_IDLE/RRC\_INACTIVE UEs.
* In [R1-2105673, Google]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Observation 1: Initial BWP with a bandwidth identical to CORESET #0 should be sufficient to provide similar broadcast services as LTE SC-PTM.
	+ Proposal 1: For RRC\_IDLE/RRC\_INACTIVE UE consuming broadcast services, at least support using the CFR with the same frequency resource as CORESET #0, regardless whether an initial BWP is configured in SIB-1 or not.
		- If an initial BWP is configured by SIB-1, the base station can indicate UE to apply either the frequency resource of CORESET #0 or the initial BWP as the MBS CFR.
	+ Proposal 2: For RRC\_IDLE/RRC\_INACTIVE UE consuming broadcast services, the base station can configure a MBS BWP which is larger than the frequency resource of CORESET #0, regardless whether an initial BWP is configured by SIB-1 or not.
		- The CORESET #0 should be fully contained in the configured MBS BWP
* In [R1-2105722, NTT DOCOMO]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Proposal 1: Support all cases to configure/define a specific common frequency resource for RRC\_IDLE/RRC\_INACTIVE UEs.
* In [R1-2105849, CHENGDU TD TECH]
	+ Proposal 2: If all CFRs are configured within the initial BWP for DL, the UE receiving MBS works on the initial BWP for DL. Otherwise, the UE receiving MBS works with the combined CFR as the working BWP where the combined CFR consists of the initial BWP for DL and the CFRs providing the MBS sessions received by the UE.
* In [R1-2104197, FUTUREWEI]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Proposal 1a: 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).
	+ Proposal 1b: CORESET0 is the default common frequency resource (CFR) i.e., the UE may assume the initial BWP as the default CFR if a specific CFR is not configured.
* In [R1-2104389, vivo]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Proposal 1: For RRC\_IDLE/RRC\_INACTIVE UEs, support that one configured/defined CFR fully contains the initial BWP in frequency domain and has the same SCS and CP as the initial BWP.
* In [R1-2104444, Spreadtrum Communications]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Proposal 1: RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, do not support to configure a dedicated BWP that is larger than the initial BWP.

###  **FL Assessment**

For this issue, contributions in [Huawei, ZTE, Nokia, CMCC, Qualcomm, Intel, MediaTek, LG, Chengdu TD] have made an analysis of the CFR for broadcast services making a distinction between MCCH and MTCH channels. Also based on the RAN2 LS to RAN1 in R1-2104165 where feedback is requested for the design of MCCH, the discussion in this document is separated into separate discussions for MCCH and MTCH, respectively. The other contributions that do not explicitly make a discussion in terms of the designs of MCCH and MTCH are also taken into consideration in this issue.

***Discussion on Cases A (CORESET#0 has same size as the CFR in the frequency domain) and
Case C (SIB-1 configured initial BWP has same size as the CFR in the frequency domain)***

Contributions in [Huawei, ZTE, CATT, Nokia, CMCC, Qualcomm, Lenovo, Intel, Apple, Samsung, MediaTek, LG, Google, NTT DOCOMO, FUTUREWEI, vivo] propose that the configured CFR for the transmission of MCCH channel contains CORESET#0 or initial BWP.

Contributions in [Huawei, CATT, Nokia, Qualcomm, OPPO, Lenovo, Intel, Apple, Samsung, MediaTek, LG, Google, NTT DOCOMO, FUTUREWEI, vivo] also propose that the configured CFR for the transmission of MCCH channel contains the SIB-1 configured initial BWP.

It is worth noting that RAN2 has made the following agreement “*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*.”. A CFR for MCCH reception with the same frequency range as CORESET#0 or the SIB-1 configured initial BWP would allow the monitoring of both MCCH channel and SI/Paging without BWP switching.

However, [ZTE, Apple] also raise the issue that UEs only apply the configuration of the SIB-1 configured initial BWP until after the reception of *RRCSetup/RRCResume/RRCReestablishment*. [Apple] also discusses that this restriction could be lifted for RRC\_IDLE/RRC\_INACTIVE UEs receiving MBS.

These cases have significant support.

***Discussion on Case E (CFR is defined based on a configured BWP)***

[Qualcomm, Intel] discussing configuration details for the transmission of MCCH channel, do not support Case E for the transmission MCCH channel. [CATT, Lenovo, Spreadtrum] discussing general aspects of CFR configuration, not explicitly for the transmission of MCCH channel, do not support Case E mainly due to concerns of potential BWP switching, specification impact or increased UE complexity.

For this issue, it is not clear contributions not discussing explicit aspects for transmission configuration of MCCH channel, address Case E for this channel. More discussion clarification on this CFR alternative for MCCH channel may be needed and there is no clear support for this alternative for MCCH channel. It is also worth mentioning that tdocs submitted to this AI have not discussed in detail for Case E potential issues with BWP switching, which may make progress difficult for the support of this CFR configuration.

***Discussion on Case B (CORESET#0 fully contains the CFR in the frequency domain)***

Although [ZTE, CATT, MediaTek, LG, NTT DOCOMO] contributions support Case B due to the higher flexibility in addition to other CFR alternatives, other contributions [Nokia, OPPO, Lenovo, Intel, Apple] do not support case B due to not clear motivation or because there is no need to have an specific CFR configuration/definition when Case B could be achieved by network implementation (e.g. FDRA) as discussed in [ZTE, Intel, MediaTek].

Based on the above, it is not clear whether contributions not discussing explicit aspects for transmission configuration of MCCH channel, address Case B for this channel. Also worth pointing out that some contributions do not clearly separate the CFR cases between CORESET#0 and SIB-1 configured initial BWP. Hence, more discussion/analysis may be need for Case B as a potential alternative for transmission configuration of MCCH channel.

***Discussion on Case D (SIB-1 configured initial BWP fully contains the CFR in the frequency domain)***

Here, similar to the discussion above for Case B, although [Huawei, CATT, Nokia, Lenovo, MediaTek, LG, NTT DOCOMO] support Case D, other contributions [OPPO, intel, Apple] do not support case D due to not clear motivation or because there is no need to have an specific CFR configuration/definition when Case D could be achieved by network implementation (e.g. FDRA) as discussed in [Intel, MediaTek].

Based on the above, it is not clear whether contributions not discussing explicit aspects for transmission configuration of MCCH channel, address Case D for this channel. Also worth pointing out that some contributions do not clearly separate the CFR cases between CORESET#0 and SIB-1 configured initial BWP. Hence, more discussion/analysis may be need for Case D as a potential alternative for transmission configuration of MCCH channel.

***Discussion on CFR configurations for MCCH and MTCH channels***

Contributions in [Huawei, Nokia, Qualcomm, Intel] explicitly support that the CFR configurations for the transmission of MCCH and MTCH channels can be different. [ZTE] although without an explicit proposal, the contribution discusses and proposes in detail different alternatives for CFR configuration, while for the transmission configuration of MCCH only a CFR contained within CORESET#0 is proposed, fact that FL interprets such as different configurations for MCCH and MTCH could be enabled. This discussion seems to have support from companies while there are not apparently from the contributions strong position onto using the same CFR configuration for both MCCH and MTCH channels.

Considering the inputs above and the subsequent analysis, the FL makes the following proposal for discussion and consideration.

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

**Proposal 2.1-1**: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, the CFR for MCCH reception can be configured with the same frequency range as CORESET#0 or the SIB-1 configured initial BWP.

* FFS are modifications required (if any) for RRC\_IDLE/RRC\_INACTIVE UEs to use the SIB-1 configured initial BWP without first receiving *RRCSetup/RRCResume/RRCReestablishment*.

**Proposal 2.1-2**: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, different CFR configurations for the transmission of MCCH channel and MTCH channel can be supported.

Please provide your comments in the table below:

|  |  |
| --- | --- |
| **company** | **comments** |
| LG | For P2.1-1: We are fine with this proposal.For P2.1-2: We are fine with this proposal. |
| Lenovo, Motorola Mobility | P2.1-1: OK with this main proposal. The FFS is not clear to us. Does it mean “modification on bandwidth of SIB1 configured initial BWP?P2.1-2: Ok with this proposal. |
| ZTE | It seems that all companies have the middle ground on the following part, i.e., the bandwidth for MCCH reception is the same as CORESET#0. We can first agree on the middle ground and discuss the remaining open issues. From our perspective, it seems the MCCH can be received without introducing the CFR conception. **Proposal 2.1-1 (Updated by ZTE)**: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, the bandwidth for MCCH reception can is the same frequency range as CORESET#0.* FFS whether the bandwidth for MCCH reception can be the same as the SIB-1 configured initial BWP, if yes, whether there are modifications required (if any) for RRC\_IDLE/RRC\_INACTIVE UEs to use the SIB-1 configured initial BWP without first receiving *RRCSetup/RRCResume/RRCReestablishment*.
* FFS whether configure the bandwidth for MCCH reception as a CFR.

If companies agree to use CFR for MCCH reception, Then we can start discussing Proposal 2.1-2. |
| CMCC | 2.1-1: Only support the same frequency range as CORESET#0. From our perspective, the modifications are required to support SIB-1 configured initial BWP.2.1-2: Support |
| Futurewei | 2.1-1: Do not understand what ‘can be..” in the proposal meant. I am assuming that it can also be different from the freq range of CORESET#0? |
| NOKIA/NSB | We support both proposals from the FL |
| Qualcomm | Support 2.1-1 and 2.2-2. |

## Issue 2: MBS Common Frequency Resource for MTCH channel

### **Background**

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

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| 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.
 |

### **Tdoc analysis**

* In [R1-2104250, Huawei et al.]
	+ Proposal 1: Separate CFR configurations for MCCH and MTCH(s) can be supported.
	+ They discuss “*For case D and case E, case D is beneficial over case E. The reason is that case D is an approach which can avoid BWP switching when UE enters RRC\_CONNECTED for receiving broadcast. When Rel-17 MBS UE after entering RRC\_CONNECTED state can continuing receiving broadcast in the initial BWP instead of switching to a CFR with a larger bandwidth than the initial BWP, so that broadcast and unicast can be both scheduled on the SIB1 configured initial BWP without the need of switching the BWP. Moreover, it should be noted that even though the CFR for case D is contained in the initial BWP configured by SIB1, it does not affect the UE not receiving broadcast services in RRC\_CONNECTED state to save power nor require such UEs to always stay in the SIB1 configured initial BWP in RRC\_CONNECTED state. The reason is that the UE not receiving broadcast services can be configured with a smaller dedicated BWP or a default BWP for power saving*”.
	+ Proposal 2: For broadcast scheduling, support configuring a CFR for group-common PDCCH/PDSCH of MTCH within the initial BWP configured by SIB1, and the configured CFR should contain CORESET#0.
* In [R1-2104338, ZTE]
	+ For Case A: “*As already agreed, the initial BWP is served as the default common frequency resource for group-common PDCCH/PDSCH if a specific common frequency resource is not configured. That is, case A is supported by default.*”
	+ Observation 1: Case C requires UE to activate the initial BWP configured by SIB1 in RRC\_IDLE state, which is conflicting with the Rel-15/Rel-16 legacy mechanism. Furthermore, Case C requires the same frequency bandwidth range for MBS and unicast, which is too restrictive.
	+ Observation 2: Case B can be implemented through FDRA under case A.
	+ Observation 3: Case D-1 (Initial DL BWP configured by SIB1 fully contains CFR, CFR fully contains CORESET#0) requires UE to activate the initial BWP configured by SIB1 in RRC\_IDLE state, which is conflicting with the Rel-15/Rel-16 legacy mechanism. Furthermore, it can be implemented through case E.
	+ Proposal 1: Case D-2 (Initial DL BWP configured by SIB1 fully contains CFR, CFR is not required to contain CORESET#0) can be used to increase the MBS transmission capacity for bandwidth-restricted UEs, e.g., Redcap UE. FFS: other restrictions on CFR configuration.
	+ They discuss “*As the CFR and the initial BWP use the same numerology, and the CFR fully contains the initial BWP. In addition, the UE's RF can always focus on the frequency range of the CFR. Undoubtedly, the MBS service transmitted within the CFR and the transmission within the initial BWP can be received at the same time*.”
	+ Observation 4: As the most direct way to expand the MBS transmission capacity, case E decouples the CFR and the initial BWP configured by SIB1, by which the impact on legacy UE can be avoided.
	+ Proposal 2: Case E should be supported in R17 NR MBS. - Case E: the CFR is defined as a configured BWP and the configured BWP fully contains the initial BWP defined by CORESET#0 in frequency domain and has the same SCS and CP as the initial BWP.
* In [R1-2104493, CATT]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Proposal 1: The case where a CFR is defined based on a configured BWP (Case E) is not supported due to the BWP switching.
	+ Proposal 2 Both the case where the initial BWP fully contains the CFR in the frequency domain (i.e. Case B and D) and the case where the initial BWP has same size as the CFR in the frequency domain (i.e. Case A and C) are supported.
	+ Proposal 3: For the case where the initial BWP fully contains the CFR in the frequency domain, the indication of the starting PRB can be based on the starting point of the initial BWP or the starting point of the carrier.
	+ Proposal 4: The current SLIV indication mechanism can be reused for common frequency resource of starting PRB and length of PRBs.
* In [R1-2104552, Nokia]
	+ Proposal-1: Support CFR [Case-A/C/D/E], but do not support CFR [Case-B].
* In [R1-2104634, CMCC]
	+ Proposal 8. For RRC\_IDLE/RRC\_INACTIVE UEs, Case A and Case C can be supported as configured/defined specific CFR for group-common PDCCH/PDSCH.
	+ Proposal 9. If initial DL BWP is configured by SIB1 which larger than CORESET0, gNB can configure whether the CFR equals to the bandwidth of CORESET0 (Case A) or initial DL BWP (Case C).
* In [R1-2104697, Qualcomm]
	+ Proposal 1: Separate CFR configuration for MCCH/MTCH.
		- For MTCH, the CFR can be configured with the frequency size same as CORESET#0 or initial BWP or larger than that of initial BWP.
	+ Proposal 2: The CFR for broadcast is defined as a Broadcast BWP.
* [R1-2104761, OPPO]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Proposal 1: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, Case B and Case D are NOT supported.
	+ Proposal 2: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, Case C is used if initial DL BWP is configured in SIB1, and Case E is used otherwise.
* In [R1-2104867, Lenovo]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Proposal 1: If a specific common frequency resource is configured for RRC\_IDLE/RRC\_INACTIVE UEs, it should be confined within the initial DL BWP and share same numerology.
	+ Proposal 2: The starting PRB index and the number of contiguous PRBs of the specific common frequency resource are configured within the initial DL BWP via RRC signaling.
	+ Proposal 4: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, for CFR configuration for group-common PDCCH/PDSCH, both Case A and Case C are supported.
	+ Proposal 5: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, for CFR configuration for group-common PDCCH/PDSCH, none of Case B, Case D and Case E is supported.
* In [R1-2104930, Intel]
	+ Proposal 1: For CFR configuration only Case A and C can be supported for both configuration and data reception. Case E can be supported only for data reception but not for configuration reception via MCCH if BWP switch is assumed to be required for Case E. If CFR is wider than initial BWP, CFR should fully contain the initial BWP or CORESET#0 such that common control and paging signals can be received.
* In [R1-2105130, Apple]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Proposal 2: For MBS UE in RRC\_IDLE/RRC\_INACTIVE mode, if CFR is configured for group-common PDCCH/PDSCH, the CFR size should be larger than SIB1 configured initial BWP, or equal to initial BWP configured by MIB or SIB1.
* In [R1-2105338, Samsung]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Proposal 1. SIBx can configure a frequency region for MBS. If that configuration for MBS CFR is not provided, the frequency region is the initial DL BWP (as configured by SIB1 or, if SIB1 does not configure an initial DL BWP, the BWP of CORESET#0).
* In [R1-2105383, MediaTek]
	+ Proposal 2: Not support MBS specific BWP configuration for UE supporting multicast/broadcast in RRC\_IDLE/RRC\_INACTIVE states.
	+ Proposal 3: For RRC\_IDLE/RRC\_INACTIVE UEs, a configured CFR for group-common PDCCH/PDSCH can be smaller or equal to the initial BWP based on network configuration.
* In [R1-2105916, Ericsson]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Observation 1: If the Initial BWP is contained within the unicast BWP and the Common Frequency Resource, then a UE that is moved from RRC Connected to RRC Inactive/Idle may continue to use the same BWP to receive the multicast in RRC Inactive/Idle and to monitor the Initial BWP in a seamless way, without involving any BWP switching.
	+ Proposal 6: The initial BWP should be contained within the Common Frequency Resource/the configured BWP, for the use case when UEs continue to receive a multicast/broadcast after having been moved from RRC Connected to RRC Inactive/Idle.
* In [R1-2105439, LG]
	+ Proposal 3: For idle/inactive UEs receiving broadcast, CFR associated to initial DL BWP can be configured with a wider bandwidth than the initial DL BWP or a bandwidth equal to or smaller than the initial DL BWP.
		- If configured as a wider bandwidth, the initial DL BWP should be confined within the MBS specific BWP.
	+ Proposal 10: PDCCH/PDSCH for MTCH transmission is transmitted on the initial DL BWP or CFR associated to the initial DL BWP, depending on a RRC message in MCCH.
* In [R1-2105602, Convida Wireless]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Proposal 2: Define the CFR that can be configured with wider frequency range than the initial BWP should be supported and should be prioritized than other cases.
	+ Proposal 3: Support Case E for the CFR design for the RRC\_IDLE/RRC\_INACTIVE UEs.
* In [R1-2105673, Google]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Observation 1: Initial BWP with a bandwidth identical to CORESET #0 should be sufficient to provide similar broadcast services as LTE SC-PTM.
	+ Proposal 1: For RRC\_IDLE/RRC\_INACTIVE UE consuming broadcast services, at least support using the CFR with the same frequency resource as CORESET #0, regardless whether an initial BWP is configured in SIB-1 or not.
		- If an initial BWP is configured by SIB-1, the base station can indicate UE to apply either the frequency resource of CORESET #0 or the initial BWP as the MBS CFR.
	+ Proposal 2: For RRC\_IDLE/RRC\_INACTIVE UE consuming broadcast services, the base station can configure a MBS BWP which is larger than the frequency resource of CORESET #0, regardless whether an initial BWP is configured by SIB-1 or not.
		- The CORESET #0 should be fully contained in the configured MBS BWP
* In [R1-2105722, NTT DOCOMO]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Proposal 1: Support all cases to configure/define a specific common frequency resource for RRC\_IDLE/RRC\_INACTIVE UEs.
* In [R1-2105849, CHENGDU TD TECH]
	+ Proposal 2: If all CFRs are configured within the initial BWP for DL, the UE receiving MBS works on the initial BWP for DL. Otherwise, the UE receiving MBS works with the combined CFR as the working BWP where the combined CFR consists of the initial BWP for DL and the CFRs providing the MBS sessions received by the UE.
* In [R1-2104197, FUTUREWEI]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Proposal 1a: 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).
	+ Proposal 1b: CORESET0 is the default common frequency resource (CFR) i.e., the UE may assume the initial BWP as the default CFR if a specific CFR is not configured.
* In [R1-2104389, vivo]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Proposal 1: For RRC\_IDLE/RRC\_INACTIVE UEs, support that one configured/defined CFR fully contains the initial BWP in frequency domain and has the same SCS and CP as the initial BWP.
* In [R1-2104444, Spreadtrum Communications]
	+ This contribution does not separate the CFR discussion into MCCH and MTCH channels.
	+ Proposal 1: RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, do not support to configure a dedicated BWP that is larger than the initial BWP.

### **FL Assessment**

For this issue, contributions in [Huawei, ZTE, Nokia, CMCC, Qualcomm, Intel, MediaTek, LG, Chengdu TD] have made an analysis of the CFR for broadcast services making a distinction between MCCH and MTCH channels. Also based on the RAN2 LS to RAN1 in R1-2104165 where feedback is requested for the design of MCCH, the discussion in this document is separated into separate discussions for MCCH and MTCH, respectively. The other contributions that do not explicitly make a discussion in terms of the designs of MCCH and MTCH are also taken into consideration in this issue.

***Discussion on Cases A (CORESET#0 has same size as the CFR in the frequency domain) and
Case C (SIB-1 configured initial BWP has same size as the CFR in the frequency domain)***

Contributions in [ZTE, CATT, Nokia, CMCC, Qualcomm, Lenovo, Intel, Apple, Samsung, MediaTek, LG, Google, NTT DOCOMO, FUTUREWEI] propose that the configured CFR for the transmission of MTCH channel contains CORESET#0 or initial BWP (Case A).

Contributions in [Huawei, CATT, Nokia, CMCC, Qualcomm, OPPO, Lenovo, Intel, Apple, Samsung, MediaTek, LG, Google, NTT DOCOMO, FUTUREWEI] propose that the configured CFR for the transmission of MTCH channel contains the SIB-1 configured initial BWP (Case C).

However, contributions in [ZTE, Apple] also raise the issue that UEs only apply the configuration of the SIB-1 configured initial BWP until after the reception of RRCSetup/RRCResume/RRCReestablishment. [Apple] also discusses that this restriction could be lifted for RRC\_IDLE/RRC\_INACTIVE UEs receiving MBS.

These cases have significant support.

***Discussion on Case E (CFR is defined based on a configured BWP)***

Contributions in [ZTE, Nokia, Qualcomm, OPPO, Intel, Apple, Ericsson, LG, Convida, Google, NTT DOCOMO, vivo] support Case E due to additional configuration flexibility and benefits over only using a Case C (SIB-1 configured initial BWP has same size as the CFR in the frequency domain).

Contributions in [Huawei, CATT, Lenovo, MediaTek, Spreadtrum] do not support Case E due to e.g., potential additional UE complexity or potential BWP switching. [Nokia] discusses that Case E may only be enabled based on UE capability, which may be a way forward to address companies’ concerns over additional UE complexity for the basic function of the feature for RRC\_IDLE/INACTIVE UEs.

There are various companies that assert that Case E does not imply BWP switching and other companies assert that Case E would require BWP switching. However, it is also worth mentioning that tdocs submitted to this AI have not discussed in detail for Case E potential issues with BWP switching, which may make progress difficult for the support of this CFR configuration.

For this case, although there are various companies that see a benefit for this case and would like to enable it, there are other companies that have concerns over potential additional UE complexity and potential BWP switching. A way forward would be to enable this case only based on UE capability.

***Discussion on Case B (CORESET#0 fully contains the CFR in the frequency domain)***

Although [CATT, MediaTek, LG, NTT DOCOMO] contributions support Case B due to the higher flexibility in addition to other CFR alternatives, other contributions [Nokia, Qualcomm, OPPO, Lenovo, Apple] do not support case B due to not clear motivation. Also relevant is that other inputs [ZTE, Intel, MediaTek] discuss that there is no need to have an specific CFR configuration/definition when Case B could be achieved by network implementation (e.g. FDRA).

It is also worth pointing out that some contributions do not clearly separate the CFR cases between CORESET#0 and SIB-1 configured initial BWP.

More discussion/analysis may be need for Case B as a potential alternative for transmission configuration of MCCH channel.

***Discussion on Case D (SIB-1 configured initial BWP fully contains the CFR in the frequency domain)***

Although [Huawei, ZTE, CATT, Nokia, MediaTek, LG, NTT DOCOMO, FUTUREWEI] contributions support Case D due to the higher flexibility in addition to other CFR alternatives, other contributions [Qualcomm, OPPO, Lenovo, Intel, Apple] do not support case D due to not clear motivation.

[Huawei] discusses that Case D case would not imply that all UEs that transition to CONNECTED state would be forced to receive the SIB-1 configured initial BWP since the gNB could configure a (potentially smaller) dedicated BWP UEs that are not receiving an MBS broadcast service. Also, in [CATT] is argued that even if SIB-1 configured initial BWP would be configured with a larger frequency range to cope with higher bit-rate services, RRC\_IDLE/INACTIVE UEs could still use CORESET#0 to receive common control OSI/paging etc.

[ZTE] further divides Case C into two subcases: Case D-1 where configured MBS BWP fully contains CORESET#0 and Case D-2 where the configured MBS BWP does not need to fully contain CORESET#0. While Case D-1 would still have the same issue as the one discussed for Case C, Case D-2 can be used to increase MBS transmission capacity.

[Intel, MediaTek] discuss that there is no need to have an specific CFR configuration/definition when Case D (i.e. smaller CFRs within the SIB-1 configured initial BWP) could be achieved by network implementation (e.g. FDRA).

It is also worth pointing out that some contributions do not clearly separate the CFR cases between CORESET#0 and SIB-1 configured initial BWP.

More discussion/analysis may be need for Case D as a potential alternative for transmission configuration of MTCH channel.

Considering the inputs above and the subsequent analysis, the FL makes the following proposal for discussion and consideration.

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

**Proposal 2.2-1**: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, the CFR for MTCH reception can be configured with the same frequency range as CORESET#0 or the SIB-1 configured initial BWP.

* FFS are modifications required (if any) for RRC\_IDLE/RRC\_INACTIVE UEs to use the SIB-1 configured initial BWP without first receiving *RRCSetup/RRCResume/RRCReestablishment*.

**Proposal 2.2-2**: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, the CFR for MTCH reception can be defined based on a configured BWP based on UE capability.

* 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.
* The configured BWP is not larger than the carrier bandwidth.

Please provide your comments in the table below:

|  |  |
| --- | --- |
| **company** | **comments** |
| LG | For P2.2-1, we think that CFR for MTCH can be configured by MCCH. For P2.2-2: we are fine with this proposal. |
| Lenovo, Motorola Mobility | P2.2-1, OK with this main proposal. The FFS is not clear to us. Does it mean “modification on bandwidth of SIB1 configured initial BWP?P2.2-2: does “the configured BWP” means SIB-1 configured BWP? |
| ZTE | We propose to agree Case A, Case E. Then, Case C and Case D can be a specific case of Case E. For Proposal 2.2-1, it seems that Case A is the middle ground among all companies. As analysed in our tdoc, if switching delay is needed for Case E, then Case C also needs switching delay because during IDLE/INACTIVE, the active BWP for UE is CORESET#0 instead of the initial BWP configured by SIB-1. Based on our understanding, no BWP switching is needed for Case E between MBS reception and non-MBS reception as long as the SCS and CP are the same. Case C can be a specific case of Case E. Actually, Case D can also be a specific case of Case E.Regarding the way forward to have a UE capability for UE to indicate support of MBS BWP, it is not clear how network can know this UE capability in IDLE/INACTIVE states.BWT, we corrected some typos in the 2.2.3 regarding the contents of our proposal. Copied below for reference.*[ZTE] further divides Case C into two subcases: Case D-1 where configured MBS BWP fully contains CORESET#0 and Case D-2 where the configured MBS BWP does not need to fully contain CORESET#0. While Case D-1 would still have the same issue as the one discussed for Case C, Case D-2 can be used to increase MBS transmission capacity.*  |
| CMCC | 2.2-1: Support.2.2-2: Not support. We still have concern about the BWP switching time between initial BWP and configured BWP for broadcast.  |
| Futurewei | Same comment as in our comment for 2.1-1: Do not understand what ‘can be..” in the proposal meant. I am assuming that it can also be different from the freq range of CORESET#0? |
| NOKIA/NSB | 2.2-1: Support2.2-2: Try to understand what is the meaning of the configured BWP, as shown in below with red-font**Proposal 2.2-2**: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, the CFR for MTCH reception can be defined based on a configured BWP based on UE capability.* 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. – Is this the Case D-2 in Figure-2?
* The CFR has the frequency resources identical to the configured BWP. – Which CFR case it is?
* The configured BWP needs to fully contain the initial BWP in frequency domain and has the same SCS and CP as the initial BWP. – This is CFR Case-E
* The configured BWP is not larger than the carrier bandwidth.
 |
| Qualcomm | Ok with 2.2-1.For 2.2-2, generally fine but prefer to delete ‘the UE capability’ in the main bullet. For IDLE UEs, network does not know the UE capability. We assume the UEs capable of supporting broadcast can support it without additional reporting of UE capability. |

## Issue 3: Details of Common Search Space design for MCCH/MTCH channels

### **Background**

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

|  |
| --- |
| * **Common search space is needed for MCCH scheduling. RAN2 should request RAN1 to discuss the details of CSS for MCCH.**
* **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 clarifications from RAN2 are relevant for this discussion.

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| 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. |

RAN2 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:

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| --- |
| 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.
 |

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

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| --- |
| 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.
 |

### **Tdoc analysis**

* In [R1-2104197, FUTUREWEI]
	+ Proposal 5: Reuse the CSS as agreed for Connected UEs as baseline, with both the Connected UEs and Idle/Inactive UEs sharing the same CSS but with a new RNTI for broadcast services.
* In [R1-2104389, vivo]
	+ They discuss “It has been agreed that for RRC\_IDLE/RRC\_INACTIVE UEs, CSS is supported for group-common PDCCH. Currently, UE can monitor a DCI format with CRC scrambled by a SI-RNTI in type 0 or type 0A CSS, a DCI format with CRC scrambled by a RA-RNTI, a MsgB-RNTI, or a TC-RNTI in type 1 CSS, and a DCI format with CRC scrambled by a P-RNTI in type 2 CSS. For MBS reception, UE needs to monitor a group-common PDCCH with CRC scrambled by a common RNTI (e.g., g-RNTI) to decode a group-common PDSCH. One alternative is that, once a UE is configured with g-RNTI, the UE will also monitor a DCI format with CRC scrambled by a g-RNTI in at least one of these CSS of types of 0/0A/1/2. Another alternative is to configure a new type of CSS (e.g., configured in PDCCH-ConfigCommon) for UE in RRC IDLE/INACTIVE state, and UE will monitor a DCI format with CRC scrambled by a g-RNTI in this new type search space. As the monitoring occasion for these existed CSS types are very limited (e.g., the periodicity for type 0 CSS is fixed as 20ms, the periodicity for type 0A CSS is large, typically), they may not be suitable for different MBS service periodicities. Furthermore, considering that 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, defining a new type CSS for MBS transmission can provide flexibility when overbooking issue exists”
	+ Proposal 3: A new type of common search Space can be configured for MBS services.
* In [R1-2105927, Huawei]
	+ Proposal 3: An additional CSS can be configured for MCCH scheduling; otherwise, CSS#0 is used by default.
* In [R1-2104250, Huawei]
	+ Proposal 3: For broadcast scheduling, additional CORESET/SS in addition to CORESET0/SS 0 can be configured for group-common PDCCH/PDSCH of MTCH.
* In [R1-2104338, ZTE]
	+ Proposal 5: For RRC\_IDLE/RRC\_INACTIVE UEs, a new CSS type is defined for group-common PDCCH.
		- The same search space can be applied for MBS control information and different broadcast service depending on network configuration.
		- FFS detailed PDCCH dropping rule for the new CSS type.
* In [R1-2104576, ZTE]
	+ proposal for LS answer: Both searchSpace#0 and common search space other than searchSpace#0 can be used for MCCH.
* In [R1-2104444, Spreadtrum]
	+ Proposal 3: A new CSS type can be introduced for RRC\_IDLE/RRC\_INACTIVE UEs with group-common PDCCH receiving.
* In [R1-2104552, Nokia]
	+ Proposal-8: Legacy SS configured for legacy UEs can be configured as search space for MCCH and/or MTCH.
	+ Proposal-9: A new SS can be introduced for MBS UEs having different monitoring periodicity in CORESET#0 as well as other CORESET(s) associated with MBS services.
* In [R1-2104634, CMCC]
	+ Proposal 3. The searchSpace#0 or a common search space other than searchSpace#0 can be used for MCCH scheduling.
	+ Under the discussion of MTCH:
	Proposal 13. The CSS type for multicast service group-common PDCCH and broadcast service group-common PDCCH should be the same.
	+ Under the discussion of MTCH:
	Proposal 14. New Type-x CSS can be defined for broadcast group-common PDCCH for RRC\_IDLE/INACTIVE/CONNECTED UEs.
	+ Under the discussion of MTCH:
	Proposal 15. The monitoring priority of new Type-x CSS is determined based on the search space set indexes of the new Type-x CSS set and USS sets.
* In [R1-2104697, Qualcomm]
	+ They discuss: “To answer the RAN2 question on MCCH [R1-2104165], we think SS#0 or an SS other than SS#0 can be configured.”
	+ They also discuss “The SS of GC-PDCCH for broadcast MTCH could be same as that of MCCH or configured by MCCH.”
	+ Proposal 4: A new type of CSS is defined as the SS of MCCH/MTCH.
		- For MCCH, SS#0 or an SS other than SS#0 can be configured.
* In [R1-2104867, Lenovo]
	+ Proposal 8: A CSS is configured for RRC IDLE/RRC INACTIVE UEs by reusing existing CSS type.
* In [R1-2105130, Apple]
	+ They discuss “One of the differences between CSS and USS is the CCE index is different. For CSS, the same CCE index is applied to all the UEs. For USS, the CCE index is different from different UEs. Another difference is the CSS has high priority than USS if the PDCCH is overbooked. For MBS, the search space could be different from existing CSS set, i.e., type 0/0A/1/2/3 and USS set, it is a CSS but with lower priority than USS. It is more suitable for define a new search space type for MBS, i.e., MBS CSS, and this new search space type can be used by MBS UE in RRC\_CONNECTED and RRC\_IDLE/RRC\_INACTIVE states.”
	+ Proposal 3: Define a new common search space type for multicast.
* In [R1-2105338, Samsung]
	+ They discuss “There have been proposals to define a “new” CSS type but with little discussion on what “new” means which is what matters. It is preferable to first discuss whether the CSS sets for GC-PDCCH for RRC\_IDLE/RRC\_INACTIVE UEs need to be different (a) than the CSS sets for GC-PDCCH for RRC\_CONNECTED UEs, (b) between broadcast and multicast, and (c) the Type-3 PDCCH CSS sets.”
	+ They also 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 *Yp*,-1=0.”.
	+ Observation 3: 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 3. Support avoidance of permanent collisions for PDCCH candidates of search space sets for GC-PDCCH for broadcast and multicast.
* In [R1-2105383, MediaTek]
	+ Proposal 5: The CSS type defined in AI 8.12.1 for MBS group scheduling with MCCH-RNTI can be reused for MCCH reception on PDSCH.
* In [R1-2105916, Ericsson]
	+ Proposal 8: If multicast to UEs in RRC Inactive/Idle is supported, we propose to reuse the same search space type as for multicast in RRC Connected.
* In [R1-2105439, LG]
	+ Proposal 4: Assuming that RAN2 introduces a new MBMS SIB, idle/inactive UE monitors PDCCH for Type0A-PDCCH CSS set to detect a DCI with SI-RNTI and receive MBMS SIB on the corresponding PDSCH on the initial DL BWP of a serving cell for broadcast.
	+ Proposal 6: For MCCH, support new CSS type of which the monitoring priority for group-common PDCCH is the same as existing Rel-15/16 CSS. New CSS type for MCCH is not used for MTCH.
	+ Proposal 11: For MTCH, support new CSS type of which the monitoring priority for group-common PDCCH is determined based on the search space set indexes for MTCHs. The CSS for MTCHs is configured by MCCH.
* In [R1-2105602, Convida]
	+ Proposal 5: A new CSS type should be defined for monitoring the group-common PDCCH.

### **FL Assessment**

For this issue, contributions in [Huawei, ZTE, Nokia, CMCC, Qualcomm, MediaTek, LG] have made an analysis of the Search Space for broadcast services making a distinction between MCCH and MTCH channels.

Based on the RAN2 LS to RAN1 in R1-2104165 where feedback is requested for the design of MCCH, the discussion in this Issue first address the question from RAN2 and the address other aspects raised in the contributions.

The contributions in [Samsung, ZTE] divide the problem into the following useful questions for other aspects of CSS design/configuration:

1. whether CSS sets for RRCIDLE/RRC\_INACTIVE UEs are different between broadcast and multicast;
2. whether CSS sets for RRC\_IDLE/RRC\_INACTIVE UEs are different to RRC\_CONNECTED UEs;
3. whether CSS sets for RRCIDLE/RRC\_INACTIVE UEs need to be different to Type-3 PDCCH CSS sets; and
4. whether the same or different CSS can be applied for both MTCH and MCCH channels.

This categorisation will be used below for the discussion of additional aspects on this issue.

***RAN2 request on discussion on Search Space for MCCH***

Contributions on [Huawei, ZTE, CMCC, Qualcomm, Nokia] support that both searchSpace#0 and common search space other than searchSpace#0 can be configured for MCCH channel. On the other hand [MediaTek] propose to reuse the solution from AI 8.12.1 (connected UEs) and [LG] propose that a new CSS can be used MCCH.

Given that the use searchSpace#0 and common search space other than searchSpace#0 for MCCH channel is supported from various companies and this would not preclude discussions on potentially new CSS, the FL will make a proposal to support it.

***Discussion on whether CSS sets for RRC\_IDLE/INACTIVE UEs are different between broadcast and multicast***

As per the RAN2 LS to RAN1, discussion for multicast support in Idle UEs will be considered later if time permits at RAN2. Hence, FL’s proposal is to focus in this meeting on broadcast reception and revisit this discussion if there is interest from companies later and after RAN2 has moved forward with the discussions.

***Discussion on whether CSS sets for RRC\_IDLE/INACTIVE UEs are different to RRC\_CONNECTED UEs***

The following RAN1#104-e agreement is relevant for this discussion for broadcast reception.

|  |
| --- |
| 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.
 |

Is FL’s understanding that the agreement above means that for broadcast reception, the same CSS would be used for connected and inactive UEs. If preferred by the companies a statement to conclude this could be agreed at this meeting.

***Discussion on whether CSS sets for RRC\_IDLE/INACTIVE UEs need to be different to Type-3 PDCCH CSS***

At RAN1#104-e the issue on whether a new CSS could be supported for broadcast reception for RRC idle/inactive UEs was discussed but without reaching an agreement. [vivo, ZTE, Spreadtrum, Nokia, CMCC, Qualcomm, Apple, LG, Convida] support defining a new CSS that could have different and more flexible monitoring occasions than existing CSS and could also address overbooking issues when the broadcast reception is received by UEs in all RRC states (i.e. connected and idle/inactive). On the other hand [Samsung, Lenovo] argue that existing CSS can be reused and different search space set equation initialisation can still be achieved even using existing e.g. Type-3 CSS sets. Another approach is the one in [Futureway, MediaTek, Ericsson] that propose reusing the solution from AI 8.12.3 (connected UEs).

Although some contributions have provided more detailed analysis, the situation is not very different to the previous meeting. Therefore, the FL will initially propose a further study on this issue.

***Discussion on whether the same or different CSS can be applied for both MTCH and MCCH channels***

For this issue while [ZTE] proposes that same CSS is applied to MCCH and MTCH, [Qualcomm, LG] propose that the CSS for MCCH and MTCH are different or can be different.

Given there has not been much discussion on this aspect in other contributions, the FL will propose a study for this.

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

**Proposal 2.3-1**: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, both searchSpace#0 and common search space other than searchSpace#0 can be configured for MCCH channel.

**Proposal 2.3-2**: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, study the following options for CSS other than searchSpace#0 for MCCH and/or MTCH channels:

* Atl 1: support of Type-3 CSS
* Alt 2: support of a new Type-x CSS
* Alt 3: reuse solution defined for RRC\_CONNECTED UEs in AI 8.12.1 as baseline

**Proposal 2.3-3:** For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, study whether the same or different CSS can be used for MCCH and MTCH channels.

Please provide your comments in the table below:

|  |  |
| --- | --- |
| **company** | **comments** |
| LG | **Proposal 2.3-1**: we are fine with this proposal.**Proposal 2.3-2**: we are fine with this proposal.**Proposal 2.3-3**: we are fine with this proposal. |
| Lenovo, Motorola Mobility | **We are Ok with the three proposals.** |
| ZTE | We support Proposal 2.3-1 and Proposal 2.3-3.Regarding Proposal 2.3-2, we support defining a new type x for broadcast. Currently, type-3 CSS can NOT be used in IDLE/INACTIVE. Alt.1 violates the current mechanism. The search type for IDLE/INACTIVE and CONNECTED UE can be different because beam sweeping is required for IDLE/INACTIVE while it may not be required for CONNECTED UEs. Thus, Alt. 3 is not appropriate. It seems only Alt. 2 is workable.**Proposal 2.3-2 (Updated by ZTE)**: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, support a new Type-x CSS for SS#0 and search space other than sSS#0 for MCCH and/or MTCH channels |
| CMCC | 2.3-1: Support2.3-2: Not support. First we don’t see the motivation to support new type CSS for MCCH. In addition, for MTCH, we prefer alt 3.2.3-3: Fine |
| Futurewei  | 2.3-1: Support2.3-2: Support2.3-3: Support |
| NOKIA/NSB | 2.3-1: Agree2.3-2: We thought the 2.3-3 should be discussed first before 2.3-2, then we could discuss further which alternative in 2.3-2 for either MCCH or MTCH or both.2.3-3: Fine |
| Qualcomm | Ok with 2.3-1, 2.3-2, 2.3-3. |

## Issue 4: RNTI and DCI design for carrying MCCH change notifications

### **Background**

RAN2 discussed the details of broadcast session delivery and agreements were made during RAN2#113-e meeting. Here we copy the relevant ones for this Issue:

|  |
| --- |
| * **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 leading to with RAN1 impacts. Here we reproduce relevant RAN2 agreements relevant to the discussion on the configuration of the CFR:

|  |
| --- |
| * **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 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**
 |

RAN2 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 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.
 |

### **Tdoc analysis**

* In [R1-2104338, ZTE]
	+ Proposal 13: A DCI with a separate RNTI is used for carrying MCCH change notifications without scheduling the new MCCH. In this case, all bits in the DCI format can be re-interpreted. And the new MCCH will be transmitted with DCI and another RNTI specific for MCCH.
* In [R1-2104552, Nokia]
	+ Proposal-10: Further discuss whether the integrated RNTI with MCCH and separated RNTI for MCCH change notification are both supported or down-selected needed.
	+ Proposal-11: RAN1 may discuss the content of DCI for MCCH change notification, i.e. bit field content, as well as whether the same DCI format as MCCH or not.
* In [R1-2104634, CMCC]
	+ they discuss “Regarding the MCCH change notification, there are two RAN1 related methods. The first method is defining a new M-N-RNTI to scramble the CRC of DCI format 1\_0, which is similar to LTE SC-PTM SC-MCCH change notification. If UE detects the DCI format 1\_0 with M-N-RNTI, UE will receive the updated MCCH at the MCCH period boundary. The second method is using the DCI field in DCI format 1\_0 to indicate the MCCH change notification. As the discussion in section 2.4, the DCI fields of DCI format 1\_0 with M-RNTI are the same with DCI format 1\_0 with SI-RNTI, and there are some reserved bits in DCI format 1\_0. Therefore, one flag can be added in the DCI format 1\_0, if UE reads the flag toggled, UE will receive the updated MCCH at the MCCH period boundary”
	+ Proposal 7. Consider two following alternatives for MCCH change notification indication:
		- Alt 1. Define a new M-N-RNTI for scramble CRC of DCI format 1\_0;
		- Alt 2. Use a DCI field in DCI format 1\_0 with M-RNTI.
* In [R1-2104697, Qualcomm]
	+ Proposal 5: DCI format 1\_0 can be used as the baseline for MCCH, MTCH, and MCCH change notifications.
	+ Proposal 6: A dedicated RNTI (e.g., MCCH-N-RNTI) can be used for MCCH change notifications.
* In [R1-2105383, MediaTek]
	+ Proposal 7: Define a new RNTI (e.g., G-N-RNTI) for NR MBS MCCH change notification.
	+ Proposal 8: DCI format 1\_X scrambled by a new RNTI (e.g., G-N-RNTI) can be used for MCCH change notification.
* In [R1-2105439, LG]
	+ Proposal 8: MCCH change notification is indicated in a DCI of which CRC is scrambled by SC-N-RNTI.
	+ Proposal 9: UE periodically monitors PDCCH for a PDCCH CSS set on the initial DL BWP or the CFR associated to the initial DL BWP to detect a DCI indicating MCCH change notification.
* In [R1-2105849, CHENGDU TD]
	+ Proposal 6: Several groups of modification period and repetition period can be configured. The different MBS types can use the different groups. For each MBS session, gNB should indicate on MCCH which group of modification period and repetition period is used by the MBS session.
* In [R1-2105927, Huawei]
	+ They discuss “For NR MBS, there is no need to introduce a new DCI format like DCI format 1C as in LTE to carry the MCCH change notification, which can be carried in the DCI format 1\_0 scheduling the MCCH. It should be further studied in RAN2 regarding the specific contents of the MCCH change notification, e.g., only inform the session start or some other information as well including multiple MCCHs and session modification/stop. In addition, the NR broadcast/multicast in Rel-17 is supposed not to consider the cases that MCCH and MTCH cannot be simultaneously received due to being in different subbands, so there is no need to carry the session start/modification/stop in the DCI scheduling the MTCH.”
	+ Proposal 4: The MCCH change notification is carried in the DCI format 1\_0 scheduling the MCCH. The detailed contents of the MCCH change notification should be further studied in RAN2.
	+ Proposal 5: There is no need to carry the information for session start/modification/stop in the DCI scheduling the MTCH.

### **FL Assessment**

RAN2 LS to RAN1 in R1-2104165 requests RAN1 feedback/investigations on details for RNTI and DCI design for carrying MCCH change notifications and contributions in [ZTE, Nokia, CMCC, Qualcomm, MediaTek, LG, CHENGDU TD, Huawei] discuss this issue.

***Discussion on whether a new DCI format is needed***

The DCI design for MCCH and MTCH channels is discussed in Issue 7 of this document. The proposals do not mention a specific DCI, i.e., whether an existing DCI (e.g. DCI\_1\_0) or a new DCI are used for the MCCH change notification.

***Discussion on RAN2 agreements and request to RAN1***

The following RAN2#113-e meeting and RAN2#113bis-e meeting agreements and RAN2 request, especially the highlighted parts are relevant:

RAN2#113-e meeting

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

RAN2#113bis-e meeting

|  |
| --- |
| * **RAN2 will discuss and down-select from the following two options for the UE to get aware of session stop/modification:**
	+ **Reading MCCH once per each MCCH modification period when receiving an ongoing broadcast session**
	+ **DCI used for MCCH notification indicates the change of an ongoing broadcast session**
 |

RAN2 requests RAN1:

|  |
| --- |
| * 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.
 |

These clarify that RAN2 has agreed that the notification is to inform about changes of MCCH configuration due to session start. However, whether a notification about modification/stop of an ongoing session is needed or not is still not decided.

***Discussion on alternatives for MCCH change notification***

Contribution in [CMCC] describes two alternatives that have been discussed in different contributions to this issue as follows: “*Regarding the MCCH change notification, there are two RAN1 related methods. The first method is defining a new M-N-RNTI to scramble the CRC of DCI format 1\_0, which is similar to LTE SC-PTM SC-MCCH change notification. If UE detects the DCI format 1\_0 with M-N-RNTI, UE will receive the updated MCCH at the MCCH period boundary. The second method is using the DCI field in DCI format 1\_0 to indicate the MCCH change notification. As the discussion in section 2.4, the DCI fields of DCI format 1\_0 with M-RNTI are the same with DCI format 1\_0 with SI-RNTI, and there are some reserved bits in DCI format 1\_0. Therefore, one flag can be added in the DCI format 1\_0, if UE reads the flag toggled, UE will receive the updated MCCH at the MCCH period boundary*.”

Two alternatives can be identified from this analysis: Alt 1 definition a dedicated RNTI to scramble the CRC of a DCI scheduling a MCCH, and Alt 2: Use of a field in a DCI format scheduling a MCCH without a dedicated RNTI for MCCH change notification. Contributions in [ZTE, Qualcomm, MediaTek, LG] propose solutions aligned with Alt 1. Contributions in [Nokia, CMCC] propose the discussion of both alternatives. The FL proposes a study of this issue to also allow companies to provide their ideas for the two alternatives in this meeting.

Regarding discussions on the contents of the MCCH change notification although [Nokia] discusses that such a discussion should be placed in RAN1, [Huawei] argues that such a discussion is in the scope of RAN2. Based on RAN2 request and clarifications (highlighted above e.g., need of notification for session modification/stop) the FL understands this is in the scope of RAN2. However, a proposal is put forward to allow discussion between companies.

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

**Proposal 2.4-1:** 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 scheduling a MCCH;
* Alt 2: Use of a field in a DCI format scheduling a MCCH without a dedicated RNTI for MCCH change notification;

**Proposal 2.4-2:** Is up to RAN2 to decide the specific contents of the MCCH change notification, e.g, whether only 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.

Please provide your comments in the table below:

|  |  |
| --- | --- |
| **company** | **comments** |
| LG | **Proposal 2.4-1:** we prefer Alt 1 as in SC-PTM.**Proposal 2.4-2:** we are fine with this proposal. |
| Lenovo, Motorola Mobility | **We are Ok with the two proposals.** |
| ZTE | It seems the Alt.1 and Alt.2 are mixed together. It seems the following updated proposal is in line with what proposed by companies.**Proposal 2.4-1 (Updated by ZTE):** 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 without scheduling a MCCH;
* Alt 2: Use of a field in a DCI format scheduling a MCCH without a dedicated RNTI for MCCH change notification;

Regarding Proposal 2.4-2, our understanding is that it is RAN2’s scope. |
| CMCC | OK with two proposals. |
| Futurewei | Fine with both proposals. For 2.4-1: Prefer Alt 1.  |
| NOKIA/NSB | Regarding Alt 1 in Proposal 2.4-1, you mean to define a dedicated RNTI specifically for MCCH change notification, is it correct understanding? |
| Qualcomm | It seems Alt1 should be ‘scheduling a MCCH change notification’.For 2.4-2, is it a conclusion? |

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

### **Background**

The following agreement for RRC\_IDLE/RRC\_INACTIVE UEs at RAN1#103-e and RAN2#104-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
 |

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.**
 |

### **Tdoc analysis**

* In [R1-2104197, FUTUREWEI]
	+ Observation1: The Idle/Inactive UEs monitoring of the group-common PDCCH transmissions corresponding to broadcast services is based on the operation:
		- Within the broadcast MCCH transmission window, UE assumes that the same broadcast messages are repeated in all beams of the sweeping pattern and thus the selection of the beam(s) for the reception of the broadcast message is up to UE implementation.
		- The MCCH transmission window is defined by MCCH repetition period, MCCH window duration and radio frame/slot offset, and is RRC configured to the UE.
* In [R1-2104389, vivo]
	+ Proposal 4: Confirm RAN2 assumption on mapping between MBS PDCCH and SSBs:
		- In case searchSpace#0 is configured for MBS PDCCH, the mapping between PDCCH occasions and SSBs is the same as for SIB1.
		- If common search space other than searchSpace#0 is configured for MBS PDCCH, the PDCCH monitoring occasions which are not overlapping with UL symbols are sequentially numbered from one in the PDCCH transmission window and mapped to SSBs using the similar rule as defined for OSI in TS 38.331.
* In [R1-2104250, Huawei]
	+ They discuss “Beam sweeping mechanism for MCCH has been discussed in RAN2 and achieved some progress. What RAN1 discusses in this meeting is mainly for MTCH which is supposed to be discussed in RAN1.”
	+ Proposal 5: If SS#0 is configured for MTCH scheduling, the mapping between PDCCH occasions and SSBs is the same as that for SIB1 as defined in TS 38.213.
	+ They discuss that “If SS other than SS#0 is configured for MTCH, similar to the mechanisms defined for paging and OSI in the specific SS other than SS#0, a window is needed so as to associate with SSB.”
	+ Proposal 6: MTCH scheduling is associated with a window defined by the MTCH monitoring periodicity K\_(G-RNTI) and the offset to the starting of the periodicity O\_(G-RNTI):
		- the PDCCH monitoring occasion(s) in slot n\_slot in the frame SFN is given by (SFN∙N\_slot+n\_slot-O\_(G-RNTI) )mod K\_(G-RNTI)=0, where N\_slot is the number of slots in a radio frame.
	+ Proposal 7: 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 Kth 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 G-RNTI window/N).
		- 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.
* In [R1-2104338, ZTE]
	+ Proposal 10: For RRC\_IDLE/RRC\_INACTIVE UEs, an MBS window is defined as a time interval for PDCCH transmission corresponding to an MBS service in different beams.
		- Note: Different MBS services can share the same MBS window.
	+ Proposal 11: For RRC\_IDLE/RRC\_INACTIVE UEs, when receiving MBS PDSCH, UE assumes that the DM-RS port of PDSCH is quasi co-located with the associated SS/PBCH block with respect to Doppler shift, Doppler spread, average delay, delay spread, spatial RX parameters when applicable.
* In [R1-2104493, CATT]
	+ Proposal 9: In NR MBS system, both options of PDCCH MO configuration can be considered, and how to initiate these two options can be further studied.
		- Option 1: PDCCH MOs in one MBS-window length are allocated to different SSBs successively, same as the PDCCH MOs for SIBx.
		- Option 2: PDCCH MOs in one MBS-window length are allocated to one SSB with consecutive MOs.
* In [R1-2104552, Nokia]
	+ Proposal-12: Considering including the SSB association mapping for SSB beams without MBS transmission.
	+ Proposal-13: Considering 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-14: Propose to allow the network to control the number of repetition transmission for each SSB beam within the MBS window duration.
* In [R1-2104634, CMCC]
	+ Proposal 5. Confirm the RAN2 agreement, that in case searchSpace#0 is configured for MCCH, the mapping between PDCCH occasions and SSBs is the same as for SIB1 and in case common search space other than searchSpace#0 is configured for MCCH, 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.
	+ Proposal 6. The same beam is used for PDCCH scheduling MCCH and MCCH message PDSCH.
	+ [MTCH design] Proposal 17. The association between transmitted SSB indexes and group-common PDCCH monitoring occasions using the similar rule as defined for OSI in TS 38.331 for RRC\_IDLE/RRC\_INACTIVE UEs.
	+ [MTCH design] Proposal 18. The same beam is used for group-common PDCCH and the corresponding scheduled PDSCH.
* In [R1-2104697, Qualcomm]
	+ they discuss “For MCCH with QPSK, transmitted from serving cell, Alt1 may be sufficient. But for MTCH with higher modulation and/or SFN transmission, TRS is needed for GC-PDSCH reception.”
	+ Proposal 9: UE may assume that the GC-PDSCH for MTCH is QCL’d with SSB or periodic TRS if configured for broadcast reception.
* In [R1-2104761, OPPO]
	+ Proposal 3: Since PDCCH monitoring occasions are directly related to the SSB locations due to beam sweeping, the higher layer parameter “MCCH duration” is no longer necessary. RAN1 should inform RAN2 about this and recommend to remove this parameter if there is no other use.
	+ Proposal 4: The MBS window is defined as SFN mod T = offset, where the period T and offset are configured by the network. The MBS window is used to number PDCCH occasion from 0 for MTCH scheduling.
	+ Proposal 5a: The first PDCCH occasion of each data are configured by the network and the PDCCH occasion from configured first PDCCH occasion in ascending order can be mapped to SSB index in ascending order of their SSB indexes for corresponding data.
	+ Proposal 5b: If first PDCCH occasion of each data are not configured by the network, the PDCCH occasion from 0 in ascending order can be mapped to SSB index in ascending order of their SSB indexes data by data.
* In [R1-2105338, Samsung]
	+ Observation 4: Broadcast PDCCH receptions from UEs without dedicated RRC connection are QCL-ed with the cell-defining SS/PBCH block as in Rel-16. There is no need to discuss beam sweeping.
* In [R1-2105439, LG]
	+ Proposal 12: For group-common PDCCH to schedule MBS transmission, different SSB indexes can be related to different occurrences of a CORESET within monitoring periodicity (i.e. *monitoringSlotPeriodicityAndOffset*), i.e. Each repetition of a CORESET is related to one or more SSB indexes.
* In [R1-2105180, Sony]
	+ Proposal 3: For RRC\_IDLE/INACTIVE UEs, the network shall provide multiple associations between SSB range and each group-common PDCCH/PDSCH.
* In [R1-2105722, NTT DOCOMO]
	+ Proposal 3: For the association between SSB indexes and group-common PDCCH/PDSCH, reuse the association rule used for paging.
* In [R1-2105849, CHENGDU TD]
	+ Proposal: Beam sweeping is used for the group common PDSCH to transmit the data of all the Non-SPS RBs of the MBS session with the same beams as the PBCH/SS block
* In [R1-2105916, Ericsson]
	+ Proposal 3: When beam sweeping is used for unicast and/or multicast to RRC Connected UEs, the same beams may also carry multicast and/or broadcast, addressing Inactive/Idle UEs.
	+ Group-common PDCCH/PDSCH is QCl’d with TRS if configured.

### **FL Assessment**

For this Issue there are multiple contributions discussing different aspects and at different levels of discussion for beam sweeping. The FL proposes to try to start agreeing from higher level aspects that could help more detailed discussions at next meetings.

***Discussion on beam sweeping aspects for MCCH channel***

[vivo, CMCC] propose to confirm the RAN2 agreements on mapping between PDCCH monitoring occasions and SSBs for MCCH channel. On the other hand, [Huawei] proposes to focus the discussion in RAN1 in MTCH channel. The FL will put forward a proposal to confirm the RAN2 agreements to check companies’ positions.

***Discussion on beam sweeping aspects for MTCH channel***

In [Huawei], as for the MCCH channel, for the MTCH channel is proposed to reuse PDCCH monitoring occasions and SSBs as done for SIB1. This approach seems to be aligned with the approach used for MCCH and agreed by RAN2. However, it is worth pointing out that there is a parallel discussion for this meeting on SS for MTCH (Issue 3).

While [CATT, Huawei, Nokia, CMCC, LG, Sony, NTT DOCOMO] discuss details of the PDCCH monitoring association with SSBs for MTCH with similar mechanisms to paging and OSI, [Huawei, ZTE, OPPO, Nokia] also discuss details of the MTCH transmission window (e.g. window duration, offset, repetitions).

[CMCC] proposes to use the same beam for group-common PDCCH and the corresponding scheduled PDSCH for both MCCH and MTCH channels.

[Qualcomm] also discuss that MTCH group-common PDSCH reception can be QCL’d with TRS if configured to allow for higher order modulation and/or SFN transmission transparent to the UEs.

[OPPO] also propose that the higher layer parameter “MCCH duration” is no longer necessary and RAN1 should inform RAN2.

[Samsung] proposes that there is no need to discuss beam sweeping since PDCCH reception from UEs in idle/inactive are QCL’d with cell-defining SSB as in Rel-17.

[Ericsson] that beam sweeping used for unicast and/or multicast should also be able to address idle/inactive UEs. They also propose that TRS can be enabled.

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

**Proposal 2.5-1:** For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, RAN1 confirms the following RAN2 agreements:

* 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.

**Proposal 2.5-2**: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, in case searchSpace#0 is configured for MTCH (if allowed), the mapping between PDCCH occasions and SSBs is the same as for SIB1 as defined in TS 38.213.

**Proposal 2.5-3:** For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, in case common search space other than searchSpace#0 is configured for MTCH (if allowed), the association between PDCCH monitoring occasions and SSBs for MTCH channel use the similar rules as defined for Paging and OSI.

* The MTCH transmission window is defined by repetition period, window duration and radio frame/slot offset.

**Proposal 2.5-4:** For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, study whether same beam is used for group-common PDCCH and the corresponding scheduled PDSCH for MCCH and MTCH channels.

* UE may assume that the group-common PDSCH for MTCH is QCL’d with SSB or periodic TRS if configured.

Please provide your comments in the table below:

|  |  |
| --- | --- |
| **company** | **comments** |
| LG | **Proposal 2.5-2:** We prefer to configure a separate search space for MTCH carrying user traffic.**Proposal 2.5-3:** We do not understand how repetition period will work for user traffic, considering difference between various traffic pattern with changed user packets and periodic repetitions of same system information. If repetition is needed, we could refer to repetition of multicast in RRC\_CONNECTED. Thus, we propose to study MTCH transmissions as follows:**Proposal 2.5-3:** For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, in case common search space other than searchSpace#0 is configured for MTCH (if allowed), study the association between PDCCH monitoring occasions and SSBs for MTCH channel ~~use the similar rules as defined for Paging and OSI.~~* ~~The MTCH transmission window is defined by repetition period, window duration and radio frame/slot offset.~~

**Proposal 2.5-4:** We are not sure if TRS should be considered. Thus, we propose to change to:**Proposal 2.5-4:** For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, study whether same beam is used for group-common PDCCH and the corresponding scheduled PDSCH for MCCH and MTCH channels.* UE may assume that the group-common PDSCH for MTCH is QCL’d with SSB ~~or periodic TRS if configured.~~
* FFS: QCL’d with periodic TRS if configured
 |
| ZTE | We are ok with Proposal 2.5-1 and 2.5-2. Regarding Proposal 2.5-3, our understanding is that MTCH should reuse the same mechanism as MCCH, i.e., reusing the OSI mechanism. Besides, the Paging mechanism is not suitable for broadcast as it separate different UEs into different POs, which is not needed for broadcast. Thus, we suggest to reuse the OSI mechanism.**Proposal 2.5-3 (Updated by ZTE):** For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, in case common search space other than searchSpace#0 is configured for MTCH (if allowed), the association between PDCCH monitoring occasions and SSBs for MTCH channel use the similar rules as defined for OSI.* The MTCH transmission window is defined by repetition period, window duration and radio frame/slot offset.

If we allow PDSCH for MCCH and MTCH to be QCLed with TRS, it would introduce huge spec change. We believe the SSB should be sufficient. We propose the following.**Proposal 2.5-4:** For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, the same beam is used for group-common PDCCH and the corresponding scheduled PDSCH for MCCH and MTCH channels. |
| CMCC | **2.5-1:** Support.**2.5-2:** Support.**2.5-3:** Not sure whether the association between PDCCH monitoring occasions and SSBs for MTCH channel use the similar rules as defined for Paging and OSI are the same. If we follow the same rule as MCCH, we can only agree similar rule as OSI as in proposal 2.5-1.**2.5-4:** Same concern as LG |
| NOKIA/NSB | **Proposal 2.5-1 Support****Proposal 2.5-2 Support****Proposal 2.5-3:** Similar rule as OSI, not paging. And we agree with LG that we need to “study the association between PDCCH monitoring occasions and SSBs for MTCH channel**”****Proposal 2.5-4:** Do we have agreed yet the TRS is supported for Rel17 MBS? To our knowledge, it is not agreed yet. |
| Qualcomm | Agree to delete paging in 2.5-3.Find with other proposals  |

## Issue 6: CORESET for MCCH and MTCH channels

### **Background**

The following agreement for RRC\_IDLE/RRC\_INACTIVE UEs at RAN1#103-e is relevant for this discussion:

|  |
| --- |
| 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. |

Additionally, the discussion at RAN1#104-e highlighted (R1-2102180) that the agreement above on CORESET configuration, it may not be clear whether the configured CORESET is in addition to or instead of CORESET0. It also seems that different companies may have different interpretations on the RAN1#103e CORESET configuration agreement.

Another controversial aspect on this discussion was the number of CORESETs which a UE could be configured. Some companies wanted to support multiple CORESETs while other companies wanted to restrict the support to a single CORESETs.

It is also worth noting that the discussions about CFRs in Issues 1&2 may have an impact on this discussion but the FL will try to phrase the proposals in a way to try to move the discussion in parallel if possible.

### **Tdoc analysis**

* In [R1-2104250, Huawei]
	+ Proposal 3: For broadcast scheduling, additional CORESET/SS in addition to CORESET0/SS 0 can be configured for group-common PDCCH/PDSCH of MTCH.
* In [R1-2104338, ZTE]
	+ Proposal 4: For RRC\_IDLE/RRC\_INACTIVE UEs,
		- the CORESET configured within the common frequency resource for group-common PDCCH can be applied for MBS control information reception, broadcast, multicast and unicast.
		- networks configures CORESET#0 or common CORESET configured by *commonControlResourceSet* for group-common PDCCH if MBS CORESET is not configured.
* In [R1-2104493, CATT]
	+ Proposal 6: When the CFR contains CORESET0, CORESET0 can be used by default if the CORESET for group-common PDCCH/PDSCH is not configured.
	+ Proposal 7: When the CORESET is configured for group-common PDCCH, CORESET0 can be also used for configuring MBS search space.
* In [R1-2104552, Nokia]
	+ They discuss “The introduced new additional CORESET may bring the UE capability issue as raised by some companies in earlier meeting, where as specified in TS 38.306 on UE capability, currently it is mandatory for UEs to support two CORESETs (CORESET#0+Additional CORESET, where the Additional CORESET is configured by *commonControlResourceSet*) per BWP, and the support of more than two CORESETs for UE is optional and depends on UE capability.”
	+ Proposal-5: Considering defining additional new CORESET, CFR\_CORESET, for CFR [Case D] and [Case E], based on UE capability.
	+ Proposal-6: Discuss whether the group-common PDCCH that scheduling corresponding group-common PDSCH can be carried outside the configured CFR.
	+ Proposal-7: Separated CORESET configuration could also be considered for MCCH and MTCH respectively based on CFR configuration.
* In [R1-2104634, CMCC]
	+ Proposal 2. CORESET0 or *commonControlResourceSet* can be re-used as the CORESET for PDCCH used for scheduling MCCH.
	+ [MTCH design] Proposal 11. The *commonControlResourceSet* can be used as the configured CORESET for group-common PDCCH when the CFR with the same size as the frequency resources as CORESET0, i.e., Case A.
	+ [MTCH design] Proposal 12. The *commonControlResourceSet* or an CORESET has larger bandwidth than CORESET0 can be used or configured as the CORESET for group-common PDCCH when the CFR with the same size as the SIB1-configured initial DL BWP, i.e., Case C. CORESET 0 is used by default if the *commonControlResourceSet* or the CORESET has larger bandwidth than CORESET0 are not configured.
* In [R1-2104697, Qualcomm]
	+ Proposal 3: CORESET of GC-PDCCH for MCCH and MTCH can be separately configured in corresponding CFR.
		- CORESET for MCCH can be configured by SIB.
		- CORESET for MTCH can be configured by MCCH.
* In [R1-2105338, Samsung]
	+ Observation 2: RRC\_IDLE/RRC\_INACTIVE UEs can be configured a maximum of 2 CORESETs (including CORESET#0).
	+ Proposal 2. When SIB1 configures an initial DL BWP, SIBx can configure one CORESET (other than CORESET#0).
* In [R1-2105602, Convida]
	+ Proposal 4: One or more CORESETs can be configured for group-common PDCCH within an MBS specific BWP for UEs in RRC\_IDLE/RRC\_INACTIVE states.
* In [R1-2105849, CHENGDU TD]
	+ Proposal 4: If only one MCCH is configured for a cell, the CORESETs for the MCCH monitoring and the MCCH specific group common PDSCH are configured within the initial BWP for DL.
* In [R1-2105916, Ericsson]
	+ Proposal 9: If multicast to UEs in RRC Inactive/Idle is supported, we propose to reuse the same CORESET solution as for multicast in RRC Connected.
		- Note: CORESET0 is normally not used for multicast (only as fallback).

### **FL Assessment**

***Discussion on number of CORESETs***

[Huawei, CATT, Convida] support that a CORESET in addition to CORESET0 can be configured for group-common PDCCH/PDSCH of MTCH.

[Samsung, Nokia] clarify that currently it is mandatory for UEs to support two CORESETs (CORESET#0+Additional CORESET). [Nokia] further clarifies that the Additional CORESET is configured by *commonControlResourceSet*) per BWP, and [Nokia, Convida] discuss the support of more than two CORESETs for UE is optional and depends on UE capability.

***Discussion on configuring common CORESET configured by commonControlResourceSet***

[ZTE, Nokia, CMCC] proposes (or discuss) that the network can configure CORESET#0 or common CORESET configured by *commonControlResourceSet* for group-common PDCCH if CORESET is not configured.

***Discussion on coreset configuration for MCCH and MTCH***

While [ZTE] proposes that the same CORESET configuration can be applied to MCCH, MTCH (as well as broadcast, multicast and unicast), [Qualcomm, Nokia, CMCC] proposes that separate CORESET configuration could be considered for MCCH and MTCH.

***Discussion on reusing RRC\_CONNECTED CORESET configuration if multicast is supported in RRC\_IDLE/INACTIVE***

[Ericsson] also proposes if multicast to UEs in RRC Inactive/Idle is supported, we propose to reuse the same CORESET solution as for multicast in RRC Connected.

For the next proposals, the FL suggests starting the discussion for the case where the CFR has the same frequency range as the initial BWP, that was the last stage of the discussion at RAN1#104-e. Also, given that multicast support for idle/inactive UEs will be discussed at RAN2 at a later point, the FL suggests focusing the discussion on for broadcast reception.

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

**Proposal 2.6-1**: For Rel-17, for broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs do not exceed the maximum number of CORESETs mandatorily supported for Rel-15/Rel-16 UEs, i.e., 2 CORESETs. If the CFR has the same frequency range as the initial BWP, 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*.
* FFS is the possibility to configure more than 2 CORESETs based on UE capability.

**Proposal 2.6-2:** For RRC\_IDLE/RRC\_INACTIVE UEs, the CORESET configurations can be the same for MCCH and MTCH channels.

* FFS is whether the CORESET configurations can be different for MCCH and MTCH channels.
* FFS is reuse of CORESET configuration for multicast reception from RRC\_CONNECTED UEs.

Please provide your comments in the table below:

|  |  |
| --- | --- |
| **company** | **comments** |
| LG | **Proposal 2.6-1**: we are fine with this proposal. We think that if the CORESET configurations can be different for MCCH and MTCH channels, CORESET for MTCH is configured by MCCH. |
| Lenovo, Motorola Mobility | **We are Ok with two proposals.** |
| ZTE | Ok with the above two proposals. |
| CMCC | 2.6-1: support2.6-2: not sure why we reuse CORESET configuration for multicast reception from RRC\_CONNECTED UEs? |
| NOKIA/NSB | Proposal 2.6-1: SupportRegarding 2.6-2, We had similar query as CMCC. Also the CORESET configuration for MCCH and MTCH may depend on the CFR configuration for MCCH and MTCH. If there are different CFR configurations for MCCH and MTCH, it can be different CORESET configurations for MCCH and MTCH as well. |
| Qualcomm | For 2.6-1, for last FFS, UE capability of IDLE UEs is not known by gNB. We assume the UEs capable of supporting broadcast can support it without additional reporting of UE capability. For 2.6-2, why different CORESET cannot be supported for MCCH/MTCH? It seems straightforward to configure same or different CORESETs for MCCH/MTCH if different CFR can be configured for MCCH and MTCH. |

## Issue 7: DCI format for MCCH and MTCH channels

### **Background**

For RRC\_IDLE/INACTIVE UEs there has not been yet a discussion on DCI formats. Multiple inputs have discussed this issue in their tdocs to this meeting. The DCI format discussion is also related to Issue 4 (RNTI and DCI design for carrying MCCH change notifications) that also has in scope the RAN2 LS in R1-2104165 (and copied in Annex B of this document).

### **Tdoc analysis**

* In [R1-2104250, Huawei]
	+ They discuss “Regarding the DCI format for broadcast scheduling for UE in RRC\_IDLE/INACTIVE states, at least DCI format 1\_0 is supposed to be supported with some fields subject to necessary modification. One instance for the modification is the FDRA field, which should be dimensioned per the size of CFR for RRC\_IDLE/RRC\_INACTIVCE UEs instead of the bandwidth of CORESET0 or the bandwidth of the SIB1 configured initial BWP.”
	+ Proposal 4: For broadcast scheduling, the FDRA filed in the DCI for scheduling MTCH or MCCH should be dimensioned per the bandwidth of the configured CFR.
* In [R1-2104634, CMCC]
	+ They separate the discussion between MCCH and MTCH channels.
	+ Proposal 4. DCI format 1\_0 is used for scheduling MCCH, which the Rel-15/16 fields of DCI format 1\_0 with CRC scrambled by SI-RNTI can all be used.
	+ [MTCH design] Proposal 16. DCI format 1\_0 is used for schedule group-common PDSCH.
* In [R1-2104697, Qualcomm]
	+ Proposal 5: DCI format 1\_0 can be used as the baseline for MCCH, MTCH, and MCCH change notifications.
* In [R1-2104867, Lenovo]
	+ Proposal 7: The number of bits for frequency domain resource assignment indicator in the group-common DCI is determined based on the bandwidth of the initial DL BWP if the specific common frequency resource is not configured or the specific common frequency resource if the specific common frequency resource is configured.
* In [R1-2104930, Intel]
	+ Proposal 2: DCI format 1\_0 is used for scheduling group common PDSCH for RRC\_IDLE/INACTIVE UE

### **FL Assessment**

All inputs discuss/propose that DCI format 1\_0 should be supported at least as the baseline. [Huawei, Lenovo] also discuss that the FDRA may need to be adjusted according to the CFR size. [Qualcomm, CMCC] also separate the discussion between MCCH and MTCH channels but agree that DCI format 1\_0 can be used for both channels.

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

**Proposal 2.7-1:** For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, DCI format 1\_0 is used as baseline for MCCH and MTCH channels.

* FFS details of FDRA.

Please provide your comments in the table below:

|  |  |
| --- | --- |
| **company** | **comments** |
| LG | WE are fine with this proposal. |
| Lenovo, Motorola Mobility | Support. |
| ZTE | Ok with the above proposal.Maybe it is better if we can clarify which RNTI for DCI 1\_0 is used as the baseline as the DCI fields for different RNTI for DCI format 1\_0 are different. But anyway, we can discuss these issue later. |
| CMCC | Support |
| Futurewei | Support |
| NOKIA/NSB | Support |
| Qualcomm | ok |

## Issue 8: RAN2 LS on broadcast session delivery and MCCH design

This is a place holder to discuss a potential reply to RAN2 based on LS on R1-2104165 based on progress on Issues 1, 2, 3 and 4.

## Other Issues

Here, we include other issues that have been discussed at the tdocs submitted to this meeting.

### **Other Issue 1: Number of MBS Common Frequency Resources**

* [R1-2104338, ZTE], [R1-2104552, Nokia], [R1-2105338, Samsung], [R1-2105849, CHENGDU TD]

### **Other Issue 2: HARQ feedback for RRC\_IDLE/RRC\_INACTIVE UE states**

* [R1-2104634, CMCC], [R1-2104761, OPPO], [R1-2104930 , Intel], [R1-2105338, Samsung], [R1-2104389, vivo]

### **Other Issue 3: PDSCH repetition/HARQ combining**

* [R1-2104338, ZTE], [R1-2104697, Qualcomm], [R1-2105722, NTT DOCOMO]

### **Other Issue 4: PDSCH Semi Persistent Scheduling**

* [R1-2104338, ZTE], [R1-2104634, CMCC], [R1-2105602, Convida], [R1-2105849, CHENGDU TD], [R1-2104389, vivo]

### **Other Issue 5: Multicast reception by UEs in IDLE/INACTIVE states**

* [R1-2105916, Ericsson]

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

* [R1-2104493, CATT]

### **Other Issue 7: PDSCH TDRA table configuration**

* [R1-2104338, ZTE]

### **Other Issue 8: PDSCH transmission parameters (MCS, MIMO layers, etc.)**

* [R1-2104697, Qualcomm]

### **Other Issue 9: Scrambling sequence initialisation for GC-PDCCH/PDSCH**

* [R1-2105338, Samsung]

### **Other Issue 10: Broadcast services supported for both RRC\_CONNECTED and RRC\_IDLE/RRC\_INACTIVE UEs**

* [R1-2104493, CATT], [R1-2105383, MediaTek]

### **Other Issue 11: MBS Interest Indication for partial beam sweeping**

* [R1-2104552, Nokia], [R1-2105180, Sony]

# Proposals for Discussion at GTW sessions

This section will include proposals for potential discussion at the different GTW scheduled for MBS at RAN1#105-e.

# Summary

This section will include the summary and potential agreements for the different issues discussed at RAN1#105-e.

# References

1. RP-201038 *Revised Work Item on NR Multicast and Broadcast Services*, Huawei, HiSilicon
2. R1-2104165 LS on broadcast session delivery and MCCH design, RAN2, Huawei
3. R1-2104576 [DRAFT] Reply LS on broadcast session delivery and MCCH design, ZTE
4. R1-2104197 MBS Support for RRC IDLE/INACTIVE UEs, FUTUREWEI
5. R1-2104250 Discussion on UE receiving broadcast in RRC IDLE/INACTIVE state, Huawei, HiSilicon, CBN
6. R1-2104338 Discussion on basic Functions for Broadcast or Multicast for RRC\_IDLE or RRC\_INACTIVE UEs, ZTE
7. R1-2104389 Discussion on basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs, vivo
8. R1-2104444 Basic Functions for Broadcast or Multicast for RRC\_IDLE or RRC\_INACTIVE UEs, Spreadtrum Communications
9. R1-2104493 Discussion on basic functions for MBS for RRC\_IDLEINACTIVE UEs, CATT, CBN
10. R1-2104552 Basic Functions for Broadcast / Multicast for RRC\_IDLE / RRC\_INACTIVE Ues, Nokia, Nokia Shanghai Bell
11. R1-2104634 Discussion on NR MBS in RRC\_IDLE/ RRC\_INACTIVE states, CMCC
12. R1-2104697 Views on group scheduling for Multicast RRC\_IDLE/INACTIVE UEs, Qualcomm Incorporated
13. R1-2104761 Discussion on support for IDLE and INACTIVE state Ues, OPPO
14. R1-2104867 Basic functions for broadcast/multicast in idle/inactive states, Lenovo, Motorola Mobility
15. R1-2104930 NR-MBS for RRC\_IDLE/INACTIVE UEs, Intel Corporation
16. R1-2105130 Discussion on MBS for RRC\_IDLE/RRC\_INACTIVE UEs, Apple
17. R1-2105180 Considerations on MBS functions for RRC\_IDLE/RRC\_INACTIVE UEs, Sony
18. R1-2105338 On basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs, Samsung
19. R1-2105383 Discussion on broadcast or multicast for RRC\_IDLE or INACTIVE UEs, MediaTek Inc.
20. R1-2105439 Basic function for broadcast/multicast, LG Electronics
21. R1-2105602 Discussion on MBS for RRC\_IDLE/RRC\_INACTIVE UEs, Convida Wireless
22. R1-2105673 Discussion on MBS for RRC\_IDLE/INACTIVE UE, Google Inc.
23. R1-2105722 Discussion on basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs, NTT DOCOMO, INC.
24. R1-2105849 Basic functions for MBS for RRC\_IDLE/RRC\_INACTIVE UEs, CHENGDU TD TECH LTD.
25. R1-2105916 Support for NR multicast reception in RRC Inactive/Idle, Ericsson
26. R1-2105526 Impact from MCCH and MTCH on broadcast reception, Huawei, HiSilicon

# 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.

# Annex B: RAN2 LS on broadcast session delivery and MCCH design

R1-2104165 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).**
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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**
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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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