**3GPP TSG RAN WG1 #106-e R1-210XXXX**

**e-Meeting, August 16th – 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.

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

[106-e-NR-MBS-03] Email discussion/approval on basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs and the LS in [R1-2106410](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_106-e%5CDocs%5CR1-2106410.zip) (from AI5) including any reply LS as necessary with checkpoints for agreements on August 19, 24 and 27 – David (BBC)

In this document the Feature Lead (FL) provides a summary of the technical documents (tdocs) submitted to RAN1#106-e to the. This document also presents proposals for discussion and agreements reached at RAN1#106-e.

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

# Issues

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

### **Background**

During RAN2#113bis-e meeting, RAN2 discussed further aspects of MCCH scheduling with RAN1 impacts. Here we reproduce relevant RAN2 agreements relevant to the discussion on the 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 in [R1-2104165] requests RAN1 to investigate and provide feedback, considering agreements made by RAN2 as indicated in the LS where the following request is relevant for the discussion on CFR:

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| * Details of the allowed transmission bandwidth/BWP configurations for MCCH transmission.
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RAN2 discussed further the aspects related to MCCH design and made the following agreements during RAN2#114 meeting relevant to the discussion on CFR for MCCH/MTCH:

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| * MBS specific SIB is defined to carry MCCH configuration.
* Postpone the discussion on whether dedicated MCCH configuration is required until RAN1 makes progress on BWP/CFR for MCCH.
* We support single MCCH (in this release)
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The following agreements for RRC\_IDLE/RRC\_INACTIVE UEs at RAN1#103-e, RAN1#104-e and RAN1#105-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.

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

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

* In [R1-2106440, R1-2107662, Huawei]
	+ *Discuss*: Comparing 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 1: For broadcast scheduling, support configuring a CFR for group-common PDCCH/PDSCH of MCCH/MTCH with the same size as the initial BWP configured by SIB1, and the configured CFR should contain CORESET#0.
	+ Observation 1: For receiving broadcast, MCCH and MTCH may have different requirements, which result in necessary separate discussions.
	+ Proposal 4: The CFR, CORESET, and search space for MCCH and MTCH can be configured separately.
		- The CFR, CORESET, and search space for MTCH scheduling can be included in MCCH.
* In [R1-2106625, vivo]
	+ *Discuss*: And thus, we believe Case B and Case D are not necessary. If gNB wants to schedule MBS service only in a CFR smaller than initial DL BWP configured by CORESET0 or SIB1, it can be up to gNB’s implementation but no need to configure a smaller CFR additionally.
	+ *Discuss*: Furthermore, in order to ensure RRC idle/inactive UEs to monitor both MCCH and SI/paging without BWP switching, CORESET0 shall be included in the configured/defined CFR, and thus, we support that one configured/defined CFR fully contains the CORESET0 in frequency domain and has the same SCS and CP as CORESET0.
	+ 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, where the initial BWP has the same frequency resources as CORESET0, to receive GC-PDCCH/PDSCH carrying MTCH.
* In [R1-2106664, Nokia]
	+ *Discussion*: So for Rel17 MBS, it is understood that there can be a new SIBx configured CFR parameter introduced, where it allows the RRC\_IDLE/INACTIVE UEs to operate with bandwidth more than just the legacy CORESET#0 narrow region for carrying larger MBS service payload if needed.
	+ Proposal-1: Considering introducing a new SIBx configured CFR parameter, where it allows the RRC\_IDLE/INACTIVE UEs to operate with bandwidth more than just the legacy CORESET#0 narrow region.
	+ Proposal-2: Support of CFR Case C, Case D-1 and Case E on top of Case A.
	+ Proposal-3: CFR for MCCH and MTCH can be configured to be the same or differently.
	+ Proposal-4: Support more than one CFRs, with separate CFR for MCCH and MTCH, respectively.
	+ Proposal-5: Considering having multiple CFRs is supported, it is enough to have single MCCH CFR configured, but there can be multiple MTCH CFRs configured corresponding to difference MBS service types applied.
	+ Proposal-6: It is proposed that the CFR for MCCH can be configured other than default CORESET#0.
* In [R1-2106718, Spreadtrum]
	+ Proposal 2: RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, do not support to configure a dedicated BWP that is larger than the initial BWP.
* In [R1-2106747, ZTE]
	+ *Discuss*: For broadcast services carried on MTCH, if they can only use the initial DL BWP defined by CORESET#0, it would be too restrictive. As we know, all the common signals/channels have to be squeezed into this initial DL BWP, which makes it difficult to accommodate common PDCCH/PDSCH for broadcast services. Thus, it is critical to configure a CFR that is larger than CORESET#0 for broadcast services.
	+ *Discuss*: The essential difference between Case E and other cases is whether a high-layer signalling is introduced to configure a special BWP for the UE in RRC\_IDLE/INACTIVE states for receiving broadcast services. Under Case C and Case D, the CFR configuration depends on the initial BWP configured by the existing signalling in the SIB1.
	+ Proposal 1: Case E is clarified as follows,
		- A high-layer signalling is introduced to configure a special BWP for the UE in RRC\_IDLE/INACTIVE states for receiving broadcast services.
		- The CFR has the frequency resources identical to the configured BWP.
		- The configured BWP needs to fully contain the initial BWP defined by CORESET#0 in frequency domain and has the same SCS and CP as the initial BWP.
		- The configured BWP is not larger than the carrier bandwidth.
	+ *Discuss*: When the UE enters the RRC\_CONNECTED state, some companies worry about BWP switching issue under the case E. That is, the UE will receive broadcast within the configured BWP, and switch to SIB1 configured initial BWP for receiving unicast. In our opinion, this problem is caused by a configuration error, which also exists under the Case C. More specifically, the first active BWP after the UE enters the RRC\_CONNECTED state is configured through signalling *firstActiveDownlinkBWP-Id*. The gNB can configure any BWP as the first active BWP. For example, the BWP configured in the RRC\_IDLE/INACTIVE states for broadcast is configured as the first active BWP. Thus, unicast and broadcast will be received within the configured BWP, and there will be no BWP switching problem. The first active BWP can also be configured to completely contain the BWP for broadcast service. Thus, the BWP configured under the RRC\_IDLE/INACTIVE states will degrade into a frequency range within the first active BWP, which is also consistent with the definition of CFR in the RRC\_CONNECTED state.
	+ Observation 1: Potential BWP switching issue under Case E as well as Case C can be avoided through reasonable RRC configurations, i.e., a first active BWP containing the CFR.
	+ Observation 2: Case C requires UE to activate the initial BWP configured by SIB1 in RRC\_IDLE/INACTIVE states, 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.
	+ Proposal 2: Case E is supported for broadcast service carried on MTCH in R17 NR MBS.
	+ 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 3: Case D-2 (Initial DL BWP configured by SIB1 fully contains CFR, CFR is not required to fully contain CORESET#0) can be used to increase the capacity of broadcast service on MTCH for bandwidth-restricted UEs, e.g., Redcap UE.
		- FFS: other restrictions on CFR configuration.
	+ Observation 4: The motivation of a CFR larger than CORESET#0 for broadcast control information carried on MCCH is not strong in R17 NR MBS.
* In [R1-2106914, Samsung]
	+ *Discuss*: It is noted that unlike RRC\_CONNECTED UEs for which the active DL BWP is UE-specific, the active DL BWP for RRC\_IDLE/RRC\_INACTIVE UEs is UE-common and it is not necessary for a gNB to configure a CFR for MBS – the gNB can do so by indicating the initial DL BWP in the SIB if the gNB wants a large CFR; otherwise, the CFR can be the BWP of CORESET#0. It is also noted that the gNB can provide the initial DL BWP with an extension in SIB1 that is only applicable to MBS UEs (if not provided for legacy UEs or non-MBS UEs which can remain unaffected if the gNB so chooses).
	+ *Discuss*: If SIB1 configures an initial DL BWP, then Case C or Case D would be used. If SIB1 does not configure an initial DL BWP, then Case A or Case B would be used, because CORESET#0 becomes the initial DL BWP as default.
	+ *Discuss*: Also, when the UE monitors the initial BWP regardless of MBS configuration, there is no benefit to monitor different frequency regions between MCCH and MTCH.
	+ 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).
	+ Proposal 2. For broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs can use the same bandwidth configurations for the CFR of GC-PDCCH/PDSCH carrying MCCH and the CFR of GC-PDCCH/PDSCH carrying MTCH.
* In [R1-2106947, CATT]
	+ Proposal 1: Case C i.e. UE use a configured/defined CFR with the same size as the initial BWP, where the initial BWP configured by SIB1, to receive GC-PDCCH/PDSCH carrying MCCH or MTCH is supported.
	+ *Discuss*: For Case E, an extra BWP (i.e. Configured BWP) is configured, and it fully contains the initial BWP. In this case, UEs will maintain two BWPs to receive MBS and SIB-x information, which will bring the BWP switching delay.
	+ Proposal 2: The case where a CFR is defined based on a configured BWP (Case E) is not supported due to the BWP switching.
* In [R1-2107095, Futurewei]
	+ 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 [R1-2107162, Lenovo]
	+ 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 signalling.
* In [R1-210723, OPPO]
	+ Proposal 1: For broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs can use a configured CFR with same size as the initial BWP, where the initial BWP has the frequency resources configured by SIB1 (i.e., Case C), to receive GC-PDCCH/PDSCH carrying MCCH.
	+ Proposal 2: For broadcast reception, case C and/or case E can be considered for RRC\_IDLE/RRC\_INACTIVE UEs with a configured CFR to receive GC-PDCCH/PDSCH carrying MTCH.
	+ Proposal 3: For broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs can use the same bandwidth configurations for the CFR of GC-PDCCH/PDSCH carrying MCCH and the CFR of GC-PDCCH/PDSCH carrying MTCH.
* In [R1-2107371, Qualcomm]
	+ *Discuss*: Now, we are discussing the UE behavior of new Rel-17 UEs capable of broadcast reception. If a CFR is configured with the same size as initial BWP broadcasted by SIB (i.e., Case C), it is common for Rel-17 UEs in all states to receive broadcast GC-PDCCH/GC-PDSCH. For RRC\_IDLE/INACTIVE UEs, the CORESET#0 is still the “initial BWP to receive SIB/paging” but the broadcast CFR with bandwidth size of “SIB-indicated initial BWP” larger than CORESET#0 can be regarded as a new BWP, differentiated from the “initial BWP to receive SIB/paging”. For Case B and D, it seems unnecessary to further limit a CFR with size smaller than the initial BWP for broadcast MCCH/MTCH.
	+ Proposal 2: For MCCH/MTCH.
		- The CFR can be configured with the frequency size same as CORESET#0 or SIB-configured initial BWP or larger than that of initial BWP.
		- Different PDSCH/PDCCH parameters can be configured in the CFR for MCCH and the CFR for MTCH.
	+ Proposal 3: For IDLE/INACTIVE UEs, the CFR for broadcast with frequency size larger than CORESET#0 can be configured as a BWP.
* In [R1-2107427, CMCC]
	+ *Discuss*: From this point of view, Case C and Case E can both achieve to configure CFR larger than CORESET#0. But comparing between these two cases, Case E has more spec impact than Case C, e.g., the BWP switching time between initial DL BWP and MBS specific BWP, the configuration of MBS specific BWP. In addition, after UE goes into RRC\_CONNECTED mode, more things need to be considered, e.g., whether both initial DL BWP configured by SIB1 and MBS specific BWP are activated if UE-specific BWP is not configured by RRC dedicated signalling, the fallback BWP switching behaviour when BWP timer expires. Therefore, Case C can be supported which has little spec impact to configure a CFR larger than CORESET#0 used for broadcast service and both suitable for RRC\_IDLE/INACTIVE and RRC\_CONNECTED UEs.
	+ Proposal 1. For RRC\_IDLE/RRC\_INACTIVE UEs, Case C can be supported as configured/defined specific CFR for MTCH/MCCH.
	+ Proposal 2. If initial DL BWP is configured by SIB1 which larger than CORESET#0, gNB can configure whether the CFR equals to the bandwidth of CORESET#0 (Case A) or initial DL BWP (Case C).
* In [R1- 2107458, LGE]
	+ Observation 1: If the CFR is associated with the initial DL BWP for a connected UE, the CFR can be also used by idle/inactive UEs.
	+ Proposal 2: For Rel-17, the CFR associated to the initial DL BWP cannot be configured with a different numerology than that of the initial DL BWP.
	+ Observation 2: Limiting to broadcast transmission within the initial DL BWP would lead to low broadcast capacity in CFR and potentially cause overload in initial DL BWP.
	+ 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.
* In [R1-2107516, MediaTek]
	+ Proposal 1: The unified CFR is defined/configured for GC-PDCCH/PDSCH carrying MCCH and GC-PDCCH/PDSCH carrying MTCH.
	+ Proposal 2: For broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs can be configured a CFR with same or smaller size as the initial BWP, where the initial BWP has the same frequency resources configured by SIB1, to receive GC-PDCCH/PDSCH carrying MCCH or MTCH.
	+ Proposal 3: Not support MBS specific BWP configuration for UE supporting broadcast reception in RRC\_IDLE/RRC\_INACTIVE states.
* In [R1-2107765, Apple]
	+ 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 SIB1.
* In [R1-2107883, NTT DOCOMO]
	+ Proposal 1: For GC-PDCCH/PDSCH carrying MTCH, support Case C, D and E.
	+ Proposal 2: For GC-PDCCH/PDSCH carrying MCCH, not support Case C, D or E.
* In [R1-2107952, Chengdu TD Tech]
	+ Proposal 1: CFR-II can be configured to contain the initial BWP for DL.
	+ Proposal 2: If CFR-II is far greater than the initial BWP for DL, it can be divided into several sub-BWPs. Each sub-BWP contains the initial BWP for DL, the CORESETs for the MCCH and MBS session monitoring, and MCCH.
* In [R1-2108028, Convida]
	+ Proposal 1: 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 2: Support Case E for the CFR design for the RRC\_IDLE/RRC\_INACTIVE UEs.
* In [R1-2108172, Ericsson]
	+ *Discuss*: Regarding the possibility to use SIB1-configured Initial BWP in all RRC states, this seems difficult since legacy unicast operation requires the UE to use the CORESET#0 Initial BWP while in Idle/Inactive to receive system information and paging. Assuming the UE cannot simultaneously use two different Initial BWPs, the UE can therefore not at the same time use the legacy-required Coreset#0 Initial BWP and a SIB1-configured Initial BWP, even with special spec changes for broadcast, assuming a UE receiving broadcast will also need to behave according to legacy unicast requirements.
	+ *Discuss*: One reason to map MCCH and MTCH to different BWPs could perhaps be power saving. However, most part of the power saving comes from the time-domain power saving using e.g. DRX. Some additional power saving could also be achieved if the frequency window of the UE could be dynamically changed depending on whether MCCH (smaller BWP) or MTCH (larger BWP) is received. If the actual frequency window is dynamically changed this implies true BWP switching, which has unacceptable consequences, especially considering that RRC Connected UEs also need to receive the transmissions, together with unicast and potentially multicast. Without such true BWP switching there is no frequency-domain power saving, since the UE then needs to keep the frequency window fixed to receive the BW of the largest BWP. The fact that MCCH is actually transmitted in a small BWP does then not allow for any power saving, since the large frequency window is anyway used all the time.
	+ *Discuss*: When MCCH and MTCH are instead both transmitted in a configured BWP the UE still needs to receive SI/paging, transmitted in the CORESET#0 Initial BWP. This is similar to the case with RRC Connected UEs receiving data in the active BWP and at the same time monitoring SI in the CORESET#0 Initial BWP. Since Connected UEs have this required functionality it looks natural to require the same for UEs receiving broadcast data on a configured BWP at the same time as receiving SI/paging in the CORESET#0 Initial BWP.
	+ Proposal 10: For broadcast, a configured CFR/BWP may be used, which contains the CORESET#0 Initial BWP.
	+ Proposal 11: The MCCH and MTCH may be mapped to the same CFR/BWP (CORESET#0 or configured CFR/BWP)
	+ Proposal 12: No support for a CFR smaller than (i.e. subset of) the CORESET#0 Initial BWP or smaller than (i.e. subset of) a configured BWP.
	+ Conclusion: SIB1-configured Initial BWP is not used for broadcast by RRC\_IDLE/RRC\_INACTIVE UEs.

### **FL Assessment**

The discussion on Common Frequency Resources (CFR) for MBS has been discussed extensively during the past meetings and multiple inputs to this meeting have addressed this topic. The discussion in this Issue on MBS CFR for broadcast reception is divided in the following sub-topics: i) discussion on down-selection from Case B to Case E, as identified at RAN1#104-e, for CFR of MCCH and MTCH, and ii) discussion on separate/same bandwidth (BW) configurations for CFR of MTCH and MCCH.

***Down-selection from Cases B, C, D and E for a configured/defined CFR for MCCH and MTCH***

The topic on configured/defined CFR was discussed extensively during the last meetings and at RAN1#105-e, it was agreed to support Case A for both MCCH and MTCH. This section discusses down-selection for the rest of cases identified at RAN1#104-e.

* *A configured/defined CFR with larger size than the initial BWP, where the initial BWP has the same frequency resources as CORESET#0*

[Huawei, vivo, Nokia, Spreadtrum, ZTE, Samsung, CATT, Futurewei, Lenovo, OPPO, Qualcomm, CMCC, LGE, MediaTek, Apple, NTT DOCOMO, Chengdu TD Tech, Ericsson] discuss/propose that at least MTCH should be able to use a configured/defined CFR with larger size than the initial BWP, where the initial BWP has the same frequency resources as CORESET#0. The limited BW of CORESET#0 together with allocation of system information signals in the same frequency range is the main motivation the use of configured/defined CFR with larger size to accommodate bit-rates required for MBS broadcast services.

[ZTE, NTT DOCOMO] while supporting CFR larger than the frequency resources of CORESET#0 for MTCH, they do not see strong motivation for MCCH.

There is clear consensus on a configured/defined CFR with larger size than the initial BWP, where the initial BWP has the same frequency resources as CORESET#0, at least MTCH. For MCCH, there are two companies that do not see a strong motivation.

A configured/defined CFR with larger size than the initial BWP, where the initial BWP has the same frequency resources as CORESET#0 can be accommodated with either Case C or Case E. However, this is a disputed topic that is addressed below.

* *Case C (SIB-1 configured initial BWP has same size as the CFR in the frequency domain) and Case E (CFR is defined based on a configured BWP)*

[Huawei, vivo, Nokia, Samsung, ZTE, CATT, Futurewei, Lenovo, OPPO, Qualcomm, CMCC, LGE, MediaTek, Apple, Ericsson] support a configured/defined CFR with the same size as the initial BWP, where the initial BWP has the frequency resources configured by SIB1 (i.e., Case C), for both MCCH and/or MTCH (or do not make a distinction between channels).

However, it is important to note that there are different opinions on how to achieve a configured/defined CFR with the same size as the initial BWP, where the initial BWP has the frequency resources configured by SIB1. In particular, [Nokia] proposes introducing a new SIBx configured CFR parameter, [Samsung] discusses the gNB can provide the initial DL BWP with an extension in SIB1 that is only applicable to MBS UEs, and [Qualcomm, ZTE, Ericsson] propose that the CFR in this case can be regarded as a configured new BWP with higher layer signalling.

The benefit of Case C avoiding BWP switching when UEs transit to RRC connected state by receiving broadcast and unicast in the SIB-1 configured initial BWP is discussed in [Huawei, CMCC]. However, [Ericsson] and similarly argued by [ZTE] discuss that assuming UEs cannot simultaneously use two different Initial BWPs, UEs can therefore not at the same time use the legacy-required Coreset#0 Initial BWP and a SIB1-configured Initial BWP, even with special spec changes for broadcast, assuming a UE receiving broadcast will also need to behave according to legacy unicast requirements.

There seems to be consensus on the size of the configured/defined CFR being with the same size as the initial BWP, where the initial BWP has the frequency resources configured by SIB1. However, there is no consensus whether to add new parameters to SIBs or to use a configured BWP. As for past meetings, whether BWP switching occurs under different configurations remains a main concern.

Therefore, the FL proposes to try to agree Case C, while leaving the signalling aspects for further study. A relevant question is whether the design of the adequate signalling is better suited for RAN2 rather to RAN1.

For Case E, defined/configured CFR based on a defined BWP is supported at least for MTCH in [vivo, Nokia, ZTE, OPPO, Qualcomm, LGE, Apple, NTT DOCOMO, Chengdu Td Tech, Ericsson]. Concerns about BWP switching for a configured BWP are presented in [Huawei, CATT, CMCC, MediaTek]. However, [ZTE] discusses that BWP switching for a configured BWP can be avoided through reasonable RRC configurations.

Although with support from various companies, there seems not to be consensus for the support of a defined/configured CFR based on a defined BWP for MCCH or MTCH at this stage. Therefore, the FL proposes to leave this case FFS.

* *Case B (CORESET#0 fully contains the CFR in the frequency domain) and Case D (SIB-1 configured initial BWP fully contains the CFR in the frequency domain)*

Most inputs have focused on the discussion on Case-C and Case-E above.

Explicit support/use for Case B or Case D has been proposed in [Nokia, ZTE (subset of case D), NTT DOCOMO, Samsung], while explicit discussion on not supporting Case B or Case D has been discussed in [vivo, Qualcomm, Ericsson, Apple].

Also, as discussed in previous meetings and in some contributions, GC-PDCCH/PDSCH transmission within a narrower portion of the Initial BWP (where the initial BWP has the frequency resources configured by SIB1 or where the initial BWP has the same frequency resources as CORESET0) could be possible by implementation via appropriate scheduling, which reduces the motivation to support Cases B and D.

There is no strong support nor consensus on Case B and Case D and therefore, the FL proposes not to provide specification support for these two cases in Rel-17.

***Discussion on Separate/Same BW configurations for CFR of MCCH and MTCH***

This topic was also discussed at RAN1#104-e but without reaching an agreement.

[Huawei, Nokia, ZTE, NTT DOCOMO] propose/discuss that the CFR BW configuration for MCCH and MTCH can be configured separately. In fact [ZTE, NTT DOCOMO] while supporting CFR larger than the frequency resources of CORESET#0 for MTCH, they do not see strong motivation for MCCH. Hence, this may imply that the CFR for MCCH and MTCH can be different.

On the other hand [Samsung, OPPO, MediaTek, Ericsson] propose/discuss that the same CFR BW configuration for MCCH and MTCH is used. However, Ericsson details concerns on mapping MCCH and MTCH to different CFR/BWPs which may lead to UE receiver front ends requiring to switch between different CFR of different size, a situation that should be avoided.

Finally, [Qualcomm] proposes/discusses that same or different CFR BW configuration for MCCH and MTCH can be used.

There is no clear support for either same or different BW configuration CFR for MTCH and MCCH. However, based on concerns raised on potential UE receiver switching by using different CFR BW configuration for MCCH and MTCH, the FL proposes to start with the last version of the proposal discussed at RAN1#104-e which tries to agree using the same CFR BW configuration for MCCH and MTCH, while leaving using different CFR BW configurations for MCCH and MTCH as FFS.

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

**Proposal 2.1-1:** No specification support in Rel-17 for broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs with configured/defined CFRs for group-common PDCCH/PDSCH with smaller size than the initial BWP, where the initial BWP either has the same frequency resources as CORESET0 (i.e., Case B) or has the frequency resources configured by SIB1 (i.e., Case D).

**Proposal 2.1-2**: GC-PDCCH/PDSCH carrying MCCH or MTCH for broadcast reception with UEs in RRC IDLE/INACTIVE state can use a configured/defined CFR with larger size than the initial BWP, where the initial BWP has the same frequency resources as CORESET0.

In Rel-17, at least support the following case:

* a configured/defined CFR with the same size as the initial BWP, where the initial BWP has the frequency resources configured by SIB1 (i.e., Case C).
	+ Note: GC-PDCCH/PDSCH transmission within a narrower portion of the Initial BWP (where the initial BWP has the frequency resources configured by SIB1) is possible by implementation via appropriate scheduling.
	+ FFS: whether signalling to enable this is included/extended as part of SIBs, whether signalling needs to use configured BWP framework, or whether it is up to RAN2 to ensure adequate signalling.
* FFS: a configured/defined CFR with larger size than the initial BWP, where the initial BWP has the frequency resources configured by SIB1.

**Proposal 2.1-3**: For broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs can use the same bandwidth configurations for the CFR of GC-PDCCH/PDSCH carrying MCCH and the CFR of GC-PDCCH/PDSCH carrying MTCH.

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

Please provide your comments in the table below:

|  |  |
| --- | --- |
| **company** | **comments** |
| NOKIA/NSB | We are NOT fine with **Proposal 2.1-1** and **Proposal 2.1-2**.The excluding of Case B is fine for us, but we don’t see why Case D-1 (as shown in our Tdoc) have to be excluded. As discussed in our Tdoc, the difference among the CFR Case C, Case D-1 and Case E is the configured bandwidth value of CFR for RRC\_IDLE/INACTIVE UEs. Practically depending on the MBS traffic payload size, the support of all 3 cases may allow the network to flexibly configure the size of CFR for RRC\_IDLE/INACTIVE UEs to monitor and receive MBS services. Therefore, we propose to support the CFR Case C, Case D-1 and Case E on top of Case A.Regarding **Proposal 2.1-3**, it is fine for us.@FL: Relate to Proposal 2.1-3, currently it is understood that the CORESET#0 region can be used as (default) CFR for MCCH CFR as we discussed at last RAN1 meeting. But it is still unclear if CFR of MCCH can be configured with size larger than CORESET#0 region? As discussed in our contribution, so far, the payload size of MCCH traffic is not clear. For MCCH carrying the information with small payload size, the capacity of limited CORESET#0 region can be enough. But if larger payload size is intended to be carried via MCCH traffic, the larger CFR size than default CORESET#0 region may be needed for MCCH. Thus, it is proposed that the CFR for MCCH can be configured other than default CORESET#0 region. I hope it is also aligned with the intention of Proposal 2.1-3. |
| Qualcomm | Fine with 3 proposals  |
| Lenovo, Motorola Mobility | **Proposal 2.1-1: Support.****Proposal 2.1-2**: We have question on this proposal. Does it imply SIB1 configures the CFR larger than initial DL BWP?**Proposal 2.1-3**: Support. |
| vivo | Not support Proposal 2.1-2.As stated by many companies in FL’s summary, CFR with larger frequency size is a need to accommodate various MBS broadcast services.However, if case C is the only solution, it will cause big constraint on initial BWP configuration by SIB1.Currently, as given in 38.331 and 38.321, configuring *initialDownlinkBWP* isoptional, and if not configured, CORESET 0 is used as the initial BWP. In this sense, if *initialDownlinkBWP* is not configured, CASE C cannot define/configure a CFR with larger frequency size than CORESET0.Furthermore, when *initialDownlinkBWP* is configured, its frequency size heavily relies on the MBS services, otherwise, some broadcast services cannot be accommodated. Enlarging the size of SIB-1 configured initial BWP affects both legacy UEs and R17 UEs supporting MBS services. According to current spec, SIB 1-configured initial BWP is only used after reception of RRCSetup/RRCResume/RRCReestablishment. For a UE initiating random access procedure but without PRACH occasions configured for the active UL BWP, it has to switch to the initial UL/DL BWP, and thus, an enlarged initial BWP causes unnecessary power consumption by RF switching to a large frequency range. Furthermore, unnecessary power consumption is also observed by using the enlarged initial BWP as the default BWP. Regarding to the BWP switching issue for case E raised by some companies, we do not see additional operation is needed compared to case C: For RRC idle/inactive UEs, as the configured/defined CFR includes CORESET0, both system information and broadcast services can be received simultaneously. For RRC connected UEs to receive broadcast services, it is up to gNB’s implementation to configure one BWP including the configured/defined CFR.Consequently, Case E should be also supported on top of case C, and leave the network flexibility to select among case A, C, and E.In Rel-17, at least support the following case:* a configured/defined CFR with the same size as the initial BWP, where the initial BWP has the frequency resources configured by SIB1 (i.e., Case C).
	+ Note: GC-PDCCH/PDSCH transmission within a narrower portion of the Initial BWP (where the initial BWP has the frequency resources configured by SIB1) is possible by implementation via appropriate scheduling.
	+ FFS: whether signalling to enable this is included/extended as part of SIBs, whether signalling needs to use configured BWP framework, or whether it is up to RAN2 to ensure adequate signalling.

~~FFS:~~ a configured/defined CFR with larger size than the initial BWP, where the initial BWP has the frequency resources configured by SIB1(i.e., Case E). |

## Issue 2: Number of MBS Common Frequency Resources

### **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, 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, one common frequency resource for group-common PDCCH/PDSCH can be defined/configured.* FFS: whether to define/configure more than one common frequency resources
 |

The following agreement for RRC\_CONNECTED UEs at RAN1#105-e is relevant for this discussion:

|  |
| --- |
| Agreement:One CFR is supported per dedicated unicast BWP for multicast of RRC-CONNECTED UEs.* FFS: Whether more than one CFR is supported per dedicated unicast BWP
* FFS: Whether multicast can be supported or not in a dedicated unicast BWP when no CFR is configured for that BWP
 |

### **Tdoc analysis**

* In [R1-2106625, vivo]
	+ Proposal 2: For RRC\_IDLE/RRC\_INACTIVE UEs, more than one common frequency resource can be defined/configured.
* In [R1-2106664, Nokia]
	+ Proposal-4: Support more than one CFRs, with separate CFR for MCCH and MTCH, respectively.
	+ Proposal-5: Considering having multiple CFRs is supported, it is enough to have single MCCH CFR configured, but there can be multiple MTCH CFRs configured corresponding to difference MBS service types applied.
* In [R1-2106747 , ZTE]
	+ Observation 5: It is beneficial for power saving by supporting more than one CFR.
	+ Observation 6: It is beneficial for MBS service expansion by supporting more than one CFR.
	+ Observation 7: It is particularly important for redcap UE to support multiple CFRs, which means that more MBS services can be received.
	+ Proposal 4: More than one CFR is supported for MTCH for UEs in RRC\_IDLE/INACTIVE states.
* In [R1-2106914, Samsung]
	+ *Discuss*: Regarding the number of CFRs, suggestions for configuring more than one CFRs were made in order to support UEs with different BW capabilities (i.e. RedCap UEs). However, regardless of any possible reason to do so, that is not in scope of the WID and would further complicate the overall design as support for RedCap UEs would require support for additional specifications in order to be functional (e.g. to address differences in coverage due to 1 Rx antenna).
	+ Observation 1: One CFR is sufficient for Rel-17 MBS.
* In [R1-2106947, CATT]
	+ Proposal 5: For RRC\_IDLE/RRC\_INACTIVE UEs, multiple CFRs for group-common PDCCH/PDSCH are not supported.
* In [R1-2107095, Futurewei]
	+ Proposal 3: For Idle/Inactive UEs, only one common frequency resource for group-common PDCCH/PDSCH can be defined/configured.
* In [R1-2107162, Lenovo]
	+ Proposal 3: Only one common frequency resource is configured within the initial DL BWP for RRC\_IDLE/RRC\_INACTIVE UEs.
* In [R1-2107427, CMCC]
	+ Proposal 3. For RRC\_IDLE/RRC\_INACTIVE UEs, only support one CFR.
* In [R1- 2107458, LGE]
	+ Proposal 1: From idle/inactive UE perspective, one CFR is associated to the initial DL BWP of UE’s serving cell for REL-17.
* In [R1-2107516, MediaTek]
	+ Proposal 4: Not support more than one CFR for UE supporting MBS in RRC\_IDLE/RRC\_INACTIVE states.
* In [R1-2107613, Intel]
	+ Proposal 2: Only one common frequency resource may be configured for MBS reception for RRC\_IDLE/INACTIVE mode UEs.

### **FL Assessment**

This issue was not discussed at RAN1#105-e.

From the inputs to this meeting, [vivo, Nokia, ZTE] support more than one CFR at least for GC-PDCCH/PDSCH carrying MTCH while [Samsung, CATT, Futurewei, Lenovo, CMCC, LGE, MediaTek, Intel] explicitly do not support more than one CFR for GC-PDCCH/PDSCH carrying MTCCH/MTCH. [ZTE] describes the potential benefits of multiple CFRs in terms of power saving, service expansion and support of RedCap UEs. On the other hand, [Samsung] highlights that support of RedCap UEs is not in the scope of the WI. Some companies also express that a single CFR for GC-PDCCH/PDSCH carrying MTCCH/MTCH also aligns with the agreements for multicast reception in RRC connected UE states AI.

Although some companies see a benefit on supporting more than one CFR for GC-PDCCH/PDSCH carrying MTCCH/MTCH there is significant opposition from multiple companies. Based on this, the FL will make a proposal to deprioritise more than one CFR for Rel-17.

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

**Proposal 2.2-1**: No specification support in Rel-17 for more than one CFR for group-common PDCCH/PDSCH carrying MCCH/MTCH for broadcast reception with UEs in RRC\_IDLE/INACTIVE state.

Please provide your comments in the table below:

|  |  |
| --- | --- |
| **company** | **comments** |
| NOKIA/NSB | Try to check my understanding of **Proposal 2.2-1**, does this mean the CFR of MCCH and MTCH always have to be configured to be the same? For example, the MCCH CFR associated with CORESET#0 and MTCH CFR associated with Initial BWP is NOT supported by Proposal 2.2-1? If it is the case, then we are not fine with Proposal 2.2-1. |
| Qualcomm | Not support Also prefer to defer this discussion after clarifying what is the parameters included in a CFR for broadcast MCCH/MTCH in 2.3.4.Our understanding is that the pdsch/pdcch parameters in MCCH CFR and MTCH CFR can be different, which means different CFRs are supported. |
| Lenovo, Motorola Mobility | Support. Our understanding is if more than one common frequency resource is required, these common frequency resources should be confined within the initial DL BWP. In that sense, more straightforward solution is to configure a larger frequency resource to cover the multiple separate common frequency resources. Hence, one common frequency resource is enough for group-common PDCCH/PDSCH reception. |
| vivo | We are not fine with Proposal 2.2-1. Regarding to a variety of MBS broadcast services, supporting more than one CFR is definitely beneficial for UE power saving by switching RF to only the bandwidth accommodating the interested services. Furthermore, switching among multiple CFRs can be up to UE’s implementation and spec effort is not needed for CFR switching.  |

## Issue 3: Definition and parameters of the CFR

### **Background**

At RAN1#105-e, as part of the discussion on *MBS Common Frequency Resource for MCCH channel*, it was highlighted that different companies may have different interpretations of what a defined/configured CFR entails.

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

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

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

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

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

The following agreement for multicast reception with RRC\_CONNECTED UEs is relevant for this discussion:

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| --- |
| Agreement:From RAN1 perspective, the CFR (common frequency resource) for multicast of RRC-CONNECTED UEs, which is confined within the frequency resource of a dedicated unicast BWP and using the same numerology (SCS and CP), includes the following configurations:* Starting PRB and the number of PRBs
* One PDSCH-config for MBS (i.e., separate from the PDSCH-Config of the dedicated unicast BWP)
* One PDCCH-config for MBS (i.e., separate from the PDCCH-Config of the dedicated unicast BWP)
* SPS-config(s) for MBS (i.e., separate from the SPS-Config of the dedicated unicast BWP)
* FFS: Other configurations and details including whether signaling of starting PRB and the length of PRBs is needed when CFR is equal to the unicast BWP
* FFS: Whether a unified CFR design is also used for broadcast reception for RRC\_IDLE/INACTIVE and RRC\_CONNECTED
* FFS: Whether Coreset(s) for CFR in addition to existing Coresets in UE dedicated BWP is needed
* Note: The terminology of CFR is only aiming for RAN1 discussion, and the detailed signaling design is up to RAN2

Note: This agreement does not negate any previous agreements made on CFR |

### **Tdoc analysis**

* In [R1-2106947, CATT]
	+ 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 Point A.
	+ Proposal 4: The current SLIV indication mechanism can be reused for common frequency resource of starting PRB and length of PRBs.
* In [R1-2107162, Lenovo]
	+ 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 signalling.
* In [R1-2107371, Qualcomm]
	+ *Discuss*: Based on the RAN1 agreements, the default CFR for broadcast is the initial BWP if not configured in SIB. However, it is not clear what is the configured/defined CFR for broadcast. We think the definition of a multicast CFR can be reused but only select the functionalities required for broadcast reception.
	+ *Discuss*: The PDCCH-config includes the parameters for GC-PDCCH and the PDSCH-config includes those for GC-PDSCH of broadcast MCCH/MTCH. For example, PDSCH-Config in the CFR may include MCS, TDRA table, etc. for GC-PDSCH; and PDCCH-Config in the CFR provide the configuration of CORESET and SS for GC-PDCCH.
	+ Proposal 1: The CFR for broadcast MCCH/MTCH if configured includes the following configurations:
		- Starting PRB and the number of PRBs
		- One PDSCH-config for broadcast
		- One PDCCH-config for broadcast

### **FL Assessment**

As part of the discussions at AI 8.12.3, the definition of the configured/defined CFR and how it is different from a default CFR has not been discussed in detail.

In [CATT, Lenovo, Qualcomm] discuss configuration parameters of the CFR. [CATT, Lenovo] discuss starting and length of the CFR, while [Qualcomm] discusses that the definition for multicast reception can be reused but only using adequate parameters for broadcast reception.

The FL will put forward a proposal to have a discussion on this issue.

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

**Proposal 2.3-1**: From RAN1 perspective, the CFR for broadcast reception of RRC\_IDLE/INACTIVE UEs, includes at least the following configurations:

* Starting PRB and the number of PRBs
	+ FFS reuse of SLIV
* One PDSCH-config for broadcast
* One PDCCH-config for broadcast

Please provide your comments in the table below:

|  |  |
| --- | --- |
| **company** | **comments** |
| NOKIA/NSB | We are generally fine with the FL’s proposal with below suggestion of re-wording:**Proposal 2.3-1**: From RAN1 perspective, the CFR for broadcast reception of RRC\_IDLE/INACTIVE UEs, includes at least the following configurations:* Starting PRB and the number of PRBs
	+ FFS reuse of SLIV
* ~~One PDSCH-config~~ PDSCH configuration for broadcast reception with GC-PDSCH
* ~~One PDCCH-config~~ PDCCH configuration for broadcast reception with GC-PDCCH
 |
| Qualcomm | Support it |
| Lenovo, Motorola Mobility | Generally fine with it. Is it better to add the initial BWP in the main bullet?**Proposal 2.3-1**: From RAN1 perspective, the CFR for broadcast reception of RRC\_IDLE/INACTIVE UEs on the initial DL BWP, includes at least the following configurations:* Starting PRB and the number of PRBs
	+ FFS reuse of SLIV
* One PDSCH-config for broadcast
* One PDCCH-config for broadcast
 |
| vivo  | Fine  |

## Issue 4: PDCCH: Details of Common Search Space design for MCCH/MTCH channels

### **Background**

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

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

|  |
| --- |
| 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. |

In [R1-2104165] RAN2 requested 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:

|  |
| --- |
| 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, RAN2#104-e and RAN1#105-e are relevant for this discussion:

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

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

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

Agreement:For broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs support the same CSS type for MCCH and MTCH.* FFS support of different CSS types for MCCH and MTCH channels for broadcast reception.

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

The following agreement for RRC\_CONNECTED UEs at RAN1#105-e is also relevant for this discussion:

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

### **Tdoc analysis**

* In [R1-2106440, Huawei]
	+ Proposal 4: The CFR, CORESET, and search space for MCCH and MTCH can be configured separately.
		- The CFR, CORESET, and search space for MTCH scheduling can be included in MCCH.
* In [R1-2106664, Nokia]
	+ Proposal-9: It is supported to have additional SS configuration(s) for MTCH in addition to SS#0 and SS for MCCH.
	+ Proposal-10: Reusing legacy CSS for RRC\_IDLE/INACTIVE UEs is enough, and there is no need to specify multicast SS (MSS) as it was discussed for RRC\_CONNECTED UEs.
	+ Proposal-11: For the operation of MBS services, there is a need to define a new TypeX-PDCCH.
* In [R1-2106718, Spreadtrum]
	+ Proposal 4: A new CSS type can be introduced for RRC\_IDLE/RRC\_INACTIVE UEs with group-common PDCCH receiving.
* In [R1-2106747, ZTE]
	+ Proposal 6: For RRC\_IDLE/RRC\_INACTIVE UEs, a new CSS type can be used for MCCH and MTCH.
		- The same search space can be applied for MBS control information and different broadcast service depending on network configuration.
		- For the new CSS type, the monitoring priority is determined based on the search space set indexes of the Type-x CSS set and USS sets
		- FFS for further supporting existing CSS type for MCCH.
* In [R1-2106914, Samsung]
	+ Observation 2: 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 signalling).
	+ Proposal 3. Support avoidance of permanent collisions for PDCCH candidates of search space sets for GC-PDCCH for broadcast and multicast.
* In [R1-2106947, CATT]
	+ Proposal 11：For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, supports define Type-MBS CSS sets for GC-PDCCH scheduling.
		- The monitoring priority of Type-MBS CSS is determined based on the search space set indexes of the Type-x CSS set.
* In [R1-2107095, Futurewei]
	+ Proposal 4: 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 [R1-2107162, Lenovo]
	+ Proposal 8: A CSS is configured for RRC IDLE/RRC INACTIVE UEs by reusing existing CSS type.
* In [R1-2107165, TCL]
	+ Proposal 1: Consider same CSS type used for SI, for MCCH or define a new search space for MBS-SIB which carries MCCH.
	+ Proposal 2: Support different or separate CSS types for MCCH and MTCH channels for broadcast reception.
	+ Proposal 3: If proposal 2 is agreed, consider CSS type3 or define a new search space type for MTCH channel for broadcast reception.
* In [R1-2107231, OPPO]
	+ *Discuss*: The monitoring periodicity of MCCH and MTCH can be different, correspondingly the search space for GC-PDCCHs scheduling MCCH and MTCH can be different. From perspective of physical layer, MCCH and MTCH are both mapped into PDSCH even with different periodicities, and the same CSS type can support it. Therefore, to reduce the design complexity in release-17 MBS, different CSS types for MCCH/MTCH is not supported.
	+ Proposal 4: It is not support of different CSS types for MCCH and MTCH channels for RRC\_IDLE/RRC\_INACTIVE UEs for broadcast reception.
	+ *Discuss*: Type-3, can be reused as a baseline with different search space sets equation initialization.
	+ Proposal 5: One of the existing CSS types can be selected and reused for RRC\_IDLE/RRC\_CONNECTED UEs for broadcast reception.
* In [R1-2107371, Qualcomm]
	+ *Discuss*: Reuse the design for multicast RRC\_CONNECTED UEs, the Type-x CSS for GC-PDCCH can be used as the SS of MCCH/MTCH.
	+ Proposal 5: Support Type-x CSS for the SS of MCCH/MTCH.
* In [R1-2107427, CMCC]
	+ Proposal 4. For CSS of GC-PDCCH for broadcast, the same CSS type as multicast is supported, i.e., Type-x CSS,
		- The monitoring priority of Type-x CSS is determined based on the search space set indexes of the Type-x CSS set and USS sets.
* In [R1- 2107458, LGE]
	+ Proposal 4: Idle/inactive UE monitors PDCCH for Type0A-PDCCH CSS set to detect a DCI with SI-RNTI and receive MBS specific SIB on the corresponding PDSCH on the initial DL BWP of a serving cell for broadcast.
	+ *Discuss*: In addition, we think that the monitoring priority of CSS for MTCH can be determined based on the search space set indexes for both multicast and broadcast.
	+ Proposal 6: For MTCH, support 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 can be optionally configured by MCCH.
* In [R1-2107516, MediaTek]
	+ Proposal 6: The CSS type defined in AI 8.12.1 (e.g., a new Type-x CSS) for MBS group scheduling can be used for both searchSpace#0 and search space other than searchSpace#0 for GC-PDCCH scheduling MCCH and MTCH.
* In [R1-2107613, Intel]
	+ *Discuss*: The PDCCH which schedules the MCCH carrying the MBS configuration can be monitored in a Type0-PDCCH CSS set configured by *searchSpaceZero* in *PDCCH-CommonConfig* and associated with a CORESET#0 for both RRC\_CONNECTED and IDLE mode UEs. Alternately it can be monitored in a new PDCCH CSS set e.g., *mcch-searchSpace* which is configured by the MBS specific PDCCH-ConfigCommon. The CSS set can be a Type-x CSS set similar to the case for RRC\_CONNECTED UEs.
	+ Proposal 3: The PDCCH scheduling the MCCH can also be monitored in a Type-x CSS set configured by the MBS specific *PDCCH-ConfigCommon*.
	+ Proposal 4: The DCI scheduling the MTCH and MCCH can both be monitored on the same CSS type.
* In [R1-2107765, Apple]
	+ Proposal 4: Type-3 CSS set is used for MBS group common PDCCH monitoring.
* In [R1-2107883, NTT DOCOMO]
	+ *Discuss*: For commonality of configurations, it is better to use the same CSS types for RRC\_CONNECTED state and RRC\_IDLE/RRC\_INACTIVE states. Which CSS type to use for RRC\_CONNECTED UEs is discussed in AI 8.12.1, and we propose to define a new type CSS [*ref therein*]. The new type CSS should also be used for RRC\_IDLE/RRC\_INACTIVE UEs as well. If gNB wants to use different scheduling (e.g., scheduling period) for MCCH and MTCH, gNB can configure multiple search spaces with the same type and use them separately. We don’t see clear motivation to define different CSS types for MCCH and MTCH.
	+ Proposal 3: For RRC\_IDLE/RRC\_INACTIVE UEs, use the same new type CSS as for RRC\_CONNECTED UEs.
* In [R1-2108028, Convida]
	+ Proposal 4: A new CSS type should be defined for monitoring the group-common PDCCH.
* In [Ericsson]
	+ Proposal 14: Different CSS types not supported for MCCH and MTCH.
	+ Proposal 15: The CSS type for broadcast should be the same as the CSS type for multicast.

### **FL Assessment**

This issue was discussed at RAN1#105-e without reaching an agreement.

***Discussion on different CSS types for MCCH and MTCH for broadcast reception***

While [TCL] proposes to use different CSS types for MCCH and MTCH, [Ericsson, OPPO, NTT DOCOMO, Intel] proposes that different CSS types for MCTH and MCCH is not supported. It is discussed that even using the same CSS type for the two logical channels different configurations (e.g. monitoring) can still be applied to each logical channel while using the same CSS type. Separate SS configurations for MCCH and MTCH is also proposed in [Huawei].

Based on the inputs there is a bigger support on not having different CSS types for MTCH and MCCH, therefore the FL will put forward a proposal to conclude this.

***Discussion on Type-x CSS for MCCH and MTCH for broadcast reception and reusing solutions agreed for CSS for multicast reception in RRC\_CONNECTED UE state***

Inputs in [Nokia, Spreadtrum, ZTE, CATT, Futurewei, Qualcomm, CMCC, MediaTek, Intel, NTT DOCOMO, Convida, Ericsson] propose to use a Type-x CSS and [Futurewei, Qualcomm, CMCC, MediaTek, Intel, NTT DOCOMO Ericsson] explicitly propose to reuse the solution adopted for multicast reception in RRC\_CONNECTED UE state for broadcast reception in RRC\_IDLE/INACTIVE UE states, i.e., using a Type-x CSS.

[Samsung, TCL, OPPO, Apple] propose to use Type-3 CSS, which is aligned with the agreement at RAN1#105-e on whether the Type-x CSS is a Type-3 CSS. [Lenovo] propose to reuse existing CSS.

Most companies support that the Type-x CSS supported for multicast in RRC\_CONNECTED is reused for broadcast in RRC\_IDLE/RRC\_INACTIVE for GC-PDCCH scheduling MCCH and MTCH which also covers the case whether the type-x CSS is a Type-3 CSS as proposed explicitly by some companies. Therefore, the FL will put forward a proposal to reach agreement on this basis.

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

**Proposal 2.4-1**: For broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs, no specification support in Rel-17 of different CSS types for MCCH and MTCH channels.

**Proposal 2.4-2**: The Type-x CSS supported for multicast in RRC\_CONNECTED is reused for broadcast in RRC\_IDLE/RRC\_INACTIVE for GC-PDCCH scheduling MCCH and MTCH.

Please provide your comments in the table below:

|  |  |
| --- | --- |
| **company** | **comments** |
| NOKIA/NSB | Regarding **Proposal 2.4-1**, reusing legacy CSS for RRC\_IDLE/INACTIVE is enough, and there is no need to specify any other/different CSS, thus we are fine with it.Regarding **Proposal 2.4-2**, to our view, there is a need to define a new TypeX-PDCCH that is similar to the Type3-PDCCH, where the configuration of TypeX-PDCCH can be associated with the configuration of MBS CFR via SIBx. And we don’t quite understand how the Type-x CSS supported for multicast in RRC\_CONNECTED can be reused for broadcast in RRC\_IDLE/RRC\_INACTIVE. It could be great if it can be clarified. |
| Qualcomm | Ok with two proposals |
| Lenovo, Motorola Mobility | OK with above two proposals. |
| vivo | Fine with two proposals |

## Issue 5: PDCCH: RNTI and DCI design for carrying MCCH change notification

### **Background**

RAN2 discussed the details of broadcast session delivery and the following agreements were made during 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).**
 |

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

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

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

|  |
| --- |
| * 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.
 |

RAN2 discussed further the aspects related to MCCH design and made the following agreements during RAN2#114 meeting:

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

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

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

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

Other solutions are not precluded and it is also not precluded whether to support both Alt1 and Alt2.Conclusion:It is up to RAN2 to decide the specific contents of the MCCH change notification, e.g, whether notification only informs about session start, whether or not notification also informs about session modification/stop or whether or not the notification informs about any other information. |

###  **Tdoc analysis**

* In [R1-2106440, R1-2108067, Huawei et al.]
	+ *Discussion*: From RAN2’s LS, RAN2 is still FFS on whether the possibility of UE missing an MCCH change notification needs to be addressed or can be left to UE implementation. Since Alt 2 can also reduce the possibility of UE missing an MCCH change notification because the DCI scheduling MCCH will be transmitted from network whenever MCCH is transmitted, an draft LS reply is also provided in [*ref therein*], which is supposed to resolve RAN2’s remaining FFS regarding MCCH change notification issue.
	+ Proposal 1: A specific DCI scrambled by a dedicated RNTI is not necessary and not sufficient for notifying the session start and the modification of an ongoing session.
	+ Proposal 2: Using a field in DCI scheduling MCCH to notify the session start and the modification of an ongoing session.
		- Reply RAN2’s LS with the mechanism RAN1 agreed.
* In [R1-2106718, Spreadtrum]
	+ Proposal 3: A new dedicated RNTI can be used to scramble the CRC of a DCI to indicate a MCCH change notification for RRC\_IDLE/RRC\_INACTIVE UEs.
* In [R1-2106747, ZTE]
	+ They discuss: According to the information provided by RAN2 in LS [*ref therein*], DCI size will add at least 2 bit under Alt.2, which may cause size of DCI format 1\_0 with CRC scrambled with SC-RNTI/G-RNTI to be greater than size of DCI format 1\_0 with CRC scrambled with P-RNTI/SI-RNTI. As a result, DCI size alignment cannot be executed. In addition, Alt.2 may also lead to a lower reliability.
	+ Proposal 7: Define a dedicated RNTI to scramble the CRC of a DCI indicating a MCCH change notification.
* In [R1-2106914, Samsung]
	+ Proposal 6. Use of a field in a DCI format scheduling a MCCH without a dedicated RNTI for MCCH change notification.
* In [R1-2106947, CATT]
	+ *Discuss*: Since the bit size of the change notification and that of DCI format which scheduling the MCCH is not discussed and determined, the effect of these two alternatives are not clear during DCI size alignment.
	+ Proposal 10: Alternatives for MCCH change notification indication can be postponed to discuss until the bits fields of broadcast DCI format and MCCH change notification are determined.
* In [R1-2107231, OPPO]
	+ Proposal 6: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, define a dedicated RNTI to scramble the CRC of a DCI indicating a MCCH change notification.
* In [R1-2107371, Qualcomm]
	+ Proposal 6: Support Alt1: Define a dedicated RNTI (e.g., MCCH-N-RNTI) to scramble the CRC of a DCI indicating MCCH change notification.
* In [R1-2107384, Google]
	+ Proposal 1: For reliability of MCCH change notification
		- If Alt-1 is supported to introduce dedicated RNTI e.g. MBS-N-RNTI
			* Study using DCI format with smaller size
		- If Alt-2 is supported to introduce a field in DCI format e.g. MBS-RNTI
			* Study PDCCH repetition for the MCCH change notification
* In [R1-2107427, R1-2107387, CMCC]
	+ *Discussion*: Alt 2 doesn’t need the introduction of new RNTI but the MCCH change notification filed bitlength may be limited, because the DCI format scheduling a MCCH is received by UEs in all three RRC states, the DCI size with MCCH-RNTI should be aligned with DCI format 1\_0 in CSS.
	+ *Discussion*: As the FDRA filed, we are still discussing whether a larger CFR than CORESET#0 can be supported for MCCH. If the FDRA filed bitlength is depend on the size of CORESET#0, there are 16 reserved bits in DCI format 1\_0 with CRC scrambled by MCCH-RNTI which can be used as the MCCH change notification. Even if the FDRA filed bitlength is depend on CFR size not the bandwidth of CORESET#0, for example, the CFR is 272 PRB which needs 15 bits FDRA filed and the 48 PRB CORESET#0 needs 11bits FDRA field, there are still 12 reserved bits in DCI format 1\_0 for the MCCH change notification. From this perspective, the bitlength in Alt 2 is enough to be used as MCCH change notification and can also provide forward compatibility.
	+ Proposal 5. For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, support using DCI bits in a DCI format scheduling a MCCH without a dedicated RNTI for MCCH change notification.
	+ Proposal 1. Support using separate DCI fields in DCI format 1\_0 with CRC scrambled by MCCH-RNTI for MCCH change notification.
* In [R1-2107516, MediaTek]
	+ Proposal 9: Define a new RNTI (e.g., MCCH-N-RNTI) for NR MBS MCCH change notification.
	+ Proposal 10: DCI format 1\_0 scrambled by a new RNTI (e.g., MCCH-N-RNTI) can be used for MCCH change notification.
* In [R1-2107613, Intel]
	+ Proposal 5: For MCCH change notification, a dedicated RNTI is used to scramble the CRC of the scheduling DCI
* In [R1-2107765, Apple]
	+ *Discussion*: For the discussed solutions, Alt 1 would require a new RNTI and new DCI format. The DCI size could be the issue for Alt 2, if there are multiple MBS sessions and 2 bits for each session. Another possible way is the MCCH change notification is indicated by the MAC CE in MAC PDU of the scheduled MCCH. The benefits are without introducing new DCI format and without impacts on DCI format size.
	+ Proposal 3: MCCH change notification is indicated by the MAC CE in MAC PDU of scheduled MCCH, notification includes MBS sessions start and MSB sessions stop.
* In [R1-2107883, NTT DOCOMO]
	+ *Discuss*: Based on the RAN2 agreements, 2 bits (i.e., a bit for modification of an ongoing session’s configuration and a bit for session start notification) are required for MCCH change notification. Since only 2 bits are needed, it will be possible to put it in a DCI format scheduling a MCCH without a dedicated RNTI. We don’t see clear motivation to define a dedicated RNTI to transfer only 2 bits of information.
	+ Proposal 6: For MCCH change notification for RRC\_IDLE/RRC\_INACTIVE UEs, support Alt 2.
* In [R1-2107952, Chengdu TD Tech]
	+ Proposal 5: A new RNTI is used for the MCCH change notification. The MCCH change notification can be transmitted several times per the MCCH repetition period. The MCCH change notification is sent in the same CORESET/search space as MCCH.
	+ Proposal 6: The MCCH specific RNTI is configured with a fixed value. The MCCH change notification specific RNTI is configured with fixed values.
	+ Proposal 7: Alternatively, the MCCH change notification can be sent in the DCI format on the MCCH specific PDCCH.

### **FL Assessment**

RAN2 LSs indicate the MCCH change notification needs to accommodate i) the notification of MCCH configuration changes due to a session start and ii) the notification of MCCH configuration changes of an ongoing session (including session stop), i.e., 2 bits.

While [Spreadtrum, ZTE, OPPO, Qualcomm, MediaTek, Intel] propose defining a dedicated RNTI to scramble the CRC of a DCI indicating a MCCH change notification (i.e., Alt 1), [Huawei, Samsung, CMCC, NTT DOCOMO] discuss and propose using a field in a DCI format scheduling a MCCH without a dedicated RNTI for MCCH change notification (i.e., Alt 2).

[ZTE] discusses that the size of DCI 1\_0 format with CRC scrambled by G-RNTI cannot be larger than the size of DCI 1\_0 format with CRC scrambled by SI-RNTI/P-RNTI. Since including the notification in the DCI would add two bits, DCI 1\_0 format with CRC scrambled G-RNTI would be larger than DCI 1\_0 format with CRC scrambled SI-RNTI/P-RNTI resulting in DCI size alignment not being able to be executed.

However, [CMCC] discusses fields required for DCI 1\_0 format with CRC scrambled G-RNTI and where only a subset of fields is proposed to be included. DCI 1\_0 formats specified in TS 38.212 (cf. section 7.3.1.2) indicate information transmitted for DCI format 1\_0 with CRC scrambled with P-RNTI and SI-RNTI that include at least 6 and 15 reserved bits, respectively, which can be used for the notification with sufficient space for forward changes.

[Huawei] also discusses that using a dedicated DCI with a dedicated RNTI to indicate one change forces UEs to monitor an additional DCI that is not used to schedule MCCH data, which also increases the likelihood of missing such notification and being able to notify one change is not sufficient to accommodate the two changes requested by RAN2.

[CATT] proposes to postpone the discussion until the fields of both the DCI format for broadcast and the MCCH notification are clarified. However, as per LS from RAN2, it is clarified that 2 bits would be required to notify of a MCCH configuration change due to a session start and change of ongoing session (including a session stop).

[Apple] proposes a different approach to Alt 1 & Alt 2 by including the notification in the MAC CE in MAC PDU without the need to define a new DCI format or having an impact on the DCI format size.

Finally, [Chengdu Ted Tech] proposes to support both alternatives while [Google] proposes to discuss reliability aspects for each of the alternatives.

Although there is similar support for both alternatives by the inputs, arguments presented indicate the following:

* using a dedicated RNTI to notify changes requires UEs to monitor an additional DCI not used for scheduling data increasing complexity,
* there are sufficient reserved bits in DCI 1\_0 format to accommodate these 2 changes in the notification without significant impact in DCI alignment, and
* transmitting the notification in the MCCH scheduling the MTCH also reduces the likelihood of missing the notification.

Given the requests of feedback from RAN2 and the last stages of the WI in Rel-17, the FL proposes to discuss this issue and try to reach an agreement.

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

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

**Proposal 2.5-1**: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, at least Alt 2 is supported to notify MCCH change due to modification of an ongoing session’s configuration (including session stop) and to notify changes of MCCH configuration due to session start:

* Alt 2: Use of a field in a DCI format scheduling a MCCH without a dedicated RNTI for MCCH change notification.

Please provide your comments in the table below:

|  |  |
| --- | --- |
| **company** | **comments** |
| NOKIA/NSB | We are fine with **Proposal 2.5-1**. Moreover, we think both Alt1 and Alt2 can be supported. |
| Qualcomm | We have concern on Alt2. The details of DCI format 1\_0 for MCCH need to be discussed first. For LTE MTC, only 1-bit is inserted in SC-MCCH DCI format 6-2 to directly indicate MCCH change notification. However, the other fields in the DCI for MTC are relatively small. Compared with DCI format 6\_2, DCI format 1\_0 at least includes FDRA to indicate much more flexible BW size (for MTC, only indicate narrowband index), 4-bit TDRA (no TDRA for MTC), and 5-bit MCS (3-bit only for MTC). In addition, DCI for MTC can be configured with PDCCH repetitions for reliability.We prefer Alt1 is better by using a separate RNTI for a compressed GC-DCI for reliable MCCH change notification. It is also similar as the way for legacy non-BL/CE UEs supporting LTE SC-PTM.  |
| Lenovo, Motorola Mobility | Support. |
| vivo  | Fine with the proposal |

## Issue 6: PDCCH: Design of DCI format for MCCH and MTCH channels

### **Background**

The following agreements at RAN1#105-e are relevant for this discussion:

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

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

Other solutions are not precluded and it is also not precluded whether to support both Alt1 and Alt2.Conclusion:It is up to RAN2 to decide the specific contents of the MCCH change notification, e.g, whether notification only informs about session start, whether or not notification also informs about session modification/stop or whether or not the notification informs about any other information. |

### **Tdoc analysis**

* In [R1-2106664, Nokia]
	+ Proposal-12: If the configured CFR size is larger than CORESET#0 region, the size of FDRA field in DCI format 1\_0 should be determined by the size of CFR.
* In [R1-2106718, Spreadtrum]
	+ Proposal 1: If a specific CFR has been configured for group-common PDCCH/PDSCH, the FDRA field should be based on the size of the CFR. On the contrary, the FDRA field should be determined by the size of the CORESET0 or the SIB1 configured initial BWP.
* In [R1-2107427, CMCC]
	+ *Discuss*: Considering the MCCH is a broadcast channel without HARQ which is similar to BCCH, the current DCI fields when the CRC is scrambled by SI-RNTI except for system information indicator can be reused as the DCI fields in DCI format 1\_0 with CRC scrambled by MCCH-RNTI. As the discussion in section 2.1, we think both Case A and Case C can be used for MCCH, and the FDRA filed can be depended on CFR size because the current reserved bits are enough. For example, assume CORESET#0 is 48 PRB and CFR equals to CORESET#0, there are 16 reserved bits in DCI format 1\_0 with CRC scrambled by MCCH-RNTI. If the CFR is 272 PRB which needs 15 bits FDRA filed, there are still 12 reserved bits in DCI format 1\_0.
	+ Proposal 6. The following DCI fields are needed in DCI format 1\_0 used for GC-PDCCH of MCCH,
		- FDRA filed which bitlength is depend on CFR size
		- TDRA filed Time domain resource assignment
		- VRB-to-PRB mapping
		- Modulation and coding scheme
		- Redundancy version
		- MCCH change notification
	+ *Discuss*: the HARQ related DCI fields e.g., NDI, DAI, PRI, HARQ timing indicator, TPC command are not needed for GC-PDCCH of MTCH, which the remaining DCI fields are the same as GC-PDCCH of MCCH except for MCCH change notification.
	+ Proposal 8. The following DCI fields are needed in DCI format 1\_0 used for GC-PDCCH of MTCH,
		- FDRA filed which bitlength is depend on CFR size
		- TDRA filed Time domain resource assignment
		- VRB-to-PRB mapping
		- Modulation and coding scheme
		- Redundancy version
	+ *Discuss*: The last issue is about DCI size alignment, as the GC-PDCCH of MCCH/MTCH should be monitored by UEs in three RRC states, the DCI size of GC-PDCCH of MCCH/MTCH should be aligned with DCI format 1\_0 in CSS in order to not increase DCI sizes.
	+ Proposal 9. The DCI size of GC-PDCCH of MCCH/MTCH should be aligned with DCI format 1\_0 in CSS.
* In [R1-2107516, MediaTek]
	+ Proposal 7: At least the following fields are supported for broadcast reception for RRC INACTIVE/IDLE UEs
		- Frequency domain resource assignment
		- Time domain resource assignment
		- VRB-to-PRB mapping
		- Modulation and coding scheme
		- Redundancy version
		- Reserved bits
	+ Proposal 8: For broadcast reception, the bit length FDRA field within DCI for scheduling MCCH/MTCH depends on the frequency size of CFR.
* In [R1-2107613, Intel]
	+ Proposal 1: The FDRA field of DCI 1\_0 is based on the starting PRB index and size of the CORESET#0 or the initial BWP.
* In [R1-2107883, NTT DOCOMO]
	+ Observation 1: If the existing RB numbering rule for PDSCH is reused, there may be RBs that cannot be allocated with DCI format 1\_0 for broadcast.
	+ Proposal 4: For GC-PDSCH carrying MTCH, RB numbering starts from the lowest RB of the CFR.
	+ Observation 2: If the granularity of GC-PDSCH allocation is 1RB, there may be RBs that cannot be allocated with DCI format 1\_0 for broadcast.
	+ Proposal 5: For GC-PDSCH carrying MTCH, support resource allocation with granularity of multiple RBs.
* In [R1-2108172, Ericsson]
	+ For the FDRA field in the DCI 1\_0 for broadcast (i.e. scrambled with G-RNTI):
		- The FDRA field size is given by the CFR size, i.e. one of the following
			* the size of coreset#0
			* the size of the configured BWP.

### **FL Assessment**

The inputs to this issue mainly discuss the field in the DCI 1\_0 format currently supported for broadcast reception with RRC idle and inactive UEs. This has not been discussed at previous meetings.

***Discussion for DCI format 1\_0 fields for MCCH and MTCH***

[Nokia, Spreadtrum, CMCC, MediaTek, Intel, Ericsson] propose that the FDRA field is based on the size of the CFR. [CMCC, MediaTek] propose the minimum set of fields that are required for the DCI scheduling GC-PDSCH. [CMCC] separates the discussion on MCCH and MTCH channels where same parameters for both logical channels are proposed except the MCCH change notification for the DCI of scheduling an GC-PDSCH carrying MCCH. [NTT DOCOMO] further proposes that existing RB numbering rule should be changed to the lowest RB of the CFR, otherwise some RB would be left unused. They also additionally propose that resource allocation granularity is increase to multiple RBs.

The FL will put forward proposals covering the aspects proposed above.

***Discussion on DCI size alignment***

[CMCC] also proposes that in order not to increase the DCI size, the size of the DCI for GC-PDCCH should be aligned with the DCI format 1\_0 for CSS.

The FL will put forward proposals covering the aspect proposed above.

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

**Proposal 2.6-1**: For broadcast reception with UEs in RRC\_IDLE/INACTIVE state, the bit length FDRA field within the DCI of GC-PDCCH scheduling a GC-PDSCH carrying MCCH/MTCH depends on the frequency size of the CFR.

**Proposal 2.6-2**: The DCI 1\_0 format for GC-PDCCH scheduling a GC-PDSCH carrying MCCH/MTCH at least includes the following fields for broadcast reception with UEs in RRC\_IDLE/INACTIVE state:

* FDRA field (size of CFR)
* TDRA field Time domain resource assignment
* VRB-to-PRB mapping
* Modulation and coding scheme
* Redundancy version
* MCCH change notification (if supported and only for MCCH)
* FFS: RB numbering starts from the lowest RB of the CFR and support of resource allocation with granularity of multiple RBs.

**Proposal 2.9-3**: For broadcast reception with UEs in RRC\_IDLE/INACTIVE state, the DCI size of GC-PDCCH scheduling a GC-PDSCH carrying MCCH/MTCH should be aligned with DCI format 1\_0 in the CSS.

Please provide your comments in the table below:

|  |  |
| --- | --- |
| **company** | **comments** |
| NOKIA/NSB | We are fine with **Proposal 2.6-1** and **Proposal 2.6-2**.If understand correctly, there is a typo, it should be **Proposal 2.6-3** instead of **Proposal 2.9-3**. Moreover, there is also DCI size alignment discussion in 8.12.1, we prefer to postpone this discussion until the discussion in 8.12.1 is clarified. |
| Qualcomm | Proposal 2.6-1: Prefer to delete “MCCH change notification (if supported and only for MCCH)”Proposal 2.6-2: ok |
| Lenovo, Motorola Mobility | Proposal 2.6-1: OK.Proposal 2.6-2: Generally fine with us. The field of VRB-to-PRB mapping may not be necessary. We can specify only interleaving is support so as to save one bit.For FFS, we agree that RB numbering is from the lowest RB of CFR. Whether to support larger RB granularity is FFS.**Proposal 2.9-3**: It should be a typo on 2.6-3. We suggest to add “C-RNTI” for DCI format 1-0 in CSS.**Proposal 2.6-3**: For broadcast reception with UEs in RRC\_IDLE/INACTIVE state, the DCI size of GC-PDCCH scheduling a GC-PDSCH carrying MCCH/MTCH should be aligned with DCI format 1\_0 with CRC scrambled by C-RNTI in the CSS. |
| vivo | The interpretation of DCI fields and DCI alignment to the existed DCI format for RRC idle/inactive UEs is highly related to the discussion for RRC-connected UEs. We propose to postpone discussing these proposals. |

## Issue 7: PDCCH: CORESET for MCCH and MTCH channels

### **Background**

The following agreements for RRC\_IDLE/RRC\_INACTIVE UEs at RAN1#103-e and RAN1#105-e are 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.Agreement:For RRC\_IDLE/RRC\_INACTIVE UEs, the CORESET index can be the same for GC-PDCCH of MCCH and MTCH.Agreement:For Rel-17, for broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs do not exceed the maximum number of CORESETs mandatorily (in the minimum capability) supported for Rel-15/Rel-16 UEs, i.e., 2 CORESETs. * If the CFR has the same frequency range as the initial BWP, where the initial BWP has the same frequency resources as CORESET0 or where the initial BWP has the frequency resources configured by SIB1, RRC\_IDLE/RRC\_INACTIVE UEs can be configured with the following options:
	+ CORESET#0 (default option if CFR is the initial BWP and CORESET is not configured); or
	+ CORESET configured by *commonControlResourceSet;* or
	+ CORESET#0 and CORESET configured by *commonControlResourceSet*.
 |

### **Tdoc analysis**

* In [R1-2106440, Huawei]
	+ Proposal 2: When the CFR for MCCH/MTCH is configured with the same size as SIB1 configured initial BWP, in addition to CORESET#0, the other CORESET larger than CORESET#0 can be configured.
* In [R1-2106664, Nokia]
	+ Proposal-7: Support different/separate CORESET can be utilized for GC-PDCCH of MCCH and MTCH.
	+ Observation-1: If CFR [Case C] in Figure-1 is agreed to be supported, the agreements that have been agreed for CFR [Case A] can be applied directly.
	+ Proposal-8: If CFR [Case D-1] and [Case E] are agreed to be supported, the corresponding CFR\_CORESET configured via SIBx of CFR configuration can be applied accordingly, and CORESET#0 is applied as default if corresponding CFR\_CORESET is not configured.
* In [R1-2106747, ZTE]
	+ Proposal 5: Regarding the CORESET configuration,
		- the CORESET configured within the CFR for GC-PDCCH can be applied for broadcast, multicast and unicast.
		- networks configures CORESET#0 or common CORESET configured by *commonControlResourceSet* for GC-PDCCH if MBS CORESET is not configured.
* In [R1-2107371, Qualcomm]
	+ Proposal 4: 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 [R1-2107952, Chengdu TD tech]
	+ Proposal 4: MCCH and MTCH share the same CORESETs/search spaces which are configured in the initial BWP for DL.
* In [R1-2108028, Convida]
	+ Proposal 3: 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 [R1-2108172, Ericsson]
	+ Proposal 13: For Rel-17, for broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs do not exceed the maximum number of CORESETs mandatorily (in the minimum capability) supported for Rel-15/Rel-16 UEs, i.e., 2 CORESETs.
		- If the CFR has the same frequency range as the initial BWP, where the initial BWP has the same frequency resources as CORESET0, 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.

### **FL Assessment**

[Huawei, ZTE, Convida] propose that an additional CORESET to CORESET#0 can be configured. However, is FL understanding that this is already possible based on the agreement at the last meeting [**is this is a misunderstanding, please do share your views in the discussion section below**]:

|  |
| --- |
| Agreement:For Rel-17, for broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs do not exceed the maximum number of CORESETs mandatorily (in the minimum capability) supported for Rel-15/Rel-16 UEs, i.e., 2 CORESETs. * If the CFR has the same frequency range as the initial BWP, where the initial BWP has the same frequency resources as CORESET0 or where the initial BWP has the frequency resources configured by SIB1, RRC\_IDLE/RRC\_INACTIVE UEs can be configured with the following options:
	+ CORESET#0 (default option if CFR is the initial BWP and CORESET is not configured); or
	+ CORESET configured by *commonControlResourceSet;* or
	+ CORESET#0 and CORESET configured by *commonControlResourceSet*.
 |

[Nokia, Qualcomm] propose that separate configurations of GC-PDCCH can done for MCCH and MTCH. While [ZTE] also proposes that the CORESET configured within the CFR for GC-PDCCH can be applied for broadcast, multicast and unicast.

Finally, [Ericsson] proposes to reformulate one of the agreements on the maximum number of CORESETs since the ongoing discussion on CFR with the same size as the SIB-1 configured initial BWP. However, in this case the FL suggests to wait until the discussion on CFR is more mature.

The FL puts forward proposals addressing the aspects above.

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

**Proposal 2.7-1**: For RRC\_IDLE/RRC\_INACTIVE UEs, the CORESET configured within the CFR for GC-PDCCH can be applied for broadcast, multicast and unicast.

**Proposal 2.7-2**: For RRC\_IDLE/RRC\_INACTIVE UEs, the CORESET of GC-PDCCH for MCCH and MTCH can be separately configured in corresponding CFR: CORESET for MCCH can be configured by SIB and CORESET for MTCH can be configured by MCCH.

Please provide your comments in the table below:

|  |  |
| --- | --- |
| **company** | **comments** |
| NOKIA/NSB | Regarding **Proposal 2.7-1**, so far, the discussion is focusing on the broadcast reception for RRC\_IDLE/INACTIVE UEs, we don’t see why it is necessary to agree anything relate to the CORESET configuration for multicast and unicast? Thus, we are not fine with **Proposal 2.7-1.** We are fine with **Proposal 2.7-2**. |
| Qualcomm | Proposal 2.7-1: not support it. There is no multicast/unicast for IDLE/INACTIVE UEs per our understanding.Proposal 2.7-2: support it. |
| Lenovo, Motorola Mobility | Proposal 2.7-1: not support it. Only broadcast is supported.Proposal 2.7-2: OK. |
| vivo | We are not clear with Proposal 2.7-1, as RRC\_IDLE/RRC\_INACTIVE UEs may not be able to support multicast and unicast in Rel 17. |

## Issue 8: PDSCH repetition/HARQ combining

### **Background**

The following agreements at RAN1#102-e, RAN1#103-e, RAN1#104-e UEs in RRC\_CONNECTED state are relevant for the discussion:

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

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

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

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

This issue was also discussed for RRC\_IDLE/INACTIVE UEs at RAN1#104-e without reaching an agreement since companies preferred to delay the discussion until after more progress was achieved at other AIs.

### **Tdoc analysis**

* In [R1-2106747, ZTE]
	+ Proposal 9: For RRC\_IDLE/RRC\_INACTIVE UEs, consecutive slot-level PDSCH repetition with repetition number configured by higher layer (e.g., via SIB) is supported for MBS.
* In [R1-2107371, Qualcomm]
	+ *Discuss*: For RRC\_CONNECTED UEs, we have agreed to support slot-level repetition for GC-PDSCH. Similar feature should be applied for RRC\_IDLE/INACTIVE UEs, when receiving broadcast services. Compared with multicast transmission, transmit diversity is relatively more important for broadcast transmission due to no CSI feedback and HARQ operation.
	+ Proposal 9: Support semi-static and dynamic repetition configuration for broadcast MCCH/MTCH.
	+ *Discuss*: In NR, a dedicated HARQ process is used for SIB, not occupying the total number of HARQ processes for unicast. For NR Rel-17 broadcast, RAN1 needs to discuss whether/how to allocate HARQ process(es) for broadcast.
	+ Proposal 10: At least for RRC\_IDLE/INACTIVE UEs, support HARQ combining using the available HARQ process(es) of unicast/multicast.
* In [R1- 2107458, LGE]
	+ Proposal 9: For slot-level repetition for group-common PDSCH for RRC\_IDLE/INACTIVE UEs receiving broadcast,
		- (Config A) UE can be optionally configured with *pdsch-AggregationFactor*.
		- (Config B) UE can be optionally configured with TDRA table with *repetitionNumber* as part of the TDRA table.
		- If UE is configured with Config B, UE does not expect to be configured with Config A for the same group-common PDSCH.
* In [R1-2107613, Intel]
	+ Discuss: Additionally, slot-level repetition similar to the case for RRC\_CONNECTED UEs can be supported. The repetition is configured as part of the TDRA table configured to idle/inactive mode UEs via SIB signalling. The repetition can then be dynamically indicated by the group common PDCCH.
	+ Proposal 10: Slot level repetition can be supported for RRC\_IDLE UEs with the repetition configured as part of the TDRA table via SIB and indicated dynamically through DCI.
* In [R1-2107883, NTT DOCOMO]
	+ *Discuss*: It was agreed that existing parameters *pdsch-AggregationFactor* and *repetitionNumber* can be configured for slot-level repetition of group-common PDSCH for RRC\_CONNECTED UEs.
	+ *Discuss*: Both semi-static and dynamic methods of indicating the number of repetitions would be useful. Their parameters should be configurable in MBS specific SIB or MCCH.
	+ Proposal 7: *pdsch-AggregationFactor* and *repetitionNumber* can be configured for group-common PDSCH for RRC\_IDLE/RRC\_INACTIVE UEs.
* In [R1-2108028, Convida]
	+ *Discuss*: As PDSCH repetition has been already agreed to be supported for MBS in RRC connected state, it should be also considered to support MBS PDSCH repetition RRC idle/inactive state.
	+ Proposal 6: Support PDSCH repetition and PDCCH repetition for MBS for the RRC\_IDLE/RRC\_INACTIVE UEs.
* In [R1-2108172, Ericsson]
	+ As an example, time diversity could be increased by using pre-scheduled retransmissions, exactly like multicast HARQ retransmissions and/or PDSCH repetitions, but not triggered by UE feedback, but pre-scheduled, as decided by the gNB to achieve a certain target broadcast coverage.
	With such alignment it would also be easier in future releases to find possibilities for an even higher degree of integration of the overall MBS system solution for unicast/multicast/broadcast, allowing increased flexibility and performance with a minimized complexity footprint.
	+ Proposal 16: The NR broadcast solution should target maximum commonality/alignment with the NR multicast solution.

### **FL Assessment**

This issue was not discussed at RAN1#105-e.

[ZTE, Qualcomm, LGE, Intel, NTT DOCOMO, Convida, Ericsson] propose/discuss the support of slot-level repetition for broadcast reception with UEs in RRC Idle/inactive state.

[Qualcomm] discusses HARQ process for broadcast reception and [Ericsson] also discusses the benefits of aligning the solutions between unicast, multicast and broadcast.

Multiple companies propose slot-level repetition for broadcast reception with UEs in RRC idle/inactive state, a feature already supported for multicast reception for RRC connected UEs. Given that further progress has been made since the discussion of this issue at RAN1#104-e, the FL puts forward a proposal to also include the support for broadcast reception with idle/inactive states.

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

**Proposal 2.8-1**: For broadcast reception with UEs in RRC\_IDLE/INACTIVE states, support slot-level repetition for GC-PDCCH/PDSCH carrying MCCH/MTCH.

* reusing solution adopted for multicast reception with UEs in RRC\_CONNECTED state.
* FFS HARQ combining using available HARQ process(es) of unicast/multicast.
* FSS dynamic and semi-static methods of indicating the number of repetitions.

Please provide your comments in the table below:

|  |  |
| --- | --- |
| **company** | **comments** |
| NOKIA/NSB | We are generally fine with the main bullet point of **Proposal 2.8-1** to support slot-level repetition. But it seems the 2nd sub-bullet regarding HARQ combing has NO relation with slot-level repetition in the main bullet, we don’t understand why it is added here, maybe it should be removed or separated with a new proposal? |
| Qualcomm | Fine with the proposal |
| Lenovo, Motorola Mobility | OK with the main bullet.The first FFS is not necessary as combining is UE implementation issue. |
| vivo | One clarification question, does this proposal also apply to ‘for broadcast reception with UEs in RRC\_CONNECTED states’?As it has not been agreed using the available HARQ process yet, can we modify first FFS below FFS HARQ combining ~~using available HARQ process(es) of unicast/multicast~~. |

## Issue 9: PDSCH: Semi Persistent Scheduling

### **Background**

The following agreements for RRC\_CONNECTED UEs made at RAN1#103-e, RAN1#104-e, RAN1#104b-e and RAN1#105-e are relevant for this discussion.

|  |
| --- |
| Agreements: Support SPS group-common PDSCH for MBS for RRC\_CONNECTED UEs* FFS: use group-common PDCCH or UE-specific PDCCH for SPS group-common PDSCH activation/deactivation
* FFS: whether to support more than one SPS group-common PDSCH configuration per UE
* FFS: whether and how uplink feedback could be configured
* FFS: retransmission of SPS group-common PDSCH

Agreement: For RRC\_CONNECTED UEs, more than one SPS group-common PDSCH configuration for MBS can be configured per UE subject to UE capability* The total number of SPS configurations supported by a UE currently defined for unicast is not increased due to additionally supporting MBS.
* FFS: How to allocate the total SPS configurations between MBS and unicast.

 Agreement: For RRC\_CONNECTED UEs, support HARQ-ACK feedback for SPS group-common PDSCH for MBS* FFS: The retransmission scheme(s)
* FFS: The HARQ-ACK details for SPS PDSCH and activation/deactivation, which can be discussed in AI 8.12.2

Agreement:The retransmission scheme for a given SPS group-common PDSCH can be either PTM scheme 1 or PTP.* FFS: Whether PTM scheme 1 retransmission and PTP retransmission can be used simultaneously for different UEs in the same MBS group

Agreement:Define G-CS-RNTI at least for SPS group-common PDSCH and activation/deactivation of SPS group-common PDSCH, different from CS-RNTI for unicast SPS PDSCH.* G-CS-RNTI is used for PTM scheme 1 based dynamic retransmission of SPS group-common PDSCH
* FFS: Whether CS-RNTI can be used for PTP retransmission of SPS group-common PDSCH.
* FFS: Number of G-CS-RNTI.

Agreement: For RRC\_CONNECTED UE supporting MBS, support up to 8 configured SPS configurations in a BWP of a serving cell for unicast and MBS in total. * It is up to gNB implementation to configure the SPS configuration indexes for unicast and MBS, respectively.

Agreement:Confirm the working assumption: For activation/deactivation of SPS group-common PDSCH for MBS in RRC\_CONNECTED state,* At least group-common PDCCH is supported
	+ FFS: Whether and how to address the missed activation and deactivation
* FFS: Whether UE-specific PDCCH is supported for activation/deactivation
 |

### **Tdoc analysis**

* In [R1-2106625, vivo]
	+ *Discuss*: Semi-persistent scheduling (SPS) is beneficial for periodic transmissions. However, in broadcast, the received UEs are not known by gNB and HARQ feedback is not expected to be supported. If UE fails to detect the activation DCI for SPS MBS PDSCH, it will miss all the subsequent transmissions. Therefore, for RRC\_IDLE/RRC\_INACTIVE UEs, SPS PDSCH with DCI activation/deactivation is not supported at least for broadcast reception. On the other hand, SPS PDSCH without dynamic activation/deactivation which is similar to uplink configured grant type 1 can be considered instead.
	+ Proposal 4: For RRC\_IDLE/RRC\_INACTIVE UEs, at least for broadcast reception, SPS PDSCH with DCI activation/deactivation is not supported.
		- FFS: SPS PDSCH without DCI activation/deactivation.
* In [R1-2106747, ZTE]
	+ Proposal 10: Support SPS group-common PDSCH for MBS for RRC\_IDLE/RRC\_INACTIVE UEs.
* In [R1-2107883, NTT DOCOMO]
	+ *Discuss*: SPS is beneficial to reduce PDCCH overhead. Based on RAN2 agreements, a UE can know the start/end of broadcast session by MCCH change notification. Therefore, SPS will work without activation/deactivation commands. Configurations required to receive SPS group-common PDSCH can be included in the MCCH. In other words, SPS group-common PDSCH with the same concept as Type-1 CG-PUSCH should be supported.
	+ Proposal 8: For RRC\_IDLE/RRC\_INACTIVE UEs, support SPS group-common PDSCH without activation/deactivation commands.
* In [R1-2108028, Convida]
	+ Proposal 5: Support scheduling without dynamic grant for the RRC\_IDLE/RRC\_INACTIVE UEs.
* In [R1-2108172, Ericsson]
	+ *Discuss*: SPS for MTCH in idle/inactive (i/i) has not be widely discussed. For SPS in i/i, a one-time activation signalled in PDCCH does not make sense, because 1) UEs can "enter" the cell by cell-reselection and we believe it should be possible that SPS is active or inactive on a per-cell basis and 2) for i/i UEs there is no HARQ-ACK/NACK, so PDCCH-based activation could not use ACK/NACK either to confirm the activation.
	+ Proposal: For SPS to UEs in RRC-Idle/Inactive, we propose configuration and activation is in the MCCH.
	+ Proposal: For SPS to UEs in RRC-Idle/Inactive, the slot offset is included in the SPS-Config IE and this IE is carried in MCCH.

### **FL Assessment**

This issue was not discussed at RAN1#105-e. For AI 8.12.3 this issue was discussed at RAN1#104-e without an agreement since various companies preferred to progress the feature adopted for AI 8.12.1 on multicast for RRC connected state UEs.

[vivo, ZTE, NTT DOCMO, Convida, Ericsson] propose the use of SPS for broadcast reception with UEs in RRC idle/inactive state.

[vivo, NTT DOCOMO, Ericsson] discuss that activation/deactivation carried in DCI is not a suitable solution for RRC idle/inactive UEs. Configuration carried in MCCH, including periodicity and offset, is proposed.

Given that this issue has progressed in the other 2 AIs of the WI and the proposals submitted to this meeting, the FL puts a proposal to try to reach agreement to enable SPS for GC-PDSCH for broadcast reception with UEs in RRC\_IDLE/INACTICE state.

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

**Proposal 2.9-1**: Support SPS GC-PDSCH carrying MTCH for broadcast reception with UEs in RRC\_IDLE/INACTICE state.

* configuration to receive SPS GC-PDSCH, including an IE *SPS-Config*, is included in MCCH.
* FFS details of the IE *SPS-Config:* periodicity and offset.

Please provide your comments in the table below:

|  |  |
| --- | --- |
| **company** | **comments** |
| NOKIA/NSB | We are fine with **Proposal 2.9-1**. |
| Qualcomm | Need further clarification/study. Which kind of SPS is discussed here:* + - * Type-1 SPS: DL SPS GC-PDSCH with SPS DCI activation/deactivation
			* Type-2 SPS: DL SPS GC-PDSCH without SPS DCI activation/deactivation

For multicast, we only agreed to support Type-1 SPS. We think Type-1 SPS cannot be supported for IDLE/INACTIVE. If we say Type-2 SPS for broadcast MTCH, it will make CONN UEs to support two types of SPS for DL PDSCH.  |
| Lenovo, Motorola Mobility | OK |
| vivo | One clarification question, does this proposal also apply to ‘ broadcast reception with UEs in RRC\_CONNECTED states’? |

## Issue 10: Beam Sweeping for MCCH and MTCH channels

### **Background**

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

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

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

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

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

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

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 [R1-2106440, Huawei]
	+ 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.
	+ 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.
	+ Proposal 8: GC-PDCCH/PDSCH can be configured to be QCL’d with periodic TRS for IDLE/INACTIVE UEs receiving MTCH.
* In [R1-2106664, Nokia]
	+ Proposal-13: Consider the SSB index to PDCCH MO mapping across the MBS window can be “disabled” by network. Thus, the mapped number of mapped SSB beams can be evenly distributed among each MCCH window duration.
	+ Proposal-14: Propose to allow the network to control the number of repetition transmission for each SSB beam within the MBS window duration.
	+ Proposal-15: Consider including the SSB association mapping for SSB beams without MBS transmission.
* [R1-2106718, Spreadtrum]
	+ Proposal 5: Do not support group-common PDCCH/PDSCH for MTCH being QCL’d with periodic TRS for RRC\_IDLE/RRC\_INACTIVE UEs.
* In [R1-2106747, ZTE]
	+ Proposal 11: Regarding beam sweeping transmission of MTCH,
		- Both searchSpace#0 and common search space other than searchSpace#0 can be used for MTCH.
		- The mapping between PDCCH occasions and SSBs for SIB1 can be reused if searchSpace#0 is configured.
		- The similar rule as defined for OSI in TS 38.331 can be reused for mapping PDCCH occasions to SSBs in the MTCH transmission window if a common search space other than searchSpace#0 is configured for MTCH scheduling.
* In [R1-2106947, CATT]
	+ *Discuss*: Considering the group-common PDCCH/PDSCH is for a group of UEs, the transmission mode is broadcast and the MCS (i.e. QPSK) of PDSCH is not high, so additional periodic TRS for broadcast is not necessary.
	+ Proposal 7: The additional periodic TRS for broadcast is not necessary.
	+ Proposal 8: 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 [R1-2107095, 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 [R1-2107231, OPPO]
	+ Proposal 7: 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 8: 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 9:
		- 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.
		- 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 [R1-2107371, Qualcomm]
	+ Proposal 11: UE may assume that the GC-PDSCH for MTCH is QCL’d with SSB or periodic TRS if configured for broadcast reception.
* In [R1-2107427, CMCC]
	+ *Discuss*: In addition, the impact of DRX also needs to be taken into account, the group-common PDCCH monitoring occasions will be extended when drx-Inactivity timer is running, and the association between monitoring occasions and SSB indexes needs to be defined.
	+ Proposal 10. 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.
* In [R1-2108172, Ericsson]
	+ Proposal 3: It should be configurable whether beams sweeping is used in the MBS broadcast mode. The beamwidth of PDSCH carrying MTCH should be possible to adjust separately from the SSB beamwidth.
	+ Proposal 4: For scheduling a PTM-PDSCH, we propose the following schemes:
		- a) PDCCH in the same beam as the PTM-PDSCH
		- b) Multiple PDCCH, one per narrower beam, each pointing to the same PTM-PDSCH in a different, potentially wider, beam.
		- c) SPS
	+ Proposal 5: The beamwidth of PDSCH carrying MCCH should be possible to adjust separately from the beamwidth of PDSCH carrying MTCH.
	+ Proposal 6: 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.
	+ Proposal 7: Group-common PDCCH/PDSCH for MTCH is QCL’d with TRS if configured.

### **FL Assessment**

***Discussion on SSB as QCL source by reusing similar rules as SIB1 and OSI***

[Huawei, ZTE, CMCC] propose that mapping between PDCCH occasions and SSBs reuse rules defined for SIB1 (for *searchSpace#0*) or OSI (for search space other than *searchSpace#0*) for MTCH, similarly as agreed for MCCH at the last RAN1 meeting.

These proposals for MTCH were proposed and discussed at RAN1#105-e without reaching an agreement. Arguments were put that more flexible configuration should be possible for MTCH. More flexible configurations are discussed in subsequent sections. FL will put forward proposals to agree at least this functionality, while also proposing further studies to allow for more flexible configuration than that provided by beam sweeping in SIB1 and OSI.

***Discussion on association rules between SSB indexes and UE monitoring occasions***

[Nokia, CATT, OPPO] discuss and proposes association rules between SSB indexes and UE monitoring occasions an open issue, as per previous agreements, for beam sweeping. It is understood that the proposals build on top of existing configuration flexibility available for SSB mapping to PDCCH monitoring occasion. To allow discussion at this meeting for the different proposals, the FL puts forward a study on the different options submitted to this meeting for more discussion with the group.

***Discussion on TRS as QCL source***

While [Huawei, Qualcomm, Ericsson] propose that GC-PDCCH/PDSCH carrying MTCH for broadcast reception can be configured to be QCL’d with periodic TRS, [Spreadtrum, CATT] argue that such functionality is not needed.

QCL with periodic TRS has been proposed across past meetings and with increasing support form companies. The FL will put forward a proposal to include such functionality to allow companies to have more discussion at this meeting.

***Discussion on separate configurations for GC-PDCCH and GC-PDSCH and between MTCH and MCCH***

[Ericsson] has multiple proposals to allow separate beam sweeping configurations between GC-PDCCH and GC-PDSCH as well as to allow for separate beam sweeping configurations between MCCH and MTCH. The proposals also include allowing the configuration of beamwidths larger for GC-PDSCH and potential association from multiple GC-PDSCCH beams. These proposals were part of the discussion at the last meeting. To allow for more discussion at this meeting, the FL puts forward a study to get companies’ opinions on these approaches.

### **1st round FL proposals for Issue 10**

**Proposal 2.10-1**: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, if searchSpace#0 is configured for MCTH, the mapping between PDCCH occasions and SSBs is the same as for SIB1.

**Proposal 2.10-2**: For RRC\_IDLE/RRC\_INACTIVE UEs with broadcast reception, if common search space other than searchSpace#0 is configured for MTCH, the mapping of PDCCH monitoring occasions to SSBs can be configured with similar rules as those defined for OSI in TS 38.331.

**Proposal 2.10-3**: UE may assume that GC-PDCCH/PDSCH carrying MTCH for broadcast reception can be configured to be QCL’d with periodic TRS for RRC\_IDLE/RRC\_INACTIVE UEs.

**Proposal 2.10-4**: For RRC\_IDLE/RRC\_INACTIVE UEs with beam sweeping for broadcast reception, study the following for GC-PDCCH/PDSCH carrying MCCH/MTCH:

* multiple GC-PDCCH, one per narrow beam, each pointing to the same GC-PDSCH in a different potentially wider beam.
* beamwidth of GC-PDSCH carrying MCCH is adjusted separately from the beamwidth of GC-PDSCH carrying MTCH.

**Proposal 2.10-5**: For RRC\_IDLE/RRC\_INACTIVE UEs with beam sweeping for broadcast reception, further study the following aspects of association rules between SSB indexes and UE monitoring occasions for GC-PDCCH/PDSCH carrying MCCH/MTCH:

* mapping of SSB index to GC-PDCCH MO across transmission window can be disabled by network.
* number of repetition transmission for each SSB beam within the transmission window duration can be controlled by network.
* association of SSB beams without MBS transmission.
* GC-PDCCH MOs in one transmission window length are allocated to different SSBs successively, same as the PDCCH MOs for SIBx
* GC-PDCCH MOs in one transmission window length are allocated to one SSB with consecutive monitoring occasions.

Please provide your comments in the table below:

|  |  |
| --- | --- |
| **company** | **comments** |
| NOKIA/NSB | Regarding **Proposal 2.10-1**, there is a typo with MTCH instead of MCTH. Otherwise we are fine with it.Regarding **Proposal 2.10-2**, we are fine with it.Regarding **Proposal 2.10-3**, regarding TRS, we could like to see more concrete proposals and performance evaluation to justify it is worthwhile to go with the proceeding work. Especially the specification effort that is going to take considering now we have only 3 RAN1 meeting left. Regarding **Proposal 2.10-4**, Rel17 MBS is the very first release for NR, we would like to keep the beam sweeping operation SIMPLE for RRC\_IDLE/INACTIVE UEs for both MCCH and MTCH. But we are open to discuss firstly whether the beamwidth of MCCH is beneficial to be different from beamwidth of MTCH. Some performance evaluation justification provided could be helpful to better understand the issue.Regarding **Proposal 2.10-5**, we are fine with it. |
| Qualcomm | Generally fine with 2-10-1/2/3. For 2.10-4, 2.10-5, may need to understand the motivation first before further study.  |
| vivo | Regarding to Proposal 2.10-3, we are wondering what’s the periodic TRS here. Does it mean to reuse the periodic TRS defined in power saving session, or newly defined for MBS? |
|  |  |

## Issue 11: HARQ feedback for RRC\_IDLE/RRC\_INACTIVE UE states

### **Background**

This issue was discussed at RAN1#104-e without reaching a conclusion:

|  |
| --- |
| **Proposal 10-rev1**: RRC\_IDLE/RRC\_INACTIVE UEs do not support UL feedback to improve reliability of Broadcast/Multicast services in Rel-17. |

The following agreements at RAN1#104b-e and RAN1#105-e for RRC connected UEs for multicast reception is relevant for this discussion:

|  |
| --- |
| Agreement:Support NACK-only based HARQ-ACK feedback for RRC\_CONNECTED UEs receiving multicast.Agreement:Support PUCCH format 0 and format 1 for NACK-only based HARQ-ACK feedback for multicast. Agreement:Support NACK-only based HARQ-ACK feedback at least for multicast SPS PDSCH without PDCCH scheduling.* FFS for SPS activation/deactivation.

Conclusion:PUCCH resource for NACK-only can be shared by UEs transmitting the NACK-only based HARQ-ACK feedback. |

### **Tdoc analysis**

* In [R1-2106625, vivo]
	+ Proposal 3: For RRC\_IDLE/RRC\_INACTIVE UEs, at least for broadcast reception, HARQ feedback is not supported.
* In [R1-2106914, Samsung]
	+ Proposal 5. RRC\_IDLE/RRC\_INACTIVE UEs do not support UL feedback.
* In [R1-2107231, OPPO]
	+ Proposal 10: It is proposed for RRC idle and inactive state UEs to provide HARQ feedback in order to meet reliability requirement of MBS application/service.
		- Only NACK feedback is needed since the number of RRC idle and inactive state UEs may not be accurately known by the network.
	+ Proposal 11: To support “only NACK” HARQ feedback for idle and inactive UEs, it should be further consider using PUCCH or PRACH.
* In [R1-2107427, CMCC]
	+ *Discuss*: As for NACK-only based HARQ-ACK feedback, we also think it has little motivation to be supported for RRC\_IDLE/INACTIVE UEs, the first reason is that the QoS requirement for broadcast service is much lower than multicast service and the second reason is that gNB can use PDSCH repetition to improve the reliability without HARQ-ACK feedback. Therefore, we think the HARQ feedback for group-common PDSCH for broadcast reception for RRC\_IDLE/INACTIVE UEs should not be supported.
	+ Proposal 7. For RRC\_IDLE/INACTIVE UEs, don’t support HARQ feedback for group-common PDSCH for broadcast reception.
* In [R1-2107613, Intel]
	+ Proposal 8: RRC\_INACTIVE/IDLE UEs can support HARQ feedback with NACK-only transmission on a common PUCCH resource configured by 4-bit RMSI indication and selected using the PRI in DCI and the starting CCE index of the PDCCH reception.

### **FL Assessment**

While [OPPO, Intel] propose the support of UL HARQ feedback for RRC idle/inactive UEs receiving broadcast, [vivo, Samsung, CMCC] do not supporting. [OPPO] discusses that UL HARQ feedback can help meet QoS requirements with low error rates, while [CMCC] argues that broadcast reception has lower QoS requirements than multicast reception with RRC connected state as well as that a reliability enhancement could be achieved by PDSCH repetition. [Samsung] also discusses that UEs in RRC idle/inactive state without uplink time synchronisation would result in severe interference to other UEs.

Although there are companies that support UL HARQ feedback to improve the reliability of broadcast reception for UEs in RRC idle/inactive state, other inputs have explicitly proposed that such a feature is not supported. Discussions at RAN1#104-e also showed multiple companies not supporting such a feature.

The FL will put a proposal for conclusion as RRC\_IDLE/RRC\_INACTIVE UEs do not support UL feedback to improve reliability of Broadcast/Multicast services in Rel-17 to check companies’ opinions.

### **1st round FL proposals for Issue 11**

**Proposal (conclusion) 2.11-1**: No specification support in Rel-17 for UL feedback for UEs in RRC\_IDLE/RRC\_INACTIVE state for broadcast reception.

Please provide your comments in the table below:

|  |  |
| --- | --- |
| **company** | **comments** |
| NOKIA/NSB | We suggest below re-wording:**Proposal (conclusion) 2.11-1**: No specification support in Rel-17 for UL feedback to improve reliability for UEs in RRC\_IDLE/RRC\_INACTIVE state for broadcast reception. |
| Qualcomm | ok |
| Lenovo, Motorola Mobility | OK. |
| vivo | fine |

## Issue 12: Broadcast services supported for both RRC\_CONNECTED and RRC\_IDLE/RRC\_INACTIVE UEs

### **Background**

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

|  |
| --- |
| 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 [R1-2106947, CATT]
	+ Proposal 6: When the configured UE-specific BWP does not contain the common frequency resource, the existing BWP switching mechanism can be used for MBS reception.
* In [R1-2107095, Futurewei]
	+ *Discuss*: However, it is up to network configuration to ensure that when a Connected UE starts to use broadcast service, it is configured such that its active BWP is in a CFR which also includes or serves as a new active BWP for unicast of the UE.
	+ Proposal 2: For broadcast reception, a common CFR for both Idle/Inactive and Connected UEs is configured.
* In [R1-2107516, MediaTek]
	+ Proposal 5: For broadcast reception, network implementation guarantee unified CFR for UEs in both RRC\_CONNECTED mode and IDLE/INACTIVE mode to receive the PTM transmission.
* In [R1-2107613, Intel]
	+ Proposal 7: If the CFR for IDLE/INACTIVE UEs is outside the active CFR or active BWP of CONNECTED mode UEs, it is up to the gNB to reconfigure the CFR or switch BWP of CONNECTED mode UEs to receive broadcast transmission. The IDLE UEs are not expected to switch BWP to align with CONNECTED mode UEs.

### **FL Assessment**

[Futurewei, MediaTek, Intel] discuss that network implementation ensures that the configuration of UE-specific active BWP of RRC\_CONNECTED UE contains the common frequency resource of RRC\_IDLE/INACTIVE UEs.

The FL puts forward a proposal reusing the wording provided in the inputs for discussion at this meeting.

### **1st round FL proposals for Issue 12**

**Proposal (conclusion) 2.12-1**: If the CFR for RRC\_IDLE/RRC\_INACTIVE UEs is outside the active CFR or active BWP of RRC\_CONNECTED UEs, it is up to the gNB to reconfigure the CFR or switch BWP of RRC\_CONNECTED UEs to receive the broadcast transmission. The RRC\_IDLE/INACTIVE UEs are not expected to switch BWP to align with RRC\_CONNECTED mode UEs.

Please provide your comments in the table below:

|  |  |
| --- | --- |
| **company** | **comments** |
| NOKIA/NSB | We understand the intention of **Proposal (conclusion) 2.12-1**, and we are generally fine with it. Moreover, we have the below rewording proposal:*For the case when UE-specific active BWP of RRC\_CONNECTED UE does not contain the common frequency resource of RRC\_IDLE/INACTIVE UEs, it is up to the gNB implementation to guarantee the proper reception of broadcast transmission by RRC\_CONNECTED UEs.* |
| Qualcomm | The intention of this proposal is to discuss UE behavior in CONN mode, which can be discussed in 8.12.1.  |
| Lenovo, Motorola Mobility | What does it mean “active CFR”? |
| vivo | We can discuss this after achieving consensus on the configured/defined CFR for RRC\_IDLE/RRC\_INACTIVE UEs. |

## Issue 13: RAN2 LS on broadcast session delivery and MCCH design

### **Background**

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:

|  |
| --- |
| 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.
 |

The following agreements are relevant for the aspects 1, 2 and 3 for which RAN2 requests feedback:

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

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

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

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

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

Discussions proposed in this meeting on *PDCCH: RNTI and DCI design for carrying MCCH change notification* are also relevant for the requests from RAN2.

In R1-2106410 (cf. Annex C), RAN2 has sent a second LS where it requests RAN1 to take their agreements into account when discussing PHY layer aspects of MCCH design.

### **Tdoc analysis**

* In [R1-2108067, Huawei]
	+ Proposal 2: Using a field in DCI scheduling MCCH to notify the session start and the modification of an ongoing session.
		- Reply RAN2’s LS with the mechanism RAN1 agreed.
* In [R1-2107371, Qualcomm]
	+ Proposal 7: Send LS to RAN2 to ask
		- Whether RAN1 should consider the case of UE supporting multiple G-RNTIs for MTCH
		- Whether RAN1 should consider the case of UE supporting multiple MCCH-RNTIs
		- Whether RAN1 should consider the case of UE supporting multiple MCCH-N-RNTIs (if defined for MCCH change notification)
* [CMM in R1-2107387 and MediaTek R1-2107513] also discuss the LS from RAN2.

### **FL Assessment**

Given RAN1 has made some agreements that are relevant to the aspects which RAN2 has requested feedback, ongoing discussion at this meeting and further request form inputs to reply and ask questions to RAN2, it is therefore proposed to discuss sending an LS from RAN1 to RAN2.

### **1st round FL proposals for Issue 13**

**Proposal 2.13-1**: Send an LS to RAN2 regarding at least the following:

* agreements on Common Search Space design for MCCH channel,
* agreements on the allowed transmission bandwidth/BWP configurations for MCCH transmission.
* agreements on RNTI and DCI design for carrying MCCH change notifications (if any)
* whether RAN1 should consider the case of UE supporting: multiple G-RNTIs for MTCH, multiple MCCH-RNTIs, multiple MCCH-N-RNTIs (if defined for MCCH change notification).

Please provide your comments in the table below:

|  |  |
| --- | --- |
| **company** | **comments** |
| NOKIA/NSB | We are generally fine with **Proposal 2.13-1**. |
| Qualcomm | ok |
| Lenovo, Motorola Mobility | OK |
| vivo | For the last sub bullet, as RAN 2 has agreed that ‘We support single MCCH (in this release)’, we don’t see the need to support multiple MCCH-RNTIs, multiple MCCH-N-RNTIs (if defined for MCCH change notification).  |

## Other Issues

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

### **Other Issue 1: Multicast reception by UEs in IDLE/INACTIVE states**

* [R1-2108172, Ericsson]

### **Other Issue 2: Discontinuous Reception (DRX) and Wakeup Signals (WUS)**

* [R1-2106947, CATT], [ R1-2107458, LGE]

### **Other Issue 3: PDSCH TDRA table configuration**

* [R1-2106747, ZTE]

### **Other Issue 4: PDSCH transmission parameters (MCS, MIMO layers, etc.)**

* [R1-2107371, Qualcomm], [R1-2106821, Sony]

### **Other Issue 5: Scrambling sequence initialisation for GC-PDCCH/PDSCH**

* [R1-2106914, Samsung], [R1-2107165TCL]

### **Other Issue 6: MBS Interest Indication for partial beam sweeping**

* [R1-2106664, Nokia], [R1-2106821Sony]

### **Other Issue 7: Support of RedCap UEs**

* [R1-2107765, Apple], [R1-2106747, ZTE]

# Proposals for Discussion at GTW sessions

This section will include proposals for potential discussion at the different GTW scheduled for MBS at RAN1#106-e.

# Stable Proposals

# Summary

This section includes the agreements for RAN1#106-e.

# References

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

**Relevant tdocs from AI 5**

1. R1-2106408 Reply LS on G-RNTI and G-CS-RNTI for MBS RAN2, CMCC
2. R1-2106410 LS on update for MCCH design RAN2, Huawei
3. R1-2108066 Draft reply LS on MCCH change notification Huawei, HiSilicon
4. R1-2108067 Discussion on MCCH change notification Huawei, HiSilicon

**Relevant tdocs from AI 8.12.3**

1. R1-2106440 Discussion on UE receiving broadcast in RRC IDLE/INACTIVE state Huawei, HiSilicon, CBN
2. R1-2106625 Discussion on basic functions for broadcast multicast for RRC\_IDLE RRC\_INACTIVE UEs vivo
3. R1-2106664 Basic Functions for Broadcast / Multicast for RRC\_IDLE / RRC\_INACTIVE Ues Nokia, Nokia Shanghai Bell
4. R1-2106718 Basic Functions for Broadcast or Multicast for RRC\_IDLE or RRC\_INACTIVE UEs Spreadtrum Communications
5. R1-2106747 Discussion on basic Functions for Broadcast or Multicast for RRC\_IDLE or RRC\_INACTIVE UEs ZTE
6. R1-2106821 Considerations on MBS functions for RRC\_IDLE/INACTIVE UEs Sony
7. R1-2106914 On basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs Samsung
8. R1-2106947 Discussion on basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs CATT, CBN
9. R1-2107095 MBS Support for RRC IDLE/INACTIVE UEs FUTUREWEI
10. R1-2107162 Basic functions for broadcast/multicast in idle/inactive states Lenovo, Motorola Mobility
11. R1-2107165 Search Space and DCI Design for MBS in IDLE and INACTIVE states TCL Communication Ltd.
12. R1-2107231 Discussion on basic functions for RRC\_IDLE/RRC\_INACTIVE UEs OPPO
13. R1-2107371 Views on group scheduling for Broadcast RRC\_IDLE/INACTIVE UEs Qualcomm Incorporated
14. R1-2107384 Discussion on MBS for RRC\_IDLE/RRC\_INACTIVE UEs Google Inc.
15. R1-2107427 Discussion on NR MBS in RRC\_IDLE/ RRC\_INACTIVE states CMCC
16. R1-2107458 Basic function for broadcast/multicast LG Electronics
17. R1-2107516 Discussion on MBS for RRC\_IDLE/INACTIVE UEs MediaTek Inc.
18. R1-2107613 NR-MBS for RRC\_IDLE/INACTIVE UEs Intel Corporation
19. R1-2107765 Discussion on MBS for RRC\_IDLE and RRC\_INACTIVE UEs Apple
20. R1-2107883 Discussion on basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs NTT DOCOMO, INC.
21. R1-2107952 NR MBS related discussion for RRC\_IDLE/RRC\_INACITVE UEs CHENGDU TD TECH LTD.
22. R1-2108028 Discussion on MBS for RRC\_IDLE/RRC\_INACTIVE UEs Convida Wireless
23. R1-2108172 Support for NR multicast reception in RRC Inactive/Idle Ericsson

**Relevant tdocs from AI 8.12.4**

1. R1-2107662 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.

## RAN1#105-e agreements

Agreement:

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

Agreement:

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

* FFS details of FDRA.

Agreement:

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

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

Agreement:

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

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

Agreement:

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

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

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

Conclusion:

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

Agreement:

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

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

Agreement:

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

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

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

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

|  |  |  |
| --- | --- | --- |
| **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:

|  |
| --- |
| * **Both idle/inactive UEs and connected mode UEs can receive MBS services transmitted by NR MBS delivery mode 2 (Broadcast service as already agreed, TBD other). The ability for connected mode UEs to receive this may depend on the network provisioning of the service (e.g. which freq), UE connected mode configuration and UE capabilities.**
* **The two-step based approach (i.e. BCCH and MCCH) as adopted by LTE SC-PTM is reused for the transmission of PTM configuration for NR MBS delivery mode 2.**
* **Assume it is possible to reuse LTE SC-PTM mechanism for the CONNECTED UEs to receive the PTM configuration for NR MBS delivery mode 2, i.e. broadcast based manner.**
* **Assume that MCCH change notification mechanism is used to notify the changes of MCCH configuration due to session start for delivery mode 2 of NR MBS (other cases FFS, if any).**
 |

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

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

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

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

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

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

# Annex C: [R1-2106410] RAN2 LS on update for MCCH design

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

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

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

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