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

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

**Agenda item: 8.12.3**

**Source:** Moderator (BBC)

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

**Document for:** Discussion and Decision

# Introduction

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

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

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

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

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

[106bis-e-NR-MBS-03] Email discussion/approval on basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs with checkpoints for agreements on October 14 and 19 – David (BBC)

In this document, the Feature Lead (FL) presents a list of open Issues to enable reception of Point to Multipoint transmissions by UEs in RRC\_IDLE/ RRC\_INACTIVE states based on the technical documents (tdocs) submitted to RAN1#106bis-e. Each of the Issues has the following subsections: background, Tdoc analysis, FL assessment and a set of proposals that are updated based on rounds of discussion between companies. The final section of this document also contains the agreements reached at RAN1#106bis-e.

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

# Issues

## Issue 1: Cases D&E down-selection for CFR of MCCH/MTCH

### **Background**

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

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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, RAN1#105-e, RAN1#106-e and RAN#93-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.

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

* In [R1-2108725, Huawei]
	+ *Discuss*: We should note that case E if supported should be termed as initial BWP as well from RAN2 perspective, which can minimize the specification impact. According to the current specification, SIB1 configured initial BWP is used only when UE enters RRC\_CONNECTED state, on which UE can receive SIB/paging and unicast without BWP switching. Likewise, the initial BWP for case E can be used for broadcast and SIB/paging and unicast without BWP switching. However, if RAN1 could not achieve consensus on the naming of case E, it could be up to RAN2.
	+ Proposal 4: Case E seems more motivated than case D by MTCH requiring a larger bandwidth size than the size of SIB configured initial BWP.
		- If case E is supported, it is up to RAN2 how to name case E for minimizing the specification impact.
* In [R1-2108806, Futurewei]
	+ Proposal 1: For Idle/Inactive UEs broadcast reception, the common frequency resource (CFR) for group-common PDCCH/PDSCH is fully contained within the initial BWP and is configured by SIB. Furthermore, the frequency resources for the CFR does not need to be equal to CORESET0 (Case D).
	+ *Discuss*: From a network operation flexibility point of view, support of both Case D and E would be preferred. However, Case E would result in a CFR that is not bounded in any way since it is entirely based on a configured BWP. In a SFN operation, having a bound on the frequency region for the reception of broadcast for UE in idle/inactive states would ensure accessibility and uniformity of services.
* In [R1-2108853, ZTE]
	+ *Discuss*: Case D and Case E can be described as following. Technically speaking, both Case D and Case E as well as Case C require UE to activate a BWP larger than CORESET#0 in RRC\_IDLE/RRC\_INACTIVE states. The spec impacts and implementation impacts for these parts are almost the same.
	+ *Discuss:* For avoiding BWP switching between reception of unicast and broadcast, once UE enters RRC\_CONNECTED state, for Case D, UE can still use SIB-1 configured initial BWP as the activated BWP or activate another BWP larger than CFR. For Case E, UE can still use BWP X as the activated BWP or activate another BWP as long as it is larger than the CFR. The only difference between Case D and Case E is just the different size of CFR*.*
	+ Proposal 1: For a configured/defined CFR for GC-PDCCH/PDSCH carrying MCCH and MTCH for broadcast reception with UEs in RRC IDLE/INACTIVE state, support both Case D and Case E.
* In [R1-2108928, Spreadtrum]
	+ *Discuss:* In NR Rel-15/Rel-16, only small data, or even no traffice data is allowed to be transmitted in idle state. High traffic volume is always transmitted in connected state. One reason is that it is higher efficiency and reliablity in connected state. The necesarity of introducing CFR with large bandwidth.e g., case E in idle state, is not clear to us.
	+ Proposal 2: For CFR configuration for RRC\_IDLE/RRC\_INACTIVE UEs, Case E is not supported.
* In [R1- 2109003, vivo]
	+ *Discuss*: Case E is beneficial as it provides flexibility for the network to configure CFR independent of SIB-1 configured initial downlink BWP, so that proper size of CFR can be freely configured to facilitate MBS services well.
	+ Appendix lists issues raised by companies on Case E.
	+ Proposal 1: For a configured/defined CFR for GC-PDCCH/PDSCH carrying MCCH and MTCH for broadcast reception with UEs in RRC IDLE/INACTIVE state:
		- Support Case-C
		- Support Case D and Case E.
		- Note: Case C, D and E are defined in previous agreements.
* In [R1-2109069, OPPO]
	+ *Discuss:* For Case C, the CFR is the same as initial DL BWP configured by SIB1, and it has the least impact to current mechanism and cost efficient. Since the CFR has the same size of initial DL BWP, there is no BWP switching when UEs transfer from IDLE to CONN state, which guarantees no interruption of MBS services reception. Same bandwidth size between CFR and initial DL BWP can also have flexibility, because initial DL BWP can be configured with wide range of frequency sizes up to 100MHz*.*
	+ Proposal 1: For a configured/defined CFR for GC-PDCCH/PDSCH carrying MCCH and MTCH for broadcast reception with UEs in RRC IDLE/INACTIVE state, Case D is selected.
	+ Proposal 2: For a configured/defined CFR for GC-PDCCH/PDSCH carrying MCCH and MTCH for broadcast reception with UEs in RRC IDLE/INACTIVE state, Case E is not supported.
* In [R1-2109196, CATT]
	+ *Discuss*: However, Case C will affect legacy UE due to initial BWP with increased bandwidth. Case E can solve the issue.
	+ Proposal 1: Support Case D and E for gNB scheduling flexibility.
* In [R1-2109305, CMCC]
	+ *Discuss*: First, Case E requires RRC\_IDLE/RRC\_INACTIVE UE maintaining two separate BWPs.
	+ Proposal 1. For RRC\_IDLE/RRC\_INACTIVE UEs, Case D can be supported as configured/defined specific CFR for MTCH/MCCH.
* In [R1-2109318, Nokia]
	+ Proposal-1: Support of both CFR Case D and Case E.
	+ Observation-1: In Rel17 MBS, there is no intention to change or modify the CORESET#0 as the initial BWP of RRC\_IDLE/INACTIVE UEs.
	+ Observation-2: For Rel17 MBS, it is understood that there will be a new configured CFR/BWP for RRC\_IDLE/INACTIVE UEs for MBS reception.
	+ Observation-3: An indication can be carried in the *RRCSetupRequest* and *RRCResumeRequest* that informs and allows the network to configure the UEs’ dedicated BWP to confine the Case E/D CFR correctly.
* In [R1-2109388, Xiaomi]
	+ Proposal 1: For a configured/defined CFR for GC-PDCCH/PDSCH carrying MCCH and MTCH for broadcast reception with UEs in RRC IDLE/INACTIVE state, support case D.
	+ *Discuss*: One concern on case C is that the larger initial DL BWP increase the power consumption for legacy UE. We don’t think this argument is reasonable as nothing new is introduced for the legacy UE in terms of initial DL BWP. Power saving is never the factor needs to be taken into account when gNB configure initial DL BWP. Furthermore, there is already sufficient mechanisms aiming at reducing power consumption, for both IDLE and CONNECTED state. Power saving is certainly out of the scope for Rel-17 MBS WI*.*
	+ *Discuss:* If a larger MBS-specific BWP is configured for MBS UE, additional BWP switching is required when it transfers to RRC CONNECTED state as it is larger than the initial DL BWP.
	+ Proposal 2: For a configured/defined CFR for GC-PDCCH/PDSCH carrying MCCH and MTCH for broadcast reception with UEs in RRC IDLE/INACTIVE state, do not support case E.
	+ Proposal 3: The SIB-1 configured initial BWP for legacy Rel-15/Rel-16 UEs in RRC\_CONNECTED state is applied as initial BWP for Rel-17 MBS capable UEs.
* In [R1-2109517, Samsung]
	+ *Discuss*: Depending on which case is supported, the details should be further discussed. When Case D is supported, the separate BWP for MBS is not needed.
	+ *Discuss*: When only Case E is supported, the signaling for frequency resource configuration within the initial BWP is not needed since all the cases support CFR having the same size as the BWP, which is either the initial BWP or the configured BWP.
* In [R1-2109540, Lenovo]
	+ Observation 1: The motivation to support Case E is not justified.
	+ Observation 2: Those UEs with small bandwidth capabilities can’t be supported in Case E.
	+ Observation 3: Frequent BWP switching happens in Case E.
	+ Observation 4: Significant standard impact is caused in Case E.
	+ Proposal 1: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, for CFR configuration for group-common PDCCH/PDSCH, Case E is not supported.
* In [R1-2109569, MediaTek]
	+ Proposal 3: CFR can be configured with any size as long as it covers CORESET#0.
* In [R1-2109635, Intel]
	+ Proposal 1: Case D can be implemented under Case C using appropriate FDRA since the resources required for broadcast reception under Case D are already included in Case C. Additional support for Case D is not required.
	+ Observation 1: For Case E when the configured BWP is wider than legacy SIB1 configured initial BWP, when the UE transitions to CONNECTED mode, the CFR will be outside the initial active BWP, requiring the switching of the UE to a wider BWP (containing CFR) for continuous broadcast reception.
	+ *Discuss*: On the other hand, if we define the “configured BWP” as another SIB-x configured initial BWP only for MBS UEs which supersedes the legacy initial BWP configuration, then the issue of CFR outside of initial active BWP for UEs transitioning to CONNECTED mode does not exist.
	+ *Discuss*: The main difference here is that the configured BWP is now a new wider initial BWP for the MBS UEs while the legacy UEs still use the legacy initial BWP.
	+ Proposal 2: Case E can be supported where the “configured BWP” is defined as a SIB-x configured wider initial BWP for MBS capable UEs which supersedes the legacy SIB1 configured initial BWP.
* In [R1-2109703, DOCOMO]
	+ *Discuss*: A problem with transitioning from RRC\_IDLE/RRC\_INACTIVE to RRC\_CONNECTED state was raised at the last RAN1 meeting. The problem is that a UE receiving broadcast in RRC\_IDLE/RRC\_INACTIVE state may not be able to continue receiving the broadcast services after transitioning to RRC\_CONNECTED state since the initial BWP applied after receiving Msg4 cannot include the CFR for broadcast in Case E. However, if gNB indicates a BWP that contains the CFR for broadcast as the first active downlink BWP, the UE will be able to continue receiving broadcast services without interruption. Also, broadcast services do not require high QoS, so interrupted reception may not be a problem.
	+ Proposal 1: For a CFR for GC-PDCCH/PDSCH for broadcast, support both Case D and E.
* In [R1-2109769, TD Tech]
	+ Proposal 1: A CFR for RRC\_IDLE/RRC\_INACTIVE UEs can be larger than the initial DL BWP and has the same numerology as the initial DL BWP.
* In [R1-2109985, 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 1: From idle/inactive UE perspective, one CFR is associated to the initial DL BWP of UE’s serving cell for REL-17.
	+ 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 [R1-2110058, Apple]
	+ *Discuss*: If the configured CFR is different from initial BWP or CORESET#0 in frequency domain, and the CFR size is larger than SIB1 configured initial DL BWP, then a BWP for MBS should be configured. The benefit of Case E is it provide the configuration flexibility to the network to provide high data rate MBS service, and there is no impacts to legacy UE and Rel.17 non-MSB UE.
	+ Proposal 2: For MBS UE in RRC\_IDLE/RRC\_INACTIVE mode, the Case E is supported for broadcast reception.
* In [R1-2110120, Convida]
	+ *Discuss*: Although using case C, the gNB can achieve a wider CFR for RRC idle/inactive UEs by configuring a wider SIB1 configured initial BWP. However, since the SIB1 configured initial BWP is defined for the UE in RRC connected state, such solution will have negative impacts to the RRC connected UEs.
	+ Proposal 1: Support Case E for the CFR design for the RRC\_IDLE/RRC\_INACTIVE UEs.
	+ Proposal 2: For case E, the size of the MBS BWP can be
		- wider than the CORESET #0 but narrower than the SIB1 configured initial BWP
		- same as the SIB1 configured initial BWP
		- wider than the SIB1 configured BWP
	+ Proposal 3: In addition to case E, case D can also be supported.
* In [R1-2110212, Qualcomm]
	+ *Discuss*: There is some discussion on different interpretations of initial BWP for RRC\_IDLE/INACTIVE and RRC\_CONNECTED UEs when initial BWP is configured in SIB larger than CORESET#0. For legacy UEs, “it keeps CORESET#0 until after reception of *RRCSetup/RRCResume/RRCReestablishment*”, which means RRC\_CONNECTED UEs may assume initial BWP for paging while RRC\_IDLE/INACTIVE UEs still camp on CORESET#0.
	+ *Discuss*: For RRC\_IDLE/INACTIVE UEs, the CORESET#0 is still the “initial BWP to receive SIB/paging” but the broadcast CFR with bandwidth size of “SIB-indicated initial BWP” larger than CORESET#0 can be regarded as a new BWP, differentiated from the “initial BWP to receive SIB/paging”.
	+ *Discus*: It would be too restricted to limit the CFR for broadcast no larger than SIB1-configured DL BWP, especially considering the video broadcast services requires high data rate. If the CFR has the size larger than CORESET#0, i.e., Case C, Case D and E, a common configuration method can be used to configure CFR by configuring a CFR/BWP via SIB signalling or MCCH.
	+ Proposal 1: For a configured/defined CFR for GC-PDCCH/PDSCH carrying MCCH and MTCH for broadcast reception with UEs in RRC IDLE/INACTIVE state,
		- Support both Case E and Case D.
		- Different PDSCH/PDCCH parameters can be configured in the CFR for MCCH and the CFR for MTCH.
* In [R1-2110251, Google]
	+ *Discuss*: From our perspective, because there is only one meeting left before RAN1 freeze. The group may not have sufficient time to complete the issue. Thus, we propose to adopt a solution with minimal UE behaver changes.
	+ Proposal 2: Support to adopt Case-D for GC-PDCCH/PDSCH carrying MCCH and MTCH for broadcast reception with UEs in RRC IDLE/INACTIVE state.
* In [R1-2110357, Ericsson]
	+ *Discuss*: When the UE receives broadcast in RRC INACTIVE/IDLE according to any of Cases C, D and E, the broadcast transmission will – by definition - exceed the CORESET#0 initial BWP. This means that broadcast will then need to be transmitted in a wider BWP (BWP-1). From a frequency resource perspective, The CFR then needs to be contained within BWP-1.
	+ *Discuss*: With Case C, the BWP may naturally be identical in size to the SIB1-configured initial BWP but would not be the initial BWP for UEs in RRC INACTIVE/IDLE, since the CORESET#0 initial BWP is still used for all UEs in RRC INACTIVE/IDLE to receive System Information and paging and also for Random Access. In addition, the SIB1 initial BWP may only, according to legacy, be used by UEs in RRC Connected.
	+ *Discuss*: With Case D, the CFR is contained within the frequency range of SIB1-configured initial BWP. As mentioned, with legacy this BWP only applies to RRC CONNECTED UEs, so the BWP (BWP-1) used for case D is still to be defined.
	+ *Discuss*: It can also be noted that when SIB1 does not configure the initial BWP, so that the CORESET#0 initial BWP is used also for UEs in RRC CONNECTED, it is only with Case E that broadcast, wider than CORESET#0 can be supported.
	+ Proposal 1: For UEs in RRC INACTIVE/IDLE, broadcast can be received according to Case E.
		- Note: CFRs according to Case C and D can be supported by Case E.
	+ Proposal 2: With Case E, the CFR is associated with a BWP and spans the same bandwidth. The BWP and CFR for broadcast are configured in a new SIBx. The PDCCH, PDSCH, SPS configurations for this BWP are used by the CFR.
	+ Proposal 3: When the UE state is changed from RRC INACTIVE/IDLE to RRC CONNECTED, the UE formally releases the BWP-1 used to receive Case E broadcast in RRC INACTIVE/IDLE. The UE however keeps the CFR, which is inherited by all configured BWPs in RRC CONNECTED, provided the CFR is contained within the respective BWP.
	+ Proposal 4: When the frequency range and numerology of the BWP to receive broadcast does not change with a change of RRC state, the UE is expected to receive the broadcast data without disruption.

### **FL Assessment**

The Common Frequency Resources (CFR) for MBS has been discussed extensively during the past meetings and multiple inputs to this meeting have also addressed this topic. In this Issue we focus on the down-selection between the Case D and Case E.

1. ***On Support for Case D & Case E***
* *Support of Case D*
	+ [Futurewei, Spreadtrum, OPPO, CMCC, Xiaomi, Lenovo, Google]
* *Support of Case E*
	+ [Huawei, Intel, Apple] \*note, different implementations are proposed for some contributions.
* *Support of Case D and E*
	+ [ZTE, vivo, CATT, Nokia, Mediatek, DOCOMO, TD Tech, LGE, Convida, Qualcomm, Ericsson]

As per previous meetings, there are different views on the cases to be supported.

1. ***Legacy behaviour of Rel-17 UEs supporting NR MBS***

At RAN1#106-e, there were multiple discussions around the legacy behaviour of Rel-17 UEs supporting NR MBS in RRC idle/inactive UE states. There was consensus then that the legacy behaviour, where SIB/Paging transmissions for RRC idle/inactive UEs are transmitted in the initial BWP with frequency resources defined by CORESET#0, should not change. Some contributions to this meeting have highlighted this issue again [Nokia, Ericsson, Qualcomm].

Since there are discussions on different potential implementations of Case E below, where one alternative is to define new initial BWP only for MBS UEs, to clarify that legacy behaviour is not changed a proposal is put forward to stablish this principle.

1. ***Motivation of Case D and Case E***
* *Flexibility on network configuration*

The main motivation for the support of cases D and E is network flexibility for the configuration of CFRs on top of case C as presented in [ZTE, Futurewei, vivo, CATT, Nokia, Apple, Qualcomm, Ericsson]. However, [OPPO, Lenovo, Xiaomi] discuss that Case C already provides flexibility on the configuration of the bandwidth that can span up to the carrier bandwidth.

* *Impact on legacy Rel-15/Rel-16 RRC connected UEs with SIB-1 configured initial BWP*

Another aspect brought up in multiple contributions on the benefit of supporting case E in addition to case C is the following. Since changing the frequency resources of the SIB-1 configured initial BWP to accommodate different bitrates under Case-C directly changes the frequency resources of legacy Rel-15/Rel-16 UEs with SIB-1 configured initial BWP in RRC connected, Case-E allows to independently configure a CFR with larger frequency resources than the frequency resources of the SIB-1 configured initial BWP if needed.

This aspect is something worth getting a common understanding between companies, so there will be a question in the section of proposals below to collect companies’ views.

1. ***BWP switching for Case D and Case E with RRC\_IDLE/INACTIVE UE states***

There have been discussions, in past meetings and highlighted in [Lenovo], on whether for RRC idle/inactive UEs with configured/defined CFRs with Case D and E would require BWP switching to receive the SIB/Paging transmitted signals in CORESET#0. As discussed in [Huawei, Ericsson] since both Case D and Case E contain the frequency resources of CORESET#0 (and share SCS and CP) the UE can receive both MBS broadcast transmissions and SIB/Paging transmissions without BWP switching. This is similar to legacy behaviour in NR where RRC connected UEs are expected to monitor System Information and paging in the Initial BWP in parallel with receiving unicast data, provided the Initial BWP is fully contained within the active BWP.

1. ***BWP switching for Case D when UE state changes from RRC\_IDLE/INACTIVE to RRC\_CONNECTED***

In previous meetings, the aspect on potential BWP switching when UEs change from RRC idle/inactive states to RRC connected state have mainly been with respect to Case E. For this meeting [ZTE, OPPO] specifically discuss BWP switching aspects for Case D. In particular [OPPO] presents that Case D may also have BWP switching issues when transitioning RRC states. If the UE in RRC connected state uses either the SIB-1 configured BWP as active BWP or activates another BWP with larger CFR than the resources of Case D, there can be service interruption since frequency range needs to be changed.

This aspect is something worth getting a common understanding between companies, so there will be a question in the section of proposals below to collect companies’ views.

1. ***BWP switching for Case E when UE state changes from RRC\_IDLE/INACTIVE to RRC\_CONNECTED***

As discussed above, most contributions to this meeting have discussed BWP switching aspects for Case E during the transmission of RRC states, as well as discussed in previous meetings. Below we discuss different scenarios depending on the active BWP of UEs in RRC connected state.

* *Scenario when UE in RRC connected state uses the SIB-1 configured BWP as active BWP*
	1. This scenario has been discussed in previous meetings, and recollected in [vivo], when the default BWP is the SIB-1 configured initial BWP. In this case there would be service loss since the CFR is of larger size than the frequency resources of the active BWP. However, it is argued in [vivo] that this situation can be avoided by network configuration where the network configures a default BWP that contains the CFR.
* *Scenario when UE in RRC connected state activates a BWP with the same frequency resources as the CFR*
	1. Here, since there is no frequency range change (nor change of SCS or CP), the UE does not need to retune and can continue receiving the service without interruption.
* *Scenario when UE in RRC connected state activates a BWP with the larger frequency resources than the CFR*
	1. Here, since the frequency range needs to change the UE needs to retune to adapt to the new (larger) frequency range which may cause service interruption.

These aspects are worth getting a common understanding between companies, so there will be questions in the section of proposals below to collect companies’ views.

1. ***On Signalling configuration of the CFR***

At the past meeting there were detailed discussion signalling of the CFR where three alternatives were discussed as follows:

* **Alt 1**: The SIB-1 configured initial BWP for legacy Rel-15/Rel-16 UEs in RRC\_CONNECTED state is also applied as initial BWP for Rel-17 MBS capable UEs.
* **Alt 2**: Rel-17 MBS capable UEs are configured with a new MBS-specific initial BWP that is different to legacy Rel-15/Rel-16 initial BWP.
* **Alt 3**: Rel-17 MBS UEs use a configured BWP other than initial BWP.
* FFS: it is up to RAN2 whether the configuration of Alt 2 and Alt 3 is in SIB1, SIB-x, MBS-specific SIB, or MCCH for MTCH.

For the implementation of Case E, Alt2 and Alt 3 were discussed as potential candidates. However, there were different views on the benefits and drawbacks of each alternative. Multiple contributions to this meeting have discussed this issue. For Alt 2 where a new MBS specific initial BWP is configured, concerns were raised on whether this approach would change the legacy behaviour of the initial BWP for RRC idle/inactive UEs and whether the network would need to deal with UEs operating with two different initial BWPs. However, it has also been proposed e.g., [Huawei] that the signalling of the specific implementation of Case E could be up to RAN2. Therefore, to understand whether this is an approach that is adequate, the FL will put a question on this to collect companies’ views.

In the section below before directly discussing the down-selection of Case D&E, the FL makes a set of questions to frame the discussion and to try to build a common understanding. Based on the discussion in the initial rounds, further proposals will be included to conclude on the down-selection of cases for CFR for RRC idle/inactive UEs.

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

**Proposal (conclusion) 2.1-1:** For broadcast reception, Rel-17 RRC\_IDLE/RRC\_INACTIVE UEs receive SIB/paging transmission in frequency resources defined by CORESET#0.

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

1. **do you support proposals 2.1-1 for conclusion? (This proposal tries to clarify that the legacy behaviour for RRC idle/inactive UEs receiving system information in frequency resources defined by CORESET#0 is not changed.) Please provide reasons and views in general if you do not agree.**
2. **Do you agree with the following motivation for Case E? Please provide reasons if you do not agree.**
	1. **Since changing the frequency resources of the SIB-1 configured initial BWP to accommodate different bitrates under Case-C directly changes the frequency resources of legacy Rel-15/Rel-16 UEs with SIB-1 configured initial BWP in RRC connected, Case-E allows to independently configure a CFR with larger frequency resources than the frequency resources of the SIB-1 configured initial BWP if needed.**
3. **Do you agree with the following statements regarding potential service interruption/loss/continuity during the transition from RRC idle/inactive to RRC connected UE states? Please provide reasons if you do not agree:**
	1. **For Case D, if the UE in RRC connected state uses either the SIB-1 configured BWP as active BWP or activates another BWP with larger CFR than the resources of Case D, there can be service interruption since frequency range needs to be changed.**
	2. **For Case E, if UE in RRC connected state uses the SIB-1 configured BWP as active BWP there is service loss since the CFR is of larger size than the frequency resources of the active BWP.**
	3. **For Case E, if the UE in RRC connected state activates a BWP with the same frequency resources as the CFR there is no frequency range change, therefore there is service continuity.**
	4. **For Case E, if the UE in RRC connected state activates a BWP with the larger frequency resources than the CFR there can be service interruption since frequency range needs to be changed.**
4. **Do you think the details on the signalling on the implementation of case D and/or Case E should be up to RAN2?**
	1. **details on signalling on implementation mean e.g., whether Case E is based on a configured BWP or whether Case E is named as “initial BWP”.**

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

|  |  |
| --- | --- |
| **company** | **comments** |
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## Issue 2: Number of MBS CFRs for MTCH

### **Background**

The following agreement for RRC\_IDLE/RRC\_INACTIVE UEs at RAN1#103-e, RAN1#104-e and RAN1#106-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

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

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 [R1-2108853, ZTE]
	+ Observation 1: Regarding CFR,
		- It is beneficial for power saving by supporting more than one CFR.
		- It is beneficial for MBS service expansion by supporting more than one CFR.
		- It is particularly important for redcap UE to support multiple CFRs, which means that more MBS services can be received.
	+ Proposal 2: More than one CFR is supported for MTCH for UEs in RRC\_IDLE/INACTIVE states.
* In [R1- 2109003, vivo]
	+ *Discuss*: Among multiple MBS services, some RRC IDLE/INACTIVE UEs may be interested in only a subset of services while some other UEs are interested in another subset of services, thus, transmitting all MBS services in one CFR for RRC IDLE/INACTIVE UEs is not friendly to power saving purpose.
	+ Proposal 2: For UEs in RRC\_IDLE/RRC\_INACTIVE, more than one common frequency resource can be defined/configured.
* In [R1-2109069, OPPO]
	+ *Discuss*: According to the use cases and deployment scenarios for MBS services in this release, only one CFR configured for MTCH is enough. Configuring more than one CFR for MTCH may introduce design complexity and need extra indication scheme, which may not be a real requirement for UEs in RRC\_IDLE/RRC\_INACTIVE state.
	+ Proposal 4: For broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs, only one CFR is configured for GC-PDCCH/PDSCH carrying MCCH and MTCH
* In [R1-2109305, CMCC]
	+ *Discuss*: In addition, as we have agreed three cases of CFR, i.e., Case A, Case C and Case D, how to switch between them need to be studied because DCI format 1\_0 cannot be used for BWP switching. Therefore, supporting only one CFR for MTCH is enough for UEs in RRC\_IDLE/INACTIVE state.
	+ Proposal 2. Only one CFR can be configured for group-common PDCCH/PDSCH carrying MTCH for broadcast reception with UEs in RRC\_IDLE/INACTIVE state.
* In [R1-2109318, Nokia]
	+ *Discuss*: However, considering that the traffic data size of different MBS services could be varying a lot, and depending on the MBS services applied, the MTCH CFR can be also configured differently for different MBS services. For instance as shown in CFR Case C-2 of Figure-2, the same MCCH CFR can be configured for both MBS services, but the CFR of MTCH-1 is configured to be associated with CORESET#0 and the CFR of MTCH-2 is configured to be associated with the larger CFR that is identical to initial BWP.
	+ Proposal-3: There can be multiple MTCH CFRs configured corresponding to difference MBS service types applied.
* In [R1-2109388, Xiaomi]
	+ Proposal 5: Only one CFR can be configured for group-common PDCCH/PDSCH carrying MTCH for broadcast reception with UEs in RRC\_IDLE/INACTIVE state.
* In [R1-2109569, MediaTek]
	+ Proposal 4: Not support more than one CFR for UE supporting MBS in RRC\_IDLE/ RRC\_INACTIVE states.
* In [R1-2109635, Intel]
	+ Proposal 3: Only one common frequency resource may be configured for MBS reception for RRC\_IDLE/INACTIVE mode UEs for both MCCH and MTCH.
* In [R1-2109703, DOCOMO]
	+ *Discuss*: Even when there are multiple broadcast services, a single CFR can transmit multiple MBS services. If CFRs are separated for each service, a UE receiving multiple broadcast services needs to receive multiple CFRs, it would complicate UE processing.
	+ Proposal 2: Support at most one CFR for MTCH for RRC\_IDLE/RRC\_INACTIVE UEs.
* In [R1-2109769, TD Tech]
	+ Proposal 2a: More than one CFRs can be configured. At most one CFR is the initial DL BWP. Each other CFR is larger than the initial DL BWP.
* In [R1-2109985, LGE]
	+ *Discuss*: RAN1 agreed that one CFR is supported per dedicated unicast BWP for multicast of RRC-CONNECTED UEs. We think that this agreement can be also applied to broadcast of idle/inactive UEs. Thus, from idle/inactive UE perspective, one CFR is associated to the initial DL BWP of UE’s serving cell for REL-17.
	+ 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 [R1-2110357, Ericsson]
	+ *Discuss*: Even with a single CFR, most part of the power saving is expected to come from the time domain DRX and change notification mechanism, which allows the UE to receive MCCH change notification using a very small percentage of all slots, once the cyclic MCCH as such as has been captured.
	Using a single CFR therefore seems to provide enough opportunities for power saving and would also relieve the UE from receiving two CFRs in parallel.
	+ Proposal 5: Only a common CFR for both MCCH and MTCH is supported in Rel-17.

### **FL Assessment**

As per Background discussion, RAN1 has agreed that only one CFR can be configured to carry MCCH. Contributions to this meeting discussing this issue support either only one CFR or they support multiple CFRs for RRC\_IDLE/ RRC\_INACTIVE UEs. However, some of the contributions do not discuss whether this is explicitly for MTCH. Given the previous RAN1 agreement, the FL will focus this discussion on the number of CFRs for MTCH only.

From the tdocs submitted to this meeting, while [ZTE, vivo, Nokia, TD Tech] support multiple CFR, [OPPO, CMCC, Xiaomi, MediaTek, Intel, DOCOMO, LG, Ericsson] only support one CFR.

Arguments in favour to configure multiple CFRs address aspects on power saving [ZTE, vivo], service expansion [ZTE], or support of redcap UEs [ZTE]. Regarding power saving [Ericsson] discusses that even with a single CFR most of the power saving can be expected from time domain DRX rather on the bandwidth of the CFR. [OPPO CMCC, DOCOMO] discuss that multiple CFRs can have additional complexity due to switching between CFRs for UEs receiving multiple services. [LGE] also discusses that an only one CFR has alignment with agreements on multicast.

Given the discussion above and the stronger support for configuring only one CFR for MTCH, the starting point of the proposal is to support only one CFR for MTCH in this release.

We note that the discussion on whether MCCH and MTCH could have different bandwidth configurations is addressed in Issue 3 in this summary. Even if we would agree that only one CFR can be configured for MTCH, it would still be possible, if agreed and pending discussion in Issue 3, that MCCH and MTCH could be configured with different bandwidth configurations.

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

**Proposal 2.2-1**: Only one CFR can be configured for group-common PDCCH/PDSCH carrying MTCH for broadcast reception with UEs in RRC\_IDLE/INACTIVE state.

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

|  |  |
| --- | --- |
| **company** | **comments** |
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## Issue 3: Parameters and configuration of the CFR for MCCH/MTCH

### **Background**

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

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

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

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

### **Tdoc analysis**

***On parameters of the CFR***

* In [R1-2108725, Huawei]
	+ Discuss: For UE receiving unicast, *RateMatchPattern* can be configured per UE per BWP in PDSCH-Config for UE to rate match PDSCH around. The resources indicated by the rate match patterns are occupied for other purpose, e.g., CSI-RS/TRS configured to other UEs, so that such resources have to be rate matched around for UEs that will have PDSCH to be transmitted on because otherwise PDSCH and CSI-RS/TRS will interfere each other.
	The motivation of configuring *RateMatchPattern* for UE receiving broadcast in RRC\_IDLE/ RRC\_INACTIVE states also holds.
	+ Proposal 5: *RateMatchPattern* can be configured together with the CFR configured for broadcast reception for RRC\_IDLE/INACTIVE UEs.
* In [R1-2109196, CATT]
	+ *On default configs*:
		- Proposal 2: Some parameters configured for PDSCH for broadcast reception can be optional. When some parameters in PDSCH for broadcast reception are not configured, the corresponding parameters in PDSCH configuration of the initial BWP can be the default configuration.
		- Proposal 3: Some parameters configured for PDCCH for broadcast reception can be optional. When some parameters in PDCCH for broadcast reception are not configured, the corresponding parameters in PDCCH configuration of the initial BWP can be the default configuration.
	+ *On reference for staring PRBs*
		- Proposal 4: The *locationAndBandwidth* parameter for PDSCH/PDCCH can be optional for Case C.
		- Proposal 5: For Case D (if supported) and Case E (if supported), the starting PRB is referenced to Point A. The current RIV mechanism can be applied for indicating the starting PRB and the length of PRB of CFR.
* In [R1-2109569, MediaTek]
	+ *Discuss*: From our perspective, as long as the parameter for broadcast is the same with legacy unicast parameter in RRC IDLE/INACTIVE states, this parameter for broadcast can be not configured, and the UE can reuse the legacy unicast parameter in RRC IDLE/INACTIVE states for broadcast reception.
	+ Proposal 6: The parameter configured for GC-PDSCH/GC-PDCCH can be optional if the unicast has the same value with that of broadcast.
* In [R1-2109318, Nokia]
	+ Proposal-7: To align the outcome agreement with RRC\_CONNECTED, the Point A as reference point of starting PRB for CFR configuration of RRC\_IDLE/INACTIVE UEs.
* In [R1-2109769, TD Tech]
	+ Proposal 3: If no CFR for RRC\_IDLE/RRC\_INACTIVE UEs is configured, the CFR is by default the initial DL BWP.
	+ Proposal 4: If a CFR for RRC\_IDLE/RRC\_INACTIVE UEs is configured by a new IE associated with the initial DL BWP, the CORESET/search spaces for GC-PDCCH carrying MCCH/MTCH can be configured as below, where the new IE can indicate the CFR is the initial DL BWP.
		- If a CORESETs/search space not configured by *initialDownlinkBWP* is shared by MCCH and MBS sessions, configure the CORESETs/search space on the MCCH specific SIB with the type of the CORESET/search space set as “Shared”.
		- If a CORESETs/search space not configured by *initialDownlinkBWP* is only used by MCCH, configure the CORESETs/search space on the MCCH specific SIB with the type of the CORESET/search space set as “NOT Shared”.
		- If a CORESETs/search space not configured by *initialDownlinkBWP* is only used by MBS sessions, configure it with the new IE on MCCH.
		- If at least one CORESET/search space configured by *initialDownlinkBWP* is used by MCCH, a CORESET/search space ID list is provided on the MCCH specific SIB to indicate which CORESETs/search spaces by *initialDownlinkBWP* are used by MCCH. For each CORESET/search space in the CORESET/search space ID list, if it’s shared by MBS sessions, its type is set as “Shared’. Otherwise its type is set as “NOT Shared”.
		- If at least one CORESET/search space configured by *initialDownlinkBWP* is used by MBS sessions but not used by MCCH, a CORESET/search space ID list is provided with the new IE on MCCH to indicate which CORESETs/search spaces by *initialDownlinkBWP* are used by MBS sessions.
* In [R1- 2110258, Asustek]
	+ Proposal 1: The current SLIV indication mechanism can be reused to indicate the starting PRB and the number of PRBs of the CFR.
	+ Proposal 2: Only the basic parameters in the current PDSCH-Config are necessary for broadcast reception for RRC\_IDLE/ INACTIVE UEs, e.g. pdsch-TimeDomainAllocationList, resourceAllocation, and rbg-Size, to simplify the implementation.
* In [R1-2110357, Ericsson]
	+ Proposal 6: To define the broadcast BWP/CFR frequency resources, reuse the legacy definition of BWP frequency resources for unicast using the combination of Point A, *offsetToCarrier* and locationAndBandwidth to indicate the exact location of the BWP/CFR with respect to the carrier starting RB.

***On different configurations between MCCH and MTCH, including bandwidth***

* In [R1-2108725, Huawei]
	+ *Discuss*: For example, the CFR, CORESET, SS for MCCH and MTCH can be different and the configuration for MTCH can come from MCCH. MTCH may require larger frequency resources than MCCH, so the CFR for MTCH can be configured in MCCH.
	+ *Discuss*: When CFR for at least MTCH can be configured with the same size as SIB1 configured initial BWP, the CORESET for MTCH scheduling can be configured to be larger than the bandwidth of CORESET#0. Hence, the CORESET for MTCH scheduling can be configured in MCCH which could be part of configuration of CFR but can be up to RAN2 for signaling design. Search space for MTCH may have different monitoring periodicity, so the search space for MTCH can be configured in MCCH.
	+ Proposal 8: 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 [R1-2109196, CATT]
	+ *Discuss*: However, the benefit is not clear with multiple MBS CFR configurations and different bandwidth configuration for MCCH and MTCH. Using different bandwidth configurations for the CFR of GC-PDCCH/PDSCH carrying MCCH and the CFR of GC-PDCCH/PDSCH carrying MTCH implies that two CFR configurations are needed for carrying MCCH and MTCH. Per our understanding, these two CFRs may be active simultaneously and will bring more discussion and additional specification efforts. Instead, a wider CFR for MCCH and MTCH is more feasible and beneficial when wide band is required for MBS reception.
	+ Proposal 6: For RRC\_IDLE/RRC\_INACTIVE UEs, different bandwidth configurations for the CFR of GC-PDCCH/PDSCH carrying MCCH and the CFR of GC-PDCCH/PDSCH carrying MTCH are not supported.
* In [R1-2109569, MediaTek]
	+ *Discuss*: However, some companies argued that different CFR should be configured for MCCH and MTCH due to different requirements for these two logical channels. From our understanding, it will need two CFRs in RRC IDLE/INACTIVE states, if different CFR are configured for MCCH and MTCH and UE needs to monitor the two CFRs simultaneously, which will make the UE processing more complexity and is not desirable. Therefore, unified CFR is preferred for MCCH and MTCH reception.
	+ Proposal 1: The unified CFR is defined/configured for GC-PDCCH/PDSCH carrying MCCH and GC-PDCCH/PDSCH carrying MTCH.
* In [R1-2109635, Intel]
	+ *Discuss*: In the last meeting it was agreed that only one CFR configuration is allowed for MCCH and that MCCH/MTCH can use the same bandwidth. Additionally, MCCH and MTCH can use the same single CFR configuration. The two channels need not have different CFR configurations where MTCH CFR is configured in MCCH since the gains from such involved design is not clear.
	+ Proposal 3: Only one common frequency resource may be configured for MBS reception for RRC\_IDLE/INACTIVE mode UEs for both MCCH and MTCH.
* In [R1-2109318, Nokia]
	+ *Discuss*: Practically the traffic payload size for MCCH and MTCH can be different a lot, where the control configuration payload carried via MCCH can be much smaller than the MBS traffic data payload carried via MTCH. Thus, the CFR for MCCH and MTCH can be also configured differently and controlled by network gNB based on traffic needs.
	+ Proposal-2: CFR for MCCH and MTCH can be configured to be differently.
* In [R1-2110212, Qualcomm]
	+ *Discuss*: Considering different types of information carried in MCCH and MTCH, separate CFR can be configured with different pdsch-config, and/or pdcch-config even in the same frequency range.
	- For MTCH, besides Case A/C, it is also possible to configure broadcast CFR larger than initial BWP (Case E) for flexible scheduling to avoid congestion by SI/paging/broadcast traffic in same band.
	- For MCCH, the CFR can be configured with the frequency size to be same as that of that of MTCH (Case A/C/E) but the parameters for GC-PDSCH/PDCCH may be separate from MTCH.
	+ Proposal 1: For a configured/defined CFR for GC-PDCCH/PDSCH carrying MCCH and MTCH for broadcast reception with UEs in RRC IDLE/INACTIVE state,
		- Support both Case E and Case D.
		- Different PDSCH/PDCCH parameters can be configured in the CFR for MCCH and the CFR for MTCH.
	+ *Discuss*: For GC-PDSCH transmission of broadcast MCCH/MTCH, the configuration can be separately considered, i.e., pdsch-config in corresponding CFR for MCCH/MTCH:
	-For sake of simplicity, GC-PDSCH for MCCH can assume QPSK and single layer, similar as SIB/paging.
	-GC-PDSCH configuration for broadcast MTCH can be more flexible, configured by MCCH.
	-Semi-static and dynamic repetitions can be configured for broadcast MCCH/MTCH to improve the link budget.
	+ Proposal 4: GC-PDSCH for broadcast MCCH can use QPSK and single layer. GC-PDSCH for broadcast MTCH can be configured by MCCH to use flexible MCS.
* In [R1-2108853, ZTE]
	+ *Discuss*: MCCH only transmits some control information for MBS. However, MTCH needs to transmit MBS traffic, which may require large bandwidth. Considering the different requirements of MCCH and MTCH, it is worthwhile for network to have the flexibility of configuring different CFRs for MCCH and MTCH.
	Further, if more than one CFR is supported for MTCH for transmitting different MBS traffics or to accommodate UEs with different bandwidth capabilities, this naturally supports the different CFR configuration for MTCH.
	+ Proposal 3: Network supports configuring different CFRs for MCCH and MTCH.
* In [R1-2109069, OPPO]
	+ *Discuss*: Even for some cases that the requirements of bandwidth are different between MCCH and MTCH, the CFR for MTCH reception should have to fully contain the CFR for MCCH in order to guarantee the GC-PDSCH reception. At present, a uniformed size design and CFR configuration is a simple way for both MCCH and MTCH and the CFR of GC-PDCCH/PDSCH carrying MCCH and MTCH is configured by SIB.
	+ Proposal 3: For broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs can use the same bandwidth configuration by SIB for the CFR of GC-PDCCH/PDSCH carrying MCCH and the CFR of GC-PDCCH/PDSCH carrying MTCH.
* In [R1-2109388, Xiaomi]
	+ Proposal 4: For broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs can use the same bandwidth configuration for the CFR of GC-PDCCH/PDSCH carrying MCCH and the CFR of GC-PDCCH/PDSCH carrying MTCH.
* In [R1-2110357, Ericsson]
	+ *Discuss*: Even with a single CFR, most part of the power saving is expected to come from the time domain DRX and change notification mechanism, which allows the UE to receive MCCH change notification using a very small percentage of all slots, once the cyclic MCCH as such as has been captured.
	Using a single CFR therefore seems to provide enough opportunities for power saving and would also relieve the UE from receiving two CFRs in parallel.
	+ Proposal 5: Only a common CFR for both MCCH and MTCH is supported in Rel-17.

***On MBS-SIB configuration of MCCH / MTCH***

* In [R1-2109569, MediaTek]
	+ *Discuss*: If one CFR is used for MCCH and MTCH, how to configure the CFR for MCCH and MTCH needs to be further discussed. From our perspective, RAN2 has defined a new MBS specific SIB (e.g., SBIx) for broadcast services configuration. Therefore, the unified CFR information for MCCH and MTCH can be configured via MBS specific SIB (e.g., SIBx).
	+ Proposal 2: The unified CFR for MCCH and MTCH can be configured via MBS specific SIB (e.g., SIB-x).
* In [R1-2109318, Nokia]
	+ Proposal-5: For broadcast reception of RRC\_IDLE/RRC\_INACTIVE UEs, the following way of CFR configuration is preferred:
		- the CFR of GC-PDCCH/PDSCH carrying MCCH is configured by SIBx.
		- the CFR of GC-PDCCH/PDSCH carrying MTCH is configured by MCCH.

### **FL Assessment**

This Issue is divided in three sub-topics: i) on parameters that are part of the configuration of the CFR, ii) on whether MCCH and MTCH can be configured differently (including the bandwidth parameter), and iii) on whether a SIB (or new MBS SIB) configures both MCCH and MTCH, or whether SIB configures MCCH and MCCH configures MTCH.

***i) On parameters of the CFR***

[CATT, MediaTek, TD Tech] propose that the PDCCH / PDSCH parameters that are not configured can take as default the values of the PDCCH / PDSCH parameters for unicast (i.e., parameters of the initial BWP). However, it is not completely clear to the FL with the descriptions in the tdocs, if the companies refer to the initial BWP of idle/inactive UEs (determined by CORESET#0) or the SIB1 configured initial BWP for connected UEs. Also, the RAN1 agreement at RAN1#103-e (cf. Background) states that 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.

[CATT, Nokia, Ericsson] propose that the existing mechanisms to define the BWP frequency resources with reference to Point A. [Ericsson] further details to use the reuse the legacy definition of BWP frequency resources for unicast using the combination of Point A, *offsetToCarrier* and *locationAndBandwidth* to indicate the exact location of the BWP/CFR with respect to the carrier starting RB.

While [Huawei] proposes that the CFR for broadcast reception includes the configuration of *RateMatchPattern* parameter, [AsusTek] proposes that only basic parameters for PDSCH-config are included for broadcast reception.

The previous RAN1 meeting started the discussion on the configuration of the CFR and the tdocs to this meeting start providing further details for discussion which are included as proposals below.

***ii) On different configurations between MCCH and MTCH, including bandwidth***

Here, two aspects can be considered. First, whether the bandwidth configuration of the MCCH and MTCH can be the different, and secondly whether (besides the bandwidth configuration) other parameters, e.g., SS, CORESET, configuration of PDSCH/PDCCH, can be different between MCCH and MTCH.

On the bandwidth configuration of MCCH and MTCH, [Huawei, Nokia, ZTE] propose that MCCH and MTCH can have different bandwidths mainly motivated by both logical channels having different data requitements. However, [CATT, MediaTek, Intel, OPPO, Xiaomi, Ericsson] only support that MCCH and MTCH have the same bandwidth configuration. In particular [CATT] argue that different bandwidths for MCCH and MTCH may increase specification impact, [MediaTek] argue that monitoring two CFRs would increase processing complexity and regarding power saving [Ericsson] discusses that even with a single CFR most of the power saving can be expected from time domain DRX rather on the bandwidth of the CFR.

Therefore, the FL will put forward a proposal for the same bandwidth configuration for MCCH and MTCH given the discussion above and the stronger support for this approach.

On whether (besides bandwidth) MCCH and MTCH can have different configurations: [Huawei, Nokia, Qualcomm, ZTE] propose that MCCH and MTCH can have different configurations mainly motivated by different requirements of the logical channels, i.e., MCCH carrying control information and MTCH carrying mainly service data information. [Qualcomm] provides more detail for the transmission of GC-PDSCH where MCCH could be configured with QPSK and single layer (like SIB/paging) while MTCH could be more flexible and configured by MCCH (flexible MCS). On the other hand [MediaTek, Intel] propose that a unified CFR is configured for MCCH and MTCH where [MediaTek] argue that monitoring two CFRs would increase processing complexity.

Here, there is apparently stronger support and less concerns that MCCH and MTCH can have different configurations (besides bandwidth). Also based on the technical discussion above the FL will put forward a proposal to support different configurations for MCCH and MTCH.

***iii) On MBS-SIB configuration of MCCH / MTCH***

Here, two contributions discuss how to configure MCCH and MTCH. [MediaTek] proposes that a MBS specific SIB configures both MCCH and MTCH (since a unified CFR configuration is also proposed) while [Nokia] proposes that the MBS specific SIB can configure MCCH while MTCH can be configured by MCCH (since different configurations for MCCH and MTCH are also proposed). This subtopic is also related to the one above. Given that the starting point for the discussion in this meeting is allowing different configurations (besides bandwidth) for MCCH and MTCH, the FL puts forward a proposal to accommodate the configuration of MTCH by MCCH.

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

**Proposal 2.3-1**: The PDCCH/PDSCH parameters for broadcast reception with GC-PDCCH/PDSCH, which are not configured, use as default the value of the PDCCH/PDSCH parameters for the configuration of the Rel-15/Rel-16 initial BWP for RRC\_IDLE/RRC\_INACTIVE UEs.

**Proposal 2.3-2:** For broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs, the starting PRB and the number of PRBs of the CFR reuse the legacy definition of BWP frequency resources for unicast using the combination of Point A, *offsetToCarrier* and *locationAndBandwidth*.

**Proposal 2.3-3:** The CFR for broadcast reception of RRC\_IDLE/INACTIVE UEs includes the configuration of *RateMatchPattern*.

**Proposal 2.3-4:** For broadcast reception, RRC\_IDLE/RRC\_INACTIVE UEs can only use the same bandwidth configuration for the CFR of GC-PDCCH/PDSCH carrying MTCH and the CFR of GC-PDCCH/PDSCH carrying MTCH.

**Proposal 2.3-5:** for broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs, different PDSCH/PDCCH parameters can be configured in the CFR of GC-PDCCH/PDSCH carrying MTCH and the CFR of GC-PDCCH/PDSCH carrying MTCH.

**Proposal 2.3-6:** for broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs:

* GC-PDCCH/PDSCH carrying MCCH can be configured by SIBx
* GC-PDCCH/PDSCH carrying MTCH can be configured by MCCH

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

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

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

### **Background**

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

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

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

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

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

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

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

Conclusion:The specification impact of having a new Type-x CSS for GC-PDCCH in RRC\_CONNECTED state can be studied and discussed further. |

### **Tdoc analysis**

* In [R1-2108725, Huawei]
	+ Discuss: Search space #0 can be used. Since the other CORESET than CORESET#0 can be configured, additional common search space for MTCH scheduling specifically can be configured. Note that RAN1#105 meeting has agreed both searchSpace#0 and common search space other than searchSpace#0 can be configured for GC-PDCCH scheduling MCCH.
	+ Proposal 7: For MTCH scheduling, both searchSpace#0 and Type-x CSS can be configured for GC-PDCCH scheduling MTCH.
* In [R1-2108928, Spreadtrum]
	+ *Discuss*: In current specification, CSS Type3 when applied for scheduling is only applicable for primary cell. For some MBS services, e.g., video streaming, for the sake of load balance, they could be carried on Scell. Thus, in our opinion, one new CSS type, e.g., Type4 could be defined for Rel-17 MBS, which could be used for both Pcell and Scell.
	+ Proposal 6: A new CSS type can be introduced for RRC\_IDLE/RRC\_INACTIVE UEs with group-common PDCCH receiving.
* In [R1- 2109003, vivo]
	+ *Discuss*: As no additional requirement is observed for CSS for RRC idle/inactive UEs over that for RRC connected UEs in MBS, the same type of CSS, i.e., type-x CSS can be used.
	+ Proposal 8: The same type of CSS supported for multicast in RRC\_CONNECTED can be reused for broadcast in RRC\_IDLE/RRC\_INACTIVE for GC-PDCCH scheduling MCCH and MTCH.
* In [R1-2109069, OPPO]
	+ *Discuss*: The Type-x CSS is a new type CSS which is introduced for monitor priority procedure. SearchSpace#0 and CSS other than SearchSpace#0 are agreed to be configured for GC-PDCCH. A new Type-x of CSS may introduce more flexible monitoring occasions, but it may not be feasible for RRC\_IDLE state. Existing CSS, e.g. Type-3, can be reused as a baseline with different search space sets equation initialization. The design of search space in RRC\_CONNECTED state should consider about the monitoring priority of CSS and USS to make sure the monitoring procedures do not beyond UEs’ capability. In RRC\_IDLE/INACTIVE state, UE does not monitor USS which should be ignored.
	+ Proposal 5: One of the existing CSS types can be selected and reused for RRC\_IDLE/RRC\_CONNECTED UEs for broadcast reception.
	+ Proposal 6: The Type-x CSS for multicast in RRC\_CONNECTED is not reused for broadcast in RRC\_IDLE/RRC\_INACTIVE for GC-PDCCH scheduling MCCH and MTCH.
* In [R1-2109305, CMCC]
	+ *Discuss*: We also think the new Type-x CSS should be used for MCCH/MTCH of broadcast service and there are several reasons as the following.
	The first is that RRC\_CONNECTED UEs can both receive broadcast service and multicast service, and it is no sense to define different CSS types and different PDCCH monitoring priority rules between broadcast and multicast.
	The second is that new Type-x CSS for MTCH can reduce unnecessary BD/CCE counting for RRC\_CONNECTED UEs…
	+ Proposal 3. For CSS of GC-PDCCH for broadcast, the same CSS type as multicast is supported, i.e., Type-x CSS.
* In [R1-2109318, Nokia]
	+ *On SS#0 and SS other than SS#0 for MTCH*
		- *Discuss*: One issue that need to be addressed is whether additional SS can be configured for MTCH specifically in addition to the SS#0 and SS for MCCH. To our view, depends on the MBS services, the MTCH traffic may need to be monitored with different periodicity than OSI/Paging messages and MCCH traffic. Thus, it is supported to have additional SS configuration(s) for MTCH in addition to SS#0 and SS for MCCH.
		- Proposal-12: It is supported to have additional SS configuration(s) for MTCH in addition to SS#0 and SS for MCCH.
	+ *On reusing Type-x CSS from multicast*
		- *Discuss*: In legacy, the Type0/0A/1/2-PDCCH can be applied to RRC\_IDLE/INACTIVE UEs associated with the CSS of CORESET#0. For the operation of MBS services, there is a need to define a new Type-y CSS that is associated with at least G-RNTI (MTCH) or GS-RNTI (MCCH), and this newly defined Type-y CSS can be monitored by RRC\_IDLE/INACTIVE UEs in the CORESET#0 as well as in the CORESET of (Case C/D/E) CFR if configured.
		Currently, in AI-8.12.1 with RRC\_CONNECTED mode UE discussion, following agreement has been made, and a so-called Type-x CSS has been agreed to be supported. From the signalling configuration perspective, it is understood that the Type-x CSS can be configured via UE dedicated *SearchSpace* configuration in PDCCH-Config with *searchSpaceType*=common. But for Type-y CSS, the corresponding *SearchSpace* configuration is carried differently either via SIB or MCCH. Therefore, from signalling configuration perspective, the Type-x CSS defined in RRC\_CONNECTED cannot be directly reused, and there may need to define a new Type-y CSS specifically for RRC\_IDLE/INACTIVE UE with MBS operation.
		- Proposal-13: From signalling configuration perspective, the Type-x CSS defined in RRC\_CONNECTED cannot be directly reused, and there may need to define a new Type-y CSS specifically for RRC\_IDLE/INACTIVE UE with MBS operation.
* In [R1-2109517, Samsung]
	+ *Discuss*: For RRC\_IDLE/RRC\_INACTIVE UEs it can only be a CSS and, unlike RRC\_CONNECTED UEs, there is no additional impact on scheduling or specifications as there are no USS sets.
	+ *Discuss*: The suggested motivation for a new CSS is to avoid the default collision among PDCCH candidates that always start from CCE index 0. Therefore, whether or not there is any modification, is not applicable to that configuration of CSS sets (can remain as for Type-3 CSS sets with UE-common/SIB1 RRC instead of UE-specific RRC) but to the search space set equation where an initialization may not always be Y\_(p,-1)=0. Such collision avoidance (also with PDCCH candidates for non-Type-3 CSS in case of CORESET#0) is necessary and should also apply for multicast for RRC\_CONNECTED UEs (with respect to PDCCH monitoring, broadcast is only a particular realization of multicast and it has been agreed that the same GC-PDCCH can be received by both RRC\_IDLE/RRC\_INACTIVE UEs and RRC\_CONNECTED UEs). The mechanism to avoid the collisions can be further discussed.
	+ Observation 1: Configuration of SS sets for GC-PDCCH can be as for Type-3 PDCCH CSS sets in Rel-16 (via UE-common, instead of UE-specific, RRC signaling).
	+ Proposal 1. Support avoidance of permanent collisions for PDCCH candidates of search space sets for GC-PDCCH for broadcast and multicast.
* In [R1-2109540, Lenovo]
	+ On the other hand, if the specific common frequency resource is configured within the initial DL BWP, a common CORESET other than CORESET 0 can be configured within the specific common frequency resource for RRC IDLE/RRC INACTIVE UEs to detect the group-common DCI. Correspondingly, an associated common search space is configured for the common CORESET, which can reuse current CSS type.
	+ Proposal 10: A CSS is configured for RRC IDLE/RRC INACTIVE UEs by reusing existing CSS type.
* In [R1-2109569, MediaTek]
	+ *Discuss*: Therefore, we prefer the same CSS type can be used for all three RRC states for broadcast transmission.
	+ Proposal 7: 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 [R1-2109635, Intel]
	+ *Discuss*: Alternately it can be monitored in a new PDCCH CSS set e.g., *searchSpaceBroadcast* which is configured by the MBS specific *PDCCH-ConfigBroadcast*. The CSS set can be a Type-x CSS set similar to the case for RRC\_CONNECTED UEs
	+ Proposal 7: The PDCCH scheduling the MCCH can also be monitored in a Type-x CSS set configured by the MBS specific *PDCCH-ConfigBroadcast.*
* In [R1-2109703, DOCOMO]
	+ *Discuss*: For commonality of configurations, it is better to use the same CSS types for multicast and broadcast. By adding RNTIs for MCCH/MTCH as RNTI types monitored in type-x CSS, type-x CSS can be reused for broadcast. We don’t see any technical problems with reusing type-x CSS for broadcast.
	+ Proposal 3: For CSS for broadcast for RRC\_IDLE/RRC\_INACTIVE UEs, reuse the Type-x CSS for multicast.
* In [R1-2109985, LGE]
	+ 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 [R1-2110120, Convida]
	+ *Discuss*: Also, similar to RRC connected state, a new CSS type should be defined for monitoring the group-common PDCCH, e.g., the CSS for MBS may not always be prioritized in PDCCH overbooking.
	+ Proposal 5: A new CSS type should be defined for monitoring the group-common PDCCH.
* In [R1-2110212, Qualcomm]
	+ *Discuss*: We think there is no specific issue identified to 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 2: Support Type-x CSS for the SS of MCCH/MTCH.
* In [R1-2110357, Ericsson]
	+ Proposal 20: The CSS type for broadcast should be the same as the CSS type for multicast.

### **FL Assessment**

This Issues is divided in two subtopics: i) the configuration of searchSpace#0 and common search space other than searchSpace#0 for MTCH, and ii) the discussion on reusing the Type-x CSS for multicast reception in RRC connected UE state for MCCH/MTCH broadcast reception.

***On searchSpace#0 and common search space other than searchSpace#0 for MTCH***

[Huawei, Nokia] propose that for MTCH both searchSpace#0 and common search space other than searchSpace#0 can be configured for GC-PDCCH scheduling MTCH noting that this configuration of search spaces was already agreed for GC-PDCCH scheduling MCCH.

Since there are not so far opposing views from the inputs to the meeting, a proposal is put forward to agree both searchSpace#0 and common search space other than searchSpace#0 for MTCH.

***On*** ***reusing Type-x CSS for multicast reception in RRC connected UE state for MCCH/MTCH broadcast reception***

The issue on Type-x CSS was discussed at RAN1#106-e without reaching an agreement. There is also a related discussion on AI 8.12.1.

[vivo, CMCC, MediaTek, Intel, DOCOMO, Qualcomm, Ericsson] propose to reuse the same type of CSS supported for multicast in RRC connected state. [vivo] highlights that there are no additional requirements for broadcast compared to multicast. [CMCC] discusses that i) for UEs in RRC connected receiving both multicast and broadcast, using the same CSS Type with same priority rules for monitoring is more adequate, and ii) that a new Type-x CSS for MTCH can reduce unnecessary BD/CCE counting for RRC\_CONNECTED UEs that can also receive broadcast MBS.

[Spreadtrum, Convida] proposes a new CSS Type for broadcast reception. [Spreadtrum] proposes to transmit MBS broadcast services in Scell, which would need new Type (Type-4) CSS.

On the other hand [OPPO, Samsung, Lenovo] propose to reuse existing CSS Types for broadcast reception with RRC idle/inactive UEs, where [OPPO, Samsung] propose using different initialisation for the search space sets equation.

As per the request of the agreement at the lats RAN1 meeting, [Nokia] discusses whether Type-x CSS used for multicast in RRC connected UE state can be reused for broadcast reception in RRC idle/inactive UE states. [Nokia] describes that from the signalling configuration point of view, the Type-x CSS can be configured via UE dedicated *SearchSpace* configuration in *PDCCH-Config* with *searchSpaceType*=common but for broadcast reception the corresponding *SearchSpace* configuration is carried via SIB/MCCH. Therefore, the Type-x CSS defined for multicast reception in RRC\_CONNECTED cannot be directly reused which requires defining a new Type-y CSS for RRC\_IDLE/INACTIVE UEs for broadcast reception.

As per previous meetings, there is strong support on reusing the Type-x CSS for multicast reception in RRC connected UE state for broadcast reception in RRC idle/inactive UE states. However, there still no consensus and there are some companies that do prefer to reuse existing CSS Types. More discussion is needed, specially taking into account that there is a related discussion at AI 8.12.1. Regarding the agreed study on whether the multicast solution on Type-x CSS could be reused for broadcast reception in RRC idle/inactive UEs, one company has found an issue that it is worth discussing with the entire group. Reaching a conclusion first on whether there are in fact any issues on reusing the Type-x CSS from multicast can help reach an agreement on the type of CSS used for broadcast reception. For this subtopic the FL requests feedback on the issue found by Nokia and other potential issues, if any, to conclude on the study agreed on the previous meeting.

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

**Proposal 2.4-1**: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, both searchSpace#0 and common search space other than searchSpace#0 can be configured for GC-PDCCH scheduling MTCH.

**Proposal (conclusion) 2.4-2**: the Type-x CSS defined in RRC\_CONNECTED UE state for multicast reception cannot be directly reused for broadcast reception with RRC\_IDLE/INACTIVE UEs for the following reason:

* Type-x CSS it is configured via UE dedicated *SearchSpace* configuration in *PDCCH-Config* with *searchSpaceType*=common but for broadcast reception the corresponding *SearchSpace* configuration is carried via SIB/MCCH.

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

1. **do you support proposals 2.4-1?**
2. **do you agree with the issue found in proposal 2.4-2? Please provide reasons and views in general if you do not agree.**
3. **Do you think there are any other issues, if any, for reusing the Type-x CSS supported for multicast in RRC\_CONNECTED as baseline for broadcast in RRC\_IDLE/RRC\_INACTIVE for GC-PDCCH scheduling MCCH and MTCH?**

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

## 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-e 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.
 |

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

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

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

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

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

Other solutions are not precluded and it is also not precluded whether to support both Alt1 and Alt2.Conclusion:It is up to RAN2 to decide the specific contents of the MCCH change notification, e.g, whether notification only informs about session start, whether or not notification also informs about session modification/stop or whether or not the notification informs about any other information.Agreement:Study and reach an agreement by RAN1#106b-e on whether Alt1 and Alt2 for MCCH change notification indication can accommodate at least 2 bits for the notification of MCCH configuration changes due to a session start and the notification of MCCH configuration changes of an ongoing session (including session stop). |

###  **Tdoc analysis**

* In [R1-2108725, Huawei]
	+ *Discuss*: For MBSFN and SC-PTM, DCI format 1C scrambled by a dedicated RNTI (M-RNTI and SC-N-RNTI for MBSFN and SC-PTM, respectively) are used for notifying the start of the session. All other bits in DCI format 1C are reserved for DCI size alignment.
	The change notified by a specific DCI which is not used for scheduling means UE needs to monitor one more DCI format in addition to the one for scheduling MCCH/MTCH, which is not necessarily needed.
	+ *Discuss*: Instead, using a field in the DCI scheduling MCCH to notify the MCCH change can reduce the possibility of UE missing an MCCH change notification, because the DCI scheduling MCCH will be transmitted from network whenever MCCH is transmitted.
	+ Proposal 11: 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 (including session stop).
	+ *Discuss*: In RAN2#115 meeting, it was agreed that do not specify any mechanism to address the possibility of UE missing an MCCH change notification and it is left to UE implementation and it is up to network implementation (e.g. paging repetitions) for addressing scenario of potential notification loss for UEs.
	+ Proposal 12: Using a field in DCI scheduling MCCH to notify the session start and the modification of an ongoing session, i.e., Alt2.
		- Send LS to RAN2 with the mechanism RAN1 agreed.
* In [R1-2108853, ZTE]
	+ *Discuss*: As DCI format 1\_0 in CSS, such as, DCI format 1\_0 with CRC scrambled with P-RNTI/SI-RNTI should also be monitored by legacy UEs, the size of DCI format 1\_0 with CRC scrambled with P-RNTI/SI-RNTI cannot be changed. This requires that size of DCI format GC-PDCCH scheduling a GC-PDSCH carrying MCCH/MTCH should be smaller than size of DCI format 1\_0 with CRC scrambled with P-RNTI/SI-RNTI.
	+ *Discuss*: 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 4: Define a dedicated RNTI to scramble the CRC of a DCI indicating a MCCH change notification (Alt.1).
* In [R1-2108928, Spreadtrum]
	+ Proposal 3: Support MCCH change notification indication includes the status of each MBS session.
	+ Proposal 4: For MCCH change notification indication, the combination of Alt1 and Alt 2 can be considered.
	+ Proposal 5: More than 2 bits can be accommodated in the MCCH change notification indication.
* In [R1-2109069, OPPO]
	+ Proposal 8: 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 [R1-2109196, CATT]
	+ *Discuss*: In Alt 1, a DCI format scrambled by a dedicated RNTI (e.g. SC-N-RNTI) is used for notifying. All other bits in DCI format are reserved for DCI size alignment. However, large number of bits will be padded during DCI size alignment. In Alt 2, at least 2 bit can be accommodated for the MCCH change notification due to the HARQ-ACK feedback may be supported for IDEL/INACTIVE UEs. We believe that companies have a consensus that the HARQ-ACK feedback is not supported for RRC\_IDLE/RRC\_INACTIVE UEs, so the HARQ-ACK related fields such as DAI (2 bits), TPC command for scheduled PUCCH (2 bits), PRI (3 bits) and K1 (3 bits) can be applied for notifying the start of the session and the notification of MCCH configuration changes of an ongoing session (including session stop). Thus, we prefer Alt2.
	+ Proposal 10: For MCCH change notification indication, Alt2 (a field in DCI scheduling MCCH) can be used to notify the session start and the modification of an ongoing session.
* In [R1-2109305, CMCC]
	+ Discuss: But as the analysis above and the example in Table 1, the reserved bits in DCI format for MCCH is much larger than 2 bits and is enough to be used as MCCH change notification and can also provide forward compatibility. Therefore, Alt 2 can be supported which is a simple and sufficient way without defining a new RNTI for MCCH change notification.
	+ Proposal 4. The DCI format for GC-PDCCH scheduling a GC-PDSCH carrying MCCH/MTCH also includes the following fields for broadcast reception with UEs in RRC\_IDLE/INACTIVE state:
		- MCCH change notification (only for MCCH)
		- VRB-to-PRB mapping
* In [R1-2109318, Nokia]
	+ *Discuss*: MCCH change notification field (if supported and only for MCCH): To answer the RAN2 LS on whether there can be a separate bit for MCCH change modification accommodated in the MCCH change notification DCI, in addition to a bit for session start notification. We see it is feasible to accommodate such an additional bit in the DCI. But it ups to RAN2 to decide whether it is beneficial to introduce such an additional bit.
* In [R1-2109388, Xiaomi]
	+ *Discuss*: Generally speaking, MCCH carries the configuration information of MBS transmission which is broadcast to all the MBS capable UEs. The situation is quite similar to SIB1 and OSI transmission, which is scheduled by DCI format 1\_0 with CRC scrambled by SI-RNTI. In order to have a clear picture on the DCI content, we provide the information fields in DCI format 1\_0 scheduling SIB1 or OSI in table 1. It can be observed there are 15 reserved bits can be further exploited even the exact same information fields are needed for MBS MCCH scheduling.
	+ *Discuss*: From our understanding, the scheduling information included in DCI format 1\_0 with CRC scrambled by SI-RNTI are sufficient for MCCH scheduling. In the other words, there are 16 bits can be further exploited for MCCH change notification indication, i.e. 1 bit system information indicator and 15 reserved bits. They are sufficient to the at least 2 bits for the notification of MCCH configuration changes.
	+ Observation: There are abundant bits to accommodate the at least 2 bits for the notification of MCCH configuration changes in the DCI format 1\_0 scheduling PDSCH carrying MCCH.
	+ *Discuss*: One concern on alternative 2 is that power consumption goes up as UE needs to monitor PDCCH in every MO configured for MTCH scheduling. Indeed, UE always needs to monitor PDCCH scheduling MTCH per network configuration. It is the principle of PDCCH design since Rel-15. We don’t see any additional power consumption introduced by alt 2. On the other hand, alternative 1 needs additional PDCCH monitoring which is dedicated only for notification of MCCH configuration changes on top of MTCH scheduling.
	+ Proposal 7: For MCCH change notification indication, use a field in a DCI format scheduling a MCCH without a dedicated RNTI for MCCH change notification.
* In [R1-2109517, Samsung]
	+ Proposal 4. Use of a field in a DCI format scheduling a MCCH without a dedicated RNTI for MCCH change notification.
* In [R1-2109569, MediaTek]
	+ Proposal 8: MBS DCI format 1\_0 used for MCCH and MTCH reception is reused for NR MBS MCCH change notification.
	+ Proposal 9: A new RNTI (e.g., MCCH-N-RNTI) can be used for MCCH change notification.
* In [R1-2109635, Intel]
	+ Proposal 6: For MCCH change notification, a field in a DCI format scheduling a MCCH can be used without a dedicated RNTI
* In [R1-2109703, DOCOMO]
	+ *Discuss*: The total number of bits of the required DCI fields will be less than 37 bits, even if all the fields that are FFS are included. Thus, an MCCH change notification can be included in a DCI format scheduling MCCH. We don’t see clear motivation to define a dedicated RNTI to transfer only 2 bits of information.
	+ Observation 1: A DCI format scheduling MCCH can accommodate an MCCH change notification.
	+ Proposal 4: For MCCH change notification for RRC\_IDLE/RRC\_INACTIVE UEs, support Alt 2.
* In [R1-2109769, TD Tech]
	+ Proposal 7: Wait for the final requirement for the idle bits from RAN2 for the MCCH change notification.
* In [R1-2110058, Apple]
	+ *Discuss*: For the discussed solutions, Alt 1 would require a new RNTI and new DCI format, the field of this DCI need to be defined, more standard works are expected. For Alt2, if only 2bits are required to indicate all MBS sessions start and sessions stop, it is reasonable to introduce a new field in the first DCI format. Currently, it was agreed 1bit Identifier for DCI format field is not needed. In addition, 2bits TPC command for scheduled PUCCH field seems not needed for MBS broadcast service, as no PUCCH feedback is supported for broadcast. Thus, introducing 2bit MCCH change notification field doesn’t impact the first DCI format size.
	+ Proposal 3: New field is introduced in first DCI format for GC-PDCCH to indicate MCCH change notification.
* In [R1-2110212, Qualcomm]
	+ Proposal 3: Support Alt1: Define a dedicated RNTI (e.g., MCCH-N-RNTI) to scramble the CRC of a DCI indicating MCCH change notification.
* In [R1-2110251, Google]
	+ Observation 1: In LTE SC-PTM, for UE other than BL UEs, UEs in CE or NB-IoT UEs, a very compact DCI format 1C is applied to SC-MCCH change notification to secure the reception reliability. In order to achieve a similar reliability as in LTE SC-PTM, delivering of MBS MCCH change notification should have higher reliability than the MBS MCCH information.
	+ Observation 2: In LTE SC-PTM, for BL UEs, UEs in CE or NB-IoT UEs, DCI format 6-2 with CRC scrambled by SC-RNTI is applied for SC-MCCH change notification and SC-MCCH information delivery. Where the transmission reliability is further enhanced by PDCCH repetition.
	+ *Discuss*: The size of NR DCI format 1\_0 is about doubled to LTE DCI formats 1C and 6-2. However, the size of CCE in NR is also doubled to CCE defined in LTE. Thus, if the notification is sent in the same CCE aggregation level, it can be expected that Alt-2 can provide similar performance to the non-BL/CE/NB-IoT UE in LTE. Further, NR supports aggregation level up to 16 CCEs (Max CCE aggregation level in LTE is 8), it can provide the reliability comparable with 2 repetitions of MCCH notification in LTE. According to the observation, we think Alt-2 is sufficient to eMBB UE.
	+ Observation 3: Considering the larger size of CCE and the higher supported aggregation level in NR, sending MCCH notification by using DCI format 1\_0 can achieve the reliability that is comparable to LTE DCI format 6-2 with 2 repetitions.
	+ Proposal 1: Support Alt-2, use of a field in a DCI format scheduling a MCCH without a dedicated RNTI for MCCH change notification.
* In [R1- 2110258, AsusTek]
	+ Proposal 3: For MCCH change notification indication, only Alt 2 is supported.
* In [R1-2110357, Ericsson]
	+ *Discuss*: With Alt1, a dedicated RNTI is transmitted only when there is a change to be signaled and the nature of the change is signaled in the DCI of the related PDCCH. To increase robustness, this message could be repeated over several modification periods, with identical content. To distinguish between a real change and a repetition, relative signaling via bit toggling relative to earlier change notifications would be preferable to absolute signaling of the change, i.e. it is the change of bits not the bit value itself that carries the information of change.
	+ *Discuss*: With Alt2, the two change notification bits are carried in the DCI of the MCCH PDCCH. As in Alt1, the change notification bits could be toggled when there is a change. With Alt2, the change notification bits will be available in every MCCH DCI, so the signaling can be extremely robust.
	With measures to increase robustness, as above, both Alt1/Alt2 approaches would be reasonable.
	+ Proposal: Further study if, and to what extent,
		- robustness could be increased in Alt1 and Alt2 via repetition and bit toggling.
		- the additional two DCI bits in Alt2 will cause an increased overhead, considering DCI size alignment with unicast/multicast.

### **FL Assessment**

***On Alt 1: dedicated RNTI to scramble the CRC of a DCI indicating a MCCH change notification***

* *Proponents of Alt 1*
	+ [ZTE, Spreadtrum, OPPO, MediaTek, Qualcomm].
* *Drawbacks of Alt 1*
	+ [Huawei, Xiaomi] discusses that Alt 1 requires the monitoring of an additional DCI format, which increase complexity and [Apple] discusses that more standardisation work is needed for Alt 1.
* *Robustness of Alt1*
	+ [Ericsson] discusses that to increase robustness, this message could be repeated over several modification periods, with identical content. Propose to study robustness aspects via repetition and bit toggling.
* *Can Alt 1 accommodate at least 2 bits for the MCCH change notification?*
	+ [CATT] describes that besides the bits used for notification (2 in this case) the rest of bits are reserved for DCI size alignment. Therefore, it is understood that Alt 1 could also accommodate 2 bits for the notification of MCCH configuration changes due to a session start and the notification of MCCH configuration changes of an ongoing session (including session stop).

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

* *Proponents of Alt 2*
	+ [Huawei, Spreadtrum, CATT, CMCC, Xiaomi, Samsung, Intel, DOCOMO, Apple, Google, AsusTek]
* *Drawbacks of Alt 2*
	+ [ZTE] discusses that since the DCI size will add at least 2 bits, it may cause that the DCI 1\_0 with CRC scrambled with GC-RNTI is of larger size that the DCI 1\_0 with CRC scrambled with P/SI-RNTI where size alignment cannot be executed.
* *Robustness of Alt2*
	+ [Huawei, Ericsson] discusses that Alt 2 can be very robust since the notification is transmitted whenever the MCCH is transmitted.
	+ [Google] presents that although the DCI format 1\_0 in NR is double the size of DCI formats 1C and 6-2 in LTE, since NR has larger size of CCE and higher supported aggregation level, sending MCCH notification by using DCI format 1\_0 can achieve a reliability that is comparable to the reliability of LTE DCI format 6-2 with 2 repetitions.
	+ [Ericsson] study robustness aspects via repetition and bit toggling.
* *Can Alt 2 accommodate at least 2 bits for the MCCH change notification?*
	+ [CATT, CMCC, Nokia, Xiaomi, DOCOMO, Apple] provide analysis of the number of total bits required for the DCI 1\_0 format scheduling PDSCH carrying a MCCH and they show there is sufficient space to accommodate the 2 bits for the notification of MCCH configuration changes due to a session start and the notification of MCCH configuration changes of an ongoing session (including session stop).

There is stronger support for Alt 2. Regarding the question whether Alt1 and Alt2 for MCCH change notification indication can accommodate at least 2 bits for the notification of MCCH configuration changes due to a session start and the notification of MCCH configuration changes of an ongoing session (including session stop), based on the analysis it seems both alternatives can accommodate at last 2 bits and therefore, RAN1 could inform RAN2 on these finding. Regarding down-selection between Alt1 and Alt 2, the situation is not very different to previous meetings. It is worth reaching a common understanding of the drawbacks for each alternative to then try to make a selection taking into account the very late stage of the standardisation in rel-17. The FL therefore puts forward some proposals for discussion and some additional questions on the FL assessment on this section to build a common understanding. Based on the discussion on initial rounds additional proposals can be discussed to try to reach a conclusion on this Issue.

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

**Proposal (conclusion) 2.5-1**: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, Alt 1 can accommodate at least 2 bits for the notification of MCCH configuration changes due to a session start and the notification of MCCH configuration changes of an ongoing session (including session stop).

**Proposal (conclusion) 2.5-2**: For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, Alt 2 can accommodate at least 2 bits for the notification of MCCH configuration changes due to a session start and the notification of MCCH configuration changes of an ongoing session (including session stop).

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

1. **do you agree the conclusions in proposals 2.5-1 and 2.5-2? Please provide reasons and views in general if you do not agree.**
2. **Do you agree with the drawbacks of Alt 1 and Alt 2 listed in the FL assessment above? Please provide reasons and views in general if you do not agree.**
3. **Do you agree with the robustness comments in Alt 1 and Alt 2 listed in the FL assessment above? Please provide reasons and views in general if you do not agree.**

**FL note: based on the discussion from these questions additional proposals can be included for agreement (e.g., down-selection between Alt 1 & Alt 2) including potential LS to RAN2.**

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| **company** | **comments** |
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## Issue 6: PDCCH: Design of DCI format for MCCH and MTCH channels

### **Background**

The following agreements at RAN1#105-e and RAN1#106-e are relevant for this discussion:

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

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

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

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

### **Tdoc analysis**

* In [R1-2108928, 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, otherwise, the FDRA field should be determined by the size of the CORESET0 or the SIB1 configured initial BWP.
* In [R1- 2109003, vivo]
	+ *Discuss*: However, broadcast PDSCH with repetition can be also received by RRC\_CONNECTED UE, if HPN and NDI is not indicated in DCI and RRC\_CONNECTED UE randomly chooses a free HPN for combination, then it will cause chaos for further unicast and multicast reception.
	+ Proposal 9: If PDSCH repetition for broadcast is supported, HARQ process number and new data indicator should be included in DCI 1-0 with the CRC scrambled by G-RNTI, MCCH-RNTI, and any other RNTIs further agreed for broadcast.
* In [R1-2109069, OPPO]
	+ *Discuss*: Since the GC-PDCCH can be used for broadcast scheduling which can also be received by RRC\_CONN UEs, the DCI format may need to be aligned among UEs with different connection states.
	+ Proposal 7: The DCI format for GC-PDCCH scheduling a GC-PDSCH carrying MCCH/MTCH additionally includes the following fields for broadcast reception with UEs in RRC\_IDLE/INACTIVE state:
		- Modulation and coding scheme
		- Reserve bits.
* In [R1-2109196, CATT]
	+ Proposal 11: At least MCCH change notification, HARQ process number, new data indicator and VRB-to-PRB mapping fields can be included in the DCI format.
* In [R1-2109540, Lenovo]
	+ Proposal 2: The number of bits for FDRA in the group-common DCI is determined based on the bandwidth of CORESET 0 in Case A or SIB-1 configured initial DL BWP in Case C.
	+ Proposal 3: RB numbering starts from the lowest RB of the CFR and the granularity of resource allocation only supports single RB.
	+ Proposal 4: The number of bits in TDRA field in the first DCI format is determined by the number of entries in the time domain resource allocation list configured for MBS.
	+ Proposal 5: VRB-to-PRB mapping in the first DCI format is 0 or 1 bit dependent on RRC configuration.
	+ Proposal 6: 5 bits MCS, 1 bit NDI, 2 bits RV and 4 bits HARQ process number are included in the first DCI format.
	+ Proposal 7: NO DAI/TPC/PRI/HARQ-timing indicator in the group-common DCI.
	+ Proposal 8: Support fields and sizes in Table 1 for the first DCI format.
	+ Proposal 9: Zero bits are appended to the group-common DCI format in case its size prior to padding is smaller than the size of DCI format 1-0 with CRC scrambled by C-RNTI and monitored in CSS.
* In [R1-2109305, CMCC]
	+ *Discuss*: Furthermore, the HARQ process number and New data indicator are not needed for HARQ-ACK feedback.
	As for blind retransmission soft buffer combination, dedicated HARQ process is defined for system information in NR and similar mechanism can be used for broadcast service. In addition, as different G-RNTI are used to differentiate broadcast services, which means the HARQ buffer has one to one mapping with G-RNTI, and it is up to UE’s implementation to buffer different services in different HARQ buffer without the necessary to be indicated the HARQ process number in the DCI.
	+ *Discuss*: But as the analysis above and the example in Table 1, the reserved bits in DCI format for MCCH is much larger than 2 bits and is enough to be used as MCCH change notification and can also provide forward compatibility. Therefore, Alt 2 can be supported which is a simple and sufficient way without defining a new RNTI for MCCH change notification.
	+ Proposal 4. The DCI format for GC-PDCCH scheduling a GC-PDSCH carrying MCCH/MTCH also includes the following fields for broadcast reception with UEs in RRC\_IDLE/INACTIVE state:
		- MCCH change notification (only for MCCH)
		- VRB-to-PRB mapping
	+ Proposal 5. The FDRA field bit length in DCI format for GC-PDCCH scheduling a GC-PDSCH carrying MCCH/MTCH is related to CFR size but not CORESET#0 size and the resource allocation granularity is single RB.
* In [R1-2109318, Nokia]
	+ Observation-6: Support of DCI format 1\_0 only seems to be sufficient for broadcast reception for RRC\_IDLE/INACTIVE UEs.
	+ Proposal-14: Discuss the resource allocation type applied for Rel17 broadcast for RRC\_IDLE/INACTIVE UEs.
	+ Proposal-15: Discuss whether the VRB-to-PRB mapping field should be included in the DCI, or it should be fixed in the specification depends on the resource allocation type applied.
	+ Proposal-16: Considering of TB scaling field be included in the DCI.
	+ Proposal-17: It is beneficial to support of HARQ combining for broadcast with slightly increase UE complexity, where a single additional dedicated HARQ process seems to be sufficient for all broadcast services associated with different G-RNTIs. And there is no need of including HARQ process number in the DCI field.
	+ Proposal-18: It is beneficial to support NDI in the DCI field for broadcast.
	+ Proposal-19: Further discuss other fields to be included in the DCI, i.e. MCCH change notification field (if supported for MCCH), and TRS related field (if supported for MTCH).
	+ Observation-7: It is feasible to accommodate such an additional bit in the DCI. But it ups to RAN2 to decide whether it is beneficial to introduce such an additional bit.
* In [R1-2109388, Xiaomi]
	+ Proposal 12: DCI format 1\_0 with CRC scrambled by G-RNTI is used to schedule a GC-PDSCH carrying MCCH/MTCH for broadcast reception with UEs in RRC\_IDLE/INACTIVE state, including the following information fields:
		- FDRA field
		- TDRA field
		- VRB-to-PRB mapping
		- Modulation and coding scheme
		- Redundancy version
		- MCCH configuration change notification
		- Reserved bits
	+ Proposal 13: The FDRA should be determined by CORESET#0 or initial DL BWP if CORESET#0 is not configured.
* In [R1-2109635, Intel]
	+ Proposal 5: 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 [R1-2109703, DOCOMO]
	+ Observation 2: If the existing RB numbering rule for PDSCH scheduled with DCI format 1\_0 in CSS is reused for PDSCH scheduled with the DCI format scheduling MCCH/MTCH, there may be RBs that cannot be allocated GC-PDSCH.
	+ Proposal 5: For GC-PDSCH carrying MCCH/MTCH, RB numbering starts from the lowest RB of the CFR.
	+ Proposal 6: Include VRB-to-PRB mapping field in the DCI format scheduling MCCH/MTCH.
* In [R1-2109769, TD Tech]
	+ Proposal 16: The following fields are included in the DCI format:
		- VRB-to-PRB mapping (for both MCCH and MTCH)
		- Downlink assignment index (only for MTCH)
* In [R1-2110357, Ericsson]
	+ *Discuss*: 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.
	+ Proposal 18: The broadcast DCI format is the same as multicast, with broadcast specific and multicast-specific fields made optional.

### **FL Assessment**

***On FDRA of DCI format 1\_0 for MCCH / MTCH***

[Spreadtrum, CMCC, Xiaomi, Intel, Lenovo, DOCOMO, Ericsson] propose that the FDRA field size is given by the size of the configured/defined CFR for GC-PDCCH/PDSCH carrying MCCH / MTCH for broadcast reception with UEs in RRC IDLE/INACTIVE state. [Nokia] also discusses that supporting of Type\_1 only with DCI format 1\_0 is sufficient.

Although Issue 1 still discusses the final down-selection for Case D&E, since Case C for the CFR is already supported there is agreement that the FDRA should accommodate cases other than a CFR with the same frequency resources as those of CORESET#0. Therefore, a proposal is put forward to agree this.

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

* *HARQ Process Number (HPN) and New Data Indicator (NDI)*

[vivo, CATT, Lenovo] propose that HARQ Process Number (HPN) and New Data Indicator (NDI) are included as fields in the DCI. [vivo] discusses that these two fields are required for reception of broadcast by RRC connected UEs. However, [CMCC, Nokia] discuss that these parameters may not be needed even for blind retransmission. Their preferred approach is dedicated HARQ process as defined for system information with an increase on UE complexity. While [CMCC] presents that both HPN and NDI are not needed, [Nokia] presents that NDI is beneficial to be included.

For these parameters, there are different views on whether the two parameters need to be included or not. The FL will include these parameters to collect more comments from more companies.

* *VRB-to-PRB mapping*

[CATT, CMCC, Nokia, Lenovo, DOCOMO, TD Tech] proposes/discuss to include VRB-to-PRB mapping as filed in the DCI. There have been discussions in previous meetings on whether this parameter should also be fixed to interleaved and therefore it could be saved. The FL will include this parameter to collect comments from more companies.

* *TB scaling field*

[Nokia] proposes to discuss the inclusion of the TB scaling field that can be beneficial to provide increased robustness for the transmission. This parameter has not been discussed in previous meetings so is also included in the proposals for discussion.

* *MCCH change notification and TRS related fields*

The inclusion of these parameters depends on whether their respective functionalities are supported pending the discussion other Issues in this summary. However, these are included as well in the proposals to collect comments from companies.

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

**Proposal 2.6-1**: the size of the FDRA field within the DCI of GC-PDCCH scheduling a GC-PDSCH carrying MCCH/MTCH depends on the size of the configured/defined CFR for broadcast reception with UEs in RRC IDLE/INACTIVE state.

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

* HARQ Process Number
* New Data Indicator
* VRB-to-PRB mapping
* TB scaling field
* MCCH change notification (if supported and only for MCCH)
* TRS related fields (if supported)

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

1. **do you agree with the proposal 2.6-1? Please provide reasons and views in general if you do not agree.**
2. **do you agree with including the fields in proposal 2.6-2? Please provide reasons and views in general if you do not agree.**

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| **company** | **comments** |
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## Issue 7: PDCCH: CORESET for MCCH and MTCH channels

### **Background**

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

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| --- |
| 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 [R1-2108725, Huawei]
	+ Proposal 6: 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 [R1-2109318, Nokia]
	+ Proposal-10: Support different/separate CORESET can be utilized for GC-PDCCH of MCCH and MTCH.
	+ Observation-5: For CFR Case C as agreed to be supported, the agreements that have been agreed for CFR Case A can be applied directly.
	+ Proposal-11: For CFR Case D and Case E, the corresponding CFR\_CORESET can be configured by network gNB, and CORESET#0 is applied as default if CFR\_CORESET is not configured.
* In [R1-2109388, Xiaomi]
	+ Proposal 6: For RRC\_IDLE/RRC\_INACTIVE UEs, the same CORESET is used for MCCH and MTCH in the same CFR.
* In [R1-2110120, Convida]
	+ Proposal 4: One or more CORESETs can be configured for group-common PDCCH within an MBS specific BWP for UEs in RRC\_IDLE/RRC\_INACTIVE states.
* In [R1-2110357, Ericsson]
	+ Proposal 17: 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**

1. ***On configuring in addition to CORESET#0, other CORESET larger than CORESET#0***

[Huawei, Convida] propose configuring in addition to CORESET#0, other CORESET larger than CORESET#0 when the CFR has the same frequency resources as the frequency resources of the initial BWP SIB1 configured. However, is FL understanding that this is already possible based on the agreement at previous meetings (see below) [**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*.
 |

1. ***On separate configurations of GC-PDCCH can done for MCCH and MTCH***

[Nokia] propose that separate configurations of GC-PDCCH can done for MCCH and MTCH. However, [Xiaomi] proposes that the same CORESET is used for MCCH and MTCH. Although this issue was discussed at the last meeting, there was not much time for discussion. Therefore, the FL puts forward a proposal to collect company comments.

1. ***On clarifications on agreement on maximum number of CORESETs mandatorily (in the minimum capability)*** ***supported***

Finally, [Ericsson] proposes to reformulate one of the agreements on maximum number of CORESETs mandatorily (in the minimum capability) supported. However, it is the understanding of the FL that with the latest agreement on CFR (including Case C), the agreement on maximum number of CORESETs mandatorily (in the minimum capability) supported is consistent.

The FL puts forward a proposal addressing the aspects above.

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

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

1. **do you agree with the proposal 2.7-1? Please provide reasons and views in general if you do not agree.**
2. **Please provide your views in case you do not agree with the FL understanding: i) on configuring in addition to CORESET#0, other CORESET larger than CORESET#0 and ii) on clarifications on agreement on maximum number of CORESETs mandatorily (in the minimum capability) supported.**

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

## 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:

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| --- |
| 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.
 |

### **Tdoc analysis**

* In [R1-2108853, ZTE]
	+ Proposal 6: 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 [R1-2109318, Nokia]
	+ Proposal-9: For broadcast reception with UEs in RRC\_IDLE/INACTIVE states, support slot-level repetition for GC-PDCCH/PDSCH carrying MCCH/MTCH.
* In [R1-2109388, Xiaomi]
	+ Proposal 8: For broadcast reception with UEs in RRC\_IDLE/INACTIVE states, support slot-level repetition for GC- PDSCH carrying MCCH/MTCH.
* In [R1-2109635, Intel]
	+ Proposal 11: 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 [R1-2109703, DOCOMO]
	+ Proposal 11: pdsch-AggregationFactor and repetitionNumber can be configured for group-common PDSCH for RRC\_IDLE/RRC\_INACTIVE UEs.
* In [R1-2109769, TD Tech]
	+ Proposal 10: Support the slot-level repetition for MCCH/MTCH.
	+ Proposal 11: The repetition times for MCCH is configured on an MCCH specific SIB.
	+ Proposal 12: The repetition times for MTCH is configured on MCCH as a part of the configuration information of the related MBS session.
* In [R1-2109985, LGE]
	+ Proposal 11: 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 [R1-2110120, Convida]
	+ Proposal 7: Support PDSCH repetition and PDCCH repetition for MBS for the RRC\_IDLE/RRC\_INACTIVE UEs.
* In [R1-2110212, Qualcomm]
	+ Proposal 5: Support semi-static and dynamic repetition configuration for broadcast MCCH/MTCH.
	+ Proposal 6: At least for RRC\_IDLE/INACTIVE UEs, support HARQ combining using the available HARQ process(es) of unicast/multicast.

### **FL Assessment**

This issue was also discussed for RRC\_IDLE/INACTIVE UEs at RAN1#106-e without reaching an agreement.

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

As per previous meetings 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.

The FL puts forward a proposal to also include the support for broadcast reception with idle/inactive states taking as starting point the latest revision at RAN1#106-e (including a comment from LGE that discussed that it would only be applicable to MTCH).

### **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 MTCH.

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

1. **do you agree with the proposal 2.8-1? Please provide reasons and views in general if you do not agree.**

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

## 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

Agreement:If a SPS-config for MBS is configured in CFR, one G-CS-RNTI is associated with the SPS-config.* FFS: Multiple G-CS-RNTIs associated with one SPS-config
 |

### **Tdoc analysis**

* In [R1-2108853, ZTE]
	+ Proposal 7: Support SPS group-common PDSCH for MBS for RRC\_IDLE/RRC\_INACTIVE UEs.
* In [R1- 2109003, vivo]
	+ Proposal 11: 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 [R1-2109318, Nokia]
	+ Observation-4: SPS with DCI activation is not sensible for broadcast reception for RRC\_ IDLE/INACTIVE UEs.
	+ Proposal-8: Discuss on support of SPS without DCI activation for broadcast.
* In [R1-2109388, Xiaomi]
	+ Proposal 10: For broadcast reception with UEs in RRC\_IDLE/INACTIVE states, support SPS GC-PDSCH carrying MTCH.
* In [R1-2109703, DOCOMO]
	+ Proposal 12: For RRC\_IDLE/RRC\_INACTIVE UEs, support SPS group-common PDSCH without activation/deactivation commands.
* In [R1-2110357, Ericsson]
	+ Proposal 15: For SPS broadcast to UEs in RRC-Idle/Inactive, we propose configuration and activation/deactivation is carried by the MCCH.
	+ Proposal 16: For SPS to UEs in RRC-Idle/Inactive, the slot offset and other parameters carried by the PDDCH for activation and release of SPS is included in the SPS-Config IE and this IE is carried in MCCH.

### **FL Assessment**

[ZTE, vivo, Nokia, Xiaomi, DOCOMO, Ericsson] propose/discuss the use of SPS GC-PDSCH for broadcast reception with UEs in RRC idle/inactive state for MTCH. Most companies highlight that SPS with DCI activation/deactivation is not feasible for broadcast reception with RRC idle/inactive UEs, so it is generally proposed to discuss solutions without DCI activation/deactivation. Ericsson proposes that configuration to receive the SPS GC-PDSCH is included in an IE carried by MCCH including activation/deactivation.

This issue was discussed at RAN1#106-e although there was not much time for discussion. To allow for more time for discussion a proposal is put forward below to collect company comments.

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

**Proposal 2.9-1**: Support SPS without DCI activation/deactivation for GC-PDSCH carrying MTCH for broadcast reception with UEs in RRC\_IDLE/INACTIVE UE states.

* configuration to receive SPS (including activation/deactivation) is included in IE *SPS-Config* carried in MCCH.

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

1. **do you agree with the proposal 2.9-1? Please provide reasons and views in general if you do not agree.**

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

## 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, RAN1#105-e and RAN1#106-e are relevant for this discussion:

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

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

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

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

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

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

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

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

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

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

### **Tdoc analysis**

* In [R1-2108725, Huawei]
	+ Proposal 9: 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 10: Within the MTCH scheduling window, the association between the PDCCH monitoring occasions and SSB is defined as:
		- the [x×N+K]th PDCCH monitoring occasion (s) for MTCH in the scheduling window corresponds to the Kth transmitted SSB, where x = 0, 1, ...X-1, K = 1, 2, …N, N is the number of actual transmitted SSBs determined according to ssb-PositionsInBurst in SIB1 and X is equal to CEIL(number of PDCCH monitoring occasions in G-RNTI window/N).
		- The UE assumes that, in the MTCH scheduling window, PDCCH for an MTCH scrambled by G-RNTI is transmitted in at least one PDCCH monitoring occasion corresponding to each transmitted SSB.
* In [R1-2109069, OPPO]
	+ Proposal 9: 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 10: 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 11:
		- 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 [R1-2109196, CATT]
	+ 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 [R1-2109318, Nokia]
	+ *Discuss*: Rel17 MBS is the very first release for NR, it is preferred to keep the robust SSB-based beam sweeping operation as SIB for RRC\_IDLE/INACTIVE UEs for both MCCH and MTCH. Due to the limited working time left for Rel17 MBS, supporting of more advanced beam sweeping operation for MBS could be considered in future releases.
	+ Proposal-22: It is preferred to keep the robust SSB-based beam sweeping operation as SIB for RRC\_IDLE/INACTIVE UEs for both MCCH and MTCH in Rel17 MBS.
	+ Observation-11: Based on the latest agreement from RAN2-115-e meeting, transmission window of MTCH is based on DRX pattern configuration, where different broadcast services can be configured and associated with different DRX pattern configuration.
	+ Proposal-23: It is proposed to consider additional association rules between SSB indexes and UE monitoring occasions other than the rule defined for OSI in TS 38.331.
	+ Proposal-24: 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-25: Allow the network to control the number of repetition transmission for each SSB beam within the on-duration window.
* In [R1-2109388, Xiaomi]
	+ Proposal 11: The current defined beam sweeping mechanisms are sufficient and any further optimization on beam sweeping is not supported in Rel-17.
* In [R1-2109769, TD Tech]
	+ Proposal 13: For the search space other than search space 0, the mapping between POs and SSB indexes within each transmission window of MCCH is defined as:
		- The POs within each transmission window of MCCH are numbered in sequence with index 0 for the first PO.
		- The PO with index k=(N\*x+n) is associated with SSB index n, where n=0,…,N-1, N is the number of the beams used for the SSBs, x=0,…,INT[L/N]-1, and L is the number of the POs in each transmission window.
	+ Proposal 14: For the search space other than search space 0, the mapping between POs and SSB indexes within each monitoring period of the search space is defined as:
		- The POs within each monitoring period are numbered in sequence with index 0 for the first PO.
		- The PO with index k=(N\*x+n) is associated with SSB index n, where n=0,…,N-1, N is the number of the beams used for the SSBs, x=0,…,INT[L1/N]-1, and L1 is the number of the POs in each monitoring period.
	+ Proposal 15: If a CSS for MTCH is shared by unicast sessions, the mapping between POs and SSB indexes for MTCH within each monitoring period of the CSS can be disabled with the following configuration supported.
* In [R1-2109985, LGE]
	+ *Discuss*: Unlike MCCH information and System information having periodically stable TB sizes at a cell, MTCH can serve more dynamic data traffic in size and periodicity. Thus, we prefer to have more flexibility in scheduling various broadcast MTCH transmissions, instead of fully reusing the concept of SI window for MTCH.
	+ Observation 3: Different SI messages can be scheduled in different SI windows with different scheduling parameters e.g. different SI periodicities.
	+ Proposal 7: Group common transmissions for different G-RNTIs with different traffic patterns can be scheduled in different transmission windows. Different transmission windows can be configured with different window lengths as well as different periodicities of transmission windows, depending on MTCH traffic characteristics.
	+ Proposal 8: Group common transmissions for different G-RNTIs with similar traffic pattern can be scheduled in same transmission windows.
	+ Observation 4: A certain broadcast service may be available only at a specific local area within a cell.
	+ Proposal 9: For a certain broadcast service, the number of actual transmitted SSBs is used to determine PDCCH monitoring occasions within a transmission window and can be smaller than the number of SSBs determined in SIB1. Different transmission windows can be configured with different number of actual transmitted SSBs, depending on actual broadcast service area.
	+ Observation 5: RAN2 agreed that MCCH contents should include information about broadcast sessions such as G-RNTI, MBS session ID as well as scheduling information for MTCH (e.g. search space, DRX).
	+ Proposal 10: PDCCH monitoring occasions are determined in DRX on-durations for MTCH of a broadcast service for idle/inactive UEs.
* In [R1-2110357, Ericsson]
	+ Proposal 9: 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 10: 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 11: The beamwidth of PDSCH carrying MCCH should be possible to adjust separately from the beamwidth of PDSCH carrying MTCH.
	+ Proposal 12: 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.

### **FL Assessment**

***On transmission window & mapping of PDCCH monitoring occasions to SSBs for MTCH for CSS other than SS#0***

[Huawei, OPPO, TD Tech] propose the definition of a transmission window and the association rules between PDCCH monitoring occasions and SSBs, where [Huawei] reuses the functionality specified for OSI. [Nokia] presents that based on latest RAN2 agreements, the transmission window of MTCH is based on DRX patters, where different broadcast services can be configured and associated with different DRX pattern configuration.

The FL puts forward a proposal to agree a basic functionality reusing the methods as specified for OSI as proposed above.

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

[CATT, Nokia, LG] propose additional rules between SSB indexes and UE monitoring occasions that would provide more flexibility compared to beam sweeping mechanism supported for system information and being reused for MBS broadcast reception with RRC idle/inactive UEs. The additional rules here have already been proposed in previous meetings. However, [Xiaomi] discusses that further optimisations should not be part of Rel-17 work.

The additional rules proposed above have been discussed at the previous meeting without reaching a conclusion. The FL puts forward the latest version of the proposals from RAN1#106-e meeting as starting point for this meeting (with minor revisions) to collect companies’ views.

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

[Ericsson] as per the previous meetings 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-PDCCH beams.

The FL puts forward the latest version of the proposals from RAN1#106-e meeting as starting point for this meeting to collect companies’ views.

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

**Proposal 2.10-1**: For RRC\_IDLE/RRC\_INACTIVE UEs for broadcast reception, 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 $\left(SFN∙N\_{slot}+n\_{slot}-O\_{G-RNTI}\right)mod K\_{G-RNTI}=0$, where $N\_{slot}$ is the number of slots in a radio frame.

**Proposal 2.10-2**: For RRC\_IDLE/RRC\_INACTIVE UEs for broadcast reception, within the MTCH scheduling window, the association between the PDCCH monitoring occasions and SSB is defined as:

* the [*x*×*N*+*K*]th PDCCH monitoring occasion(s) for MTCH in the scheduling window corresponds to the *K*th transmitted SSB, where *x* = 0, 1, ...*X*-1, *K* = 1, 2, …*N*, *N* is the number of actual transmitted SSBs determined according to *ssb-PositionsInBurst* in SIB1 and *X* is equal to CEIL(*number of PDCCH monitoring occasions in 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 2.10-3**: For RRC\_IDLE/RRC\_INACTIVE UEs for broadcast reception, further study to reach an agreement at RAN1#107-e the following issues of additional association rules between SSB indexes and UE monitoring occasions for GC-PDCCH scheduling MTCH:

* Issues 1: mapping across transmission windows:
	+ Mapping of SSB index to GC-PDCCH MO across transmission window can be disabled by network.
* Issue 2: mapping within a transmission window:
	+ Issue 2.1: actual transmitted SSB smaller than number of SSBs determined in SIB1:
		- Number of actual transmitted SSBs in [*x*×*N*+*K*]th PDCCH monitoring occasions smaller than the number of SSBs determined in SIB1
		- Mapping of SSB beams without MBS transmission
	+ Issue 2.2: repetition mapping within a transmission window
		- GC-PDCCH MOs in one transmission window length are allocated to different SSBs successively (e.g., based on the PDCCH MOs for SIBx) or GC-PDCCH MOs in one transmission window length are allocated to one SSB with consecutive monitoring occasions.
		- Number of repetition transmission for each SSB beam within the transmission window duration can be controlled by network.

**Proposal 2.10-4**: For RRC\_IDLE/RRC\_INACTIVE UEs for broadcast reception, study to reach an agreement at RAN1#107-e 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.

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

1. **do you agree with the proposal 2.10-1 to 2.1-4? Please provide reasons, views in general or alternative proposals if you do not agree.**

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

## Issue 11: TRS as QLC source

### **Background**

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

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

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

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

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

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

### **Tdoc analysis**

* In [R1-2108725, Huawei]
	+ *Discuss*: TRS as QCL source is used for time/frequency tracking in SFN manner where SSB per cell is not workable properly.
	+ *Discuss*: Considering the broadcast deployment will dominate in low frequency range, e.g., 600MHz/700MHz, periodic TRS as QCL source can be used for finer time/frequency tracking instead of beam training that is more necessary for FR2. Therefore, when periodic TRS is to be configured as QCL source, there is no need to configure SSB as the QCL source of the periodic TRS.
	We should note that the specification impact is quite minor because there is no change to TRS itself but rather specifying the support of the TRS configuration (as supported for RRC\_CONNECTED UE) in SIB/MCCH for MTCH carrying broadcast for RRC\_IDLE/INACTIVE UE. Also, the SFN operation is transparent to UE.
	+ Proposal 3: Periodic TRS can be configured as QCL source for broadcast transmission especially for RRC\_IDLE/INACTIVE UE.
* In [R1- 2109003, vivo]
	+ Proposal 7: Study the following aspects to determine whether to support TRS as QCL source for broadcast transmission.
		- Indication method for QCL information of TRS, i.e., whether associated with SSB
		- Transmission manner of TRS, e.g., whether beam sweeping is supported in FR2
		- Timing acquisition, e.g., how to acquire cell timing
* In [R1-2109318, Nokia]
	+ *Discuss*: However, from robustness perspective for RRC\_IDLE/INACTIVE UE with broadcast reception, the scheme based on SSB with lower modulation scheme could be a better solution in practice. For further discussion and supporting of TRS with higher modulation scheme, it is preferred having performance evaluation and justification provided from the proponents before the proceeding of detailed specification work.
	+ Observation-8: Scheme based on SSB with lower modulation scheme could be a better solution in practice from robustness perspective for RRC\_IDLE/INACTIVE UE with broadcast transmission.
	+ Proposal-20: For further discussion and supporting of TRS with higher modulation scheme, it is preferred having performance evaluation and justification from the proponents before the detailed specification work.
	+ Observation-9: Based on the outcome of RAN#93e, there is no update of Rel17 MBS WID, meaning that there is no standardized support specifically for SFN is provided in Rel17 MBS WI. Any SFN operation should be transparent to the UE.
	+ Observation-10: There is ongoing work on support of TRS for RRC\_IDLE/INATIVE UEs in Rel17 UE power saving WI. How to align the two Rel17 Wis need to be carefully considered, so as to parallel duplicated work in Rel17 on supporting of TRS for RRC\_IDLE/INATIVE UEs.
	+ Proposal-21: If there is not enough time for specifying TRS for RRC\_IDLE/INACTIVE UEs in Rel17 MBS, it can be further considered as a candidate in upcoming Rel18 MBS work.
* In [R1-2109389, Xiaomi]
	+ *Discuss*: For physical broadcast channel, it carries the most essential information targeting to all UEs. Compared to efficiency, reliability is the ultimate goal. From this perspective, there is no motivation to support advanced modulation schemes for current physical broadcast channels. For NR Multicast and Broadcast services, diverse services with large TBS are on the table and need to be supported, e.g. V2X applications, transparent IPv4/IPv6 multicast delivery, IPTV, software delivery over wireless, group communications and IoT applications.
	+ *Discuss*: In order to support higher modulation order compared to QPSK, the synchronization accuracy becomes a bottleneck for UEs in Idle/Inactive state. One straightforward mechanism is to introduce a group-specific TRS for UEs in Idle/Inactive states which support MBS traffic.
	+ Proposal: Introduce group-specific TRS for MBS capable UE in order to improve the accuracy of T/F synchronization.
		- MBS UE receives the group-specific TRS only when it is in Idle/Inactive state.
* In [R1-2110212, Qualcomm]
	+ *Discuss*: If broadcast is transmitted from SFNed multiple cells, GC-PDCCH/PDSCH should be QCL’d with periodic TRS with the multiple cells. The TRS can be configured in a broadcast CFR with transmission no larger than that of the CFR. Although the time delay spread is different from that of serving cell’s SSB, the TRS can be QCL-ed with SSB at least in terms of timing, doppler shift.
	Even if the broadcast is transmission from single cell, the GC-PDSCH for MTCH may use high modulation and TRS is beneficial to link budget.
	+ Proposal 7: TRS can be configured in a broadcast CFR for RRC\_IDLE/INACTIVE UEs.
		- UE may assume that the GC-PDCCH/PDSCH is QCL’d with periodic TRS if configured for broadcast.
		- The TRS can be QCL-ed with SSB at least in terms of timing, doppler.
* In [R1-2110357, Ericsson]
	+ *Discuss*: TRS are beneficial for operation at low SINR, typically for SINR<3dB and at low bandwidth, typically <6 PRBs.
	In a broadcast scenario SINR<3dB can easily happen for UEs close to the cell border, even with beam sweeping. Small bandwidth allocations for MBS services that do not exceed 6 PRBs are also easily conceivable, e.g. MCPTT voice service. Configuring TRS for MBS broadcast can make sense in such scenarios.
	+ Proposal 13: Group-common PDCCH/PDSCH for MTCH is QCL’d with TRS if configured.

### **FL Assessment**

* *Supporters of configuring TRS as a QLC source for broadcast reception in RRC idle/inactive UEs*
	+ [Huawei, Xiaomi, Qualcomm, Ericsson]
* *More discussion is needed for the support of TRS as a QLC source for broadcast reception*
	+ [vivo, Nokia].
	+ [Nokia] highlights ongoing work on support of TRS for RRC\_IDLE/INATIVE UEs in Rel17 UE power saving WI and that additional results may be needed to justify the introduction of the functionality if the motivation is to enable higher order modulation schemes.
* *Use case of TRS as QLC source*
	+ [Huawei, Xiaomi, Qualcomm]: improved time/frequency tracking accuracy, especially in the lower frequency ranges, e.g., 600-700 MHz for both transmissions from a single-cell or from multiple-cells (intra-DU SFN)
	+ [Huawei] not for beam training at FR2.
* *Items for further study for TRS as QLC source* [vivo, Nokia]
	+ Indication method for QCL information of TRS, i.e., whether associated with SSB
	+ Transmission manner of TRS, e.g., whether beam sweeping is supported in FR2
	+ Timing acquisition, e.g., how to acquire cell timing

Based on the above and to allow more discussion the FL puts forward the proposals below.

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

**Proposal 2.11-1**: for RRC\_IDLE/INACTIVE UEs, periodic TRS can be configured as QCL source for broadcast reception of GC-PDCCH/PDSCH carrying MTCH.

**Proposal 2.11-2**: Study the following aspects on the configuration of TRS as QCL source for broadcast transmission.

* Indication method for QCL information of TRS, i.e., whether associated with SSB
* Transmission manner of TRS, e.g., whether beam sweeping is supported in FR2
* Timing acquisition, e.g., how to acquire cell timing

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

1. **do you agree with the proposal 2.11-1? Please provide reasons, views in general if you do not agree.**
2. **do you agree with the study items listed in proposal 2.11-2? Please provide reasons, views in general or an alternative list if you do not agree.**

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

## Issue 12: Scrambling sequence initialisation for GC-PDCCH/PDSCH and DMRS

### **Background**

The following agreements at RAN1#106-e for RRC\_CONNECTED UEs are relevant for this discussion.

|  |
| --- |
| Agreement:For initializing scrambling sequence generator for GC-PDCCH with the second DCI format, * $n\_{ID}$ equals the higher layer parameter *pdcch-DMRS-ScramblingID* if it is configured in the CORESET in a CFR used for the GC-PDCCH;$n\_{ID}=N\_{ID}^{cell}$ otherwise.
* FFS: Values for $n\_{RNTI}$. Choices include one or more of the following:
	+ Alt1: G-RNTI used for the GC-PDCCH.
	+ Alt2: 0
	+ Alt3: Other fixed values

Agreement:For initializing scrambling sequence generator for GC-PDSCH scheduled by the second DCI format for multicast received in Type-x CSS, * $n\_{ID}$ equals the higher layer parameter *dataScramblingIdentityPDSCH* if it is configured in *PDSCH-Config* in a CFR used for GC-PDSCH and the RNTI equals the G-RNTI or G-CS-RNTI;$n\_{ID}=N\_{ID}^{cell}$ otherwise.
* $n\_{RNTI}$ corresponds to the RNTI associated with the GC-PDSCH transmission (i.e., the G-RNTI used by the scheduling GC-PDCCH, or the G-CS-RNTI used by the SPS GC-PDSCH activation PDCCH)

Agreement:For initializing sequence generator for DMRS of GC-PDCCH with the second DCI format received in Type-x CSS, * $N\_{ID}$ equals the higher layer parameter *pdcch-DMRS-ScramblingID* if it is configured in the CORESET in a CFR used for the GC-PDCCH; $N\_{ID}=N\_{ID}^{cell}$ otherwise.
 |

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

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

### **Tdoc analysis**

* In [R1-2108725, Huawei]
	+ Proposal 1: Support a configurable ID for scrambling sequence and DMRS generator initialization for scheduling broadcast, specifically:
		- For initializing scrambling sequence generator for GC-PDCCH/PDSCH with/scheduled by the first DCI format, n\_"ID" is an value configured by the higher layer parameter, respectively.
		- For initializing DMRS generator of GC-PDCCH/PDSCH with/scheduled by the first DCI format, n\_"ID" is a value configured by the higher layer parameter, respectively.
	+ Proposal 2: The configurable ID for scrambling sequence and DMRS generator initialization for scheduling broadcast is per G-RNTI instead of per UE.
* In [R1- 2109003, vivo]
	+ Proposal 3: For scrambling sequence initialization for GC-PDCCH using DCI format 1\_0 with the CRC scrambled by G-RNTI, MCCH-RNTI, and any other RNTIs further agreed for broadcast,
		-  can be configured by high-layer parameters, i.e., *GC-pdcch-DMRS-ScramblingID-broadcast*, $n\_{ID}=N\_{ID}^{cell}$ if not configured.
		-  can be selected as one or more of the following
			* Alt1: G-RNTI used for the GC-PDCCH
			* Alt2: 0
			* Alt3: Other fixed values
	+ Proposal 4: For scrambling sequence initialization for GC-PDSCH scheduled by GC-PDCCH using DCI format 1\_0 with the CRC scrambled by G-RNTI, MCCH-RNTI, and any other RNTIs further agreed for broadcast,
		-  can be configured by high-layer parameters, i.e., *DataScramblingIdentityGC-PDSCH-broadcast,* $n\_{ID}=N\_{ID}^{cell}$ if not configured.
		-  corresponds to the RNTI associated with the GC-PDSCH transmission.
	+ Proposal 5: For DMRS sequence generator initialization for GC-PDCCH using DCI format 1\_0 with the CRC scrambled by G-RNTI, MCCH-RNTI, and any other RNTIs further agreed for broadcast,
		- can be configured by high-layer parameters, i.e., *GC-pdcch-DMRS-ScramblingID-broadcast*,if not configured.
	+ Proposal 6: For DMRS sequence generator initialization for GC-PDSCH scheduled by GC-PDCCH using DCI format 1\_0 with the CRC scrambled by G-RNTI, MCCH-RNTI, and any other RNTIs further agreed for broadcast,
	+ can be configured by high-layer parameters, i.e., *GC-pdsch-DMRS-ScramblingID-broadcast*,if not configured.
* In [R1-2109305, CMCC]
	+ Proposal 6. For initializing scrambling sequence generator for GC-PDCCH for MCCH/MTCH,
		- $n\_{ID}$ equals the higher layer parameter *pdcch-DMRS-ScramblingID* if it is configured in a CFR used for the GC-PDCCH for MCCH/MTCH;$n\_{ID}=N\_{ID}^{cell}$ otherwise.
		- $n\_{RNTI}$ is given by the G-RNTI or MCCH-RNTI for a PDCCH if the higher-layer parameter *pdcch-DMRS-ScramblingID* is configured; $n\_{RNTI}=0$ otherwise.
	+ Proposal 7. For initializing scrambling sequence generator for GC-PDSCH for MCCH/MTCH,
		- $n\_{ID}$ equals the higher layer parameter *dataScramblingIdentityPDSCH* if it is configured in a CFR used for GC-PDSCH for MCCH/MTCH and the RNTI equals the G-RNTI or MCCH-RNTI;$n\_{ID}=N\_{ID}^{cell}$ otherwise.
		- $n\_{RNTI}$ corresponds to the RNTI associated with the GC-PDSCH transmission.
	+ Proposal 8. For initializing sequence generator for DMRS of GC-PDCCH for MCCH/MTCH,
		- $N\_{ID}$ equals the higher layer parameter *pdcch-DMRS-ScramblingID* if it is configured in a CFR used for the GC-PDCCH for MCCH/MTCH; $N\_{ID}=N\_{ID}^{cell}$ otherwise.
	+ Proposal 9. For initializing sequence generator for DMRS of GC-PDSCH for MCCH/MTCH,
		- $N\_{ID}^{0} $equals the higher-layer parameters *scramblingID0* if it is configured in the *DMRS-DownlinkConfig*IE in a CFR used for GC-PDSCH for MCCH/MTCH; $N\_{ID}^{\overbar{n}\_{SCID}^{\overbar{λ}}}=N\_{ID}^{cell} $ otherwise.
* In [R1-2109318, Nokia]
	+ *Discuss*: Proposal-6: Regarding the scrambling sequence initialization for PDCCH/PDSCH and DMRS sequence generator initialization for PDCCH/PDSCH for broadcast transmission, similar discussion can be discussed as for RRC\_CONNECTED UE. Any SFN related operation should be transparent to the UE, as agreed in RAN#93-e meeting.
* In [R1-2109517, Samsung]
	+ Proposal 2. The Group-common PDSCH can be scrambled using  .
* In [R1-2109703, DOCOMO]
	+ Proposal 7: For initializing sequence generator for DMRS of GC-PDCCH scheduling MCCH/MTCH,
		- $N\_{ID}$ equals the higher-layer parameter pdcch-DMRS-ScramblingID if it is configured in the CORESET in a CFR used for the GC-PDCCH; $N\_{ID}=N\_{ID}^{cell}$ otherwise.
	+ Proposal 8: For initializing sequence generator for DMRS of GC-PDSCH carrying MCCH/MTCH,
		- $N\_{ID}^{0}$ equals the higher-layer parameter scramblingID0 in the DMRS-DownlinkConfig IE for broadcast if provided ; $N\_{ID}^{\overbar{n}\_{SCID}^{\overbar{λ}}}=N\_{ID}^{cell}$ otherwise.
	+ Proposal 9: For initializing scrambling sequence generator for GC-PDCCH scheduling MCCH/MTCH,
		- $n\_{ID}$ equals the higher layer parameter pdcch-DMRS-ScramblingID if it is configured in the CORESET in a CFR used for the GC-PDCCH; $n\_{ID}=N\_{ID}^{cell}$ otherwise.
	+ Proposal 10: For initializing scrambling sequence generator for GC-PDSCH carrying MCCH/MTCH
		- $n\_{ID}$ equals the higher layer parameter dataScramblingIdentityPDSCH if it is configured in PDSCH-Config in a CFR used for GC-PDSCH; $n\_{ID}=N\_{ID}^{cell}$ otherwise.

### **FL Assessment**

[Huawei, vivo, CMCC, Nokia, Samsung, DOCOMO] all propose initialisation scrambling sequences for the sequence generator of GC-PDCCH/PDSCH and the DMRS with detailed proposals reusing the discussions on AI 8.12.1 on RRC connected UEs. The FL puts forward proposals for agreement based on the proposals presented by the companies.

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

**Proposal 2.12-1**: For initializing scrambling sequence generator for GC-PDCCH for MCCH/MTCH,

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

**Proposal 2.12-2**: For initializing scrambling sequence generator for GC-PDSCH for MCCH/MTCH,

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

**Proposal 2.12-3:** For initializing sequence generator for DMRS of GC-PDCCH for MCCH/MTCH,

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

**Proposal 2.12-4:** For initializing sequence generator for DMRS of GC-PDSCH for MCCH/MTCH,

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

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

1. **do you agree with the proposals 2.12-1 to 2.12-4? Please provide reasons, views in general, or alternative proposals if you do not agree.**

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

## Other Issues

Here, we include other issues that have been discussed at the tdocs submitted to this meeting. However, it is not the initial plan of the FL to tread these issues in this meeting. If you have any views or recommendations do please put your comments in the table below.

### **Other Issue 1: HARQ feedback for RRC\_IDLE/RRC\_INACTIVE UE states**

* [vivo, OPPO, CMCC, Xiaomi, Samsung, Intel]

### **Other Issue 2: Broadcast services supported for both RRC\_CONNECTED and RRC\_IDLE/RRC\_INACTIVE UEs**

* [CATT, MediaTek, Intel, TD Tech, Ericsson]

### **Other Issue 3: Discontinuous Reception (DRX) and Wakeup Signals (WUS)**

* [CATT]

### **Other Issue 4: PDSCH TDRA table configuration**

* [ZTE]

### **Other Issue 5: UE feedback for MBS Interest Indication for partial beam sweeping or MCS determination**

* [Nokia, Sony]

### **Other Issue 6: Support of RedCap UEs**

* [Apple, ZTE]

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

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

# Proposals for Discussion at GTW sessions

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

# Stable Proposals

# Summary of Agreements

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

# References

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

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

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

**Relevant tdoc from AI 5**

1. R1-2109566 Discussion on RAN2 LS on broadcast session delivery about MCCH design MediaTek Inc.

**Relevant tdocs from AI 8.12.3**

1. R1-2108725 Discussion on UE receiving broadcast in RRC IDLE/INACTIVE state Huawei, HiSilicon, CBN
2. R1-2108806 MBS Support for RRC IDLE/INACTIVE UEs FUTUREWEI
3. R1-2108853 Discussion on basic Functions for Broadcast or Multicast for RRC\_IDLE or RRC\_INACTIVE UEs ZTE
4. R1-2108928 Basic Functions for Broadcast or Multicast for RRC\_IDLE or RRC\_INACTIVE UEs Spreadtrum Communications
5. R1-2109003 Remaining issues on basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE Ues vivo
6. R1-2109069 Discussion on basic functions for RRC\_IDLE/RRC\_INACTIVE UEs OPPO
7. R1-2109196 Discussion on basic functions for broadcast multicast for RRC\_IDLE RRC\_INACTIVE UEs CATT
8. R1-2109305 Discussion on NR MBS in RRC\_IDLE/ RRC\_INACTIVE states CMCC
9. R1-2109318 Basic Functions for Broadcast / Multicast for RRC\_IDLE / RRC\_INACTIVE Ues Nokia, Nokia Shanghai Bell
10. R1-2109517 On basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs Samsung
11. R1-2109540 Basic functions for broadcast/multicast in idle/inactive states Lenovo, Motorola Mobility
12. R1-2109569 Discussion on MBS for RRC\_IDLE/INACTIVE UEs MediaTek Inc.
13. R1-2109635 NR-MBS for RRC\_IDLE/INACTIVE UEs Intel Corporation
14. R1-2109703 Discussion on basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs NTT DOCOMO, INC.
15. R1-2109769 Further discussion on basic functions for RRC\_IDLE/RRC\_INACTIVE UEs TD Tech, Chengdu TD Tech
16. R1-2109802 Considerations on MBS functions for RRC\_IDLE/INACTIVE UEs Sony
17. R1-2109985 Basic function for broadcast/multicast LG Electronics
18. R1-2110058 Discussion on MBS for RRC\_IDLE and RRC\_INACTIVE UEs Apple
19. R1-2110120 Discussion on MBS for RRC\_IDLE/RRC\_INACTIVE UEs Convida Wireless
20. R1-2110212 Views on group scheduling for Broadcast RRC\_IDLE/INACTIVE UEs Qualcomm Incorporated
21. R1-2110251 Discussion on MBS for RRC\_IDLE/RRC\_INACTIVE UEs Google Inc.
22. R1-2110258 Discussion on basic functions for broadcast or multicast for RRC\_IDLE and RRC\_INACTIVE UEs ASUSTeK
23. R1-2110357 Support for NR multicast reception in RRC Inactive/Idle Ericsson
24. R1-2109388 Discussion on basic functions for broadcastmulticast for RRC\_IDLERRC\_INACTIVE UEs Xiaomi

**Relevant tdocs from AI 8.12.4**

1. R1-2109389 Discussion on remaining issues for idle and inactive UE Xiaomi
2. R1-2109742 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*.

## RAN1#106-e agreements

Agreement:

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

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

Conclusion:

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

Agreement:

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

Agreement:

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

Agreement:

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

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

Agreement:

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

Agreement:

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

Agreement:

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

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

Conclusion:

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

Agreement:

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

Agreement:

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

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

## RAN#93-e agreements

Agreement:

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

Agreement (Updated proposal from RAN1#106e):

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

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

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

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

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

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

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

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

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

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| * **The concept of MCCH transmission window, similar to the one used for LTE SC-PTM, is used for NR MCCH scheduling. The exact parameters to define the window are FFS (discussed in the following proposals).**
* **The MCCH transmission window is defined by MCCH repetition period, MCCH window duration and radio frame/slot offset.**
* **New RNTI is defined for scheduling MCCH.**
* **Common search space is needed for MCCH scheduling. RAN2 should request RAN1 to discuss the details of CSS for MCCH.**
* **R2 assumes PDCCH occasions for MCCH search space are associated with SSBs in a pre-defined manner so that the UE can receive MCCH scheduling on PDCCH occasions according to its detected SSB.**
* **R2 assumes, In case searchSpace#0 is configured for MCCH (if allowed, pending RAN1 decision), the mapping between PDCCH occasions and SSBs is the same as for SIB1.**
* **R2 assumes that If common search space other than searchSpace#0 is configured for MCCH (if allowed, pending RAN1 decision), the PDCCH monitoring occasions for MCCH message which are not overlapping with UL symbols are sequentially numbered from one in the MCCH transmission window and mapped to SSBs using the similar rule as defined for OSI in TS 38.331.**
* **Request RAN1 to discuss the details of the configuration of the bandwidth for MCCH reception.**
* **The modification period is defined for NR MCCH and NR MCCH contents are only allowed to be modified at each modification period boundary.**
* **The updated MCCH message should be sent in the same MCCH modification period where the change notification is sent.**
* **UE in RRC IDLE/INACTIVE should be able to monitor/read both MCCH channel and SI/Paging without BWP switch. It is up to RAN1 to decide how this is ensured.**
* **It is up to RAN1 to to decide about the RNTI and DCI format used for MCCH change notifications.**
* **FFS whether to support multiple MCCH, e.g. to support different service types.**
* **RAN2 will discuss and down-select from the following two options for the UE to get aware of session stop/modification:**
	+ **Reading MCCH once per each MCCH modification period when receiving an ongoing broadcast session**
	+ **DCI used for MCCH notification indicates the change of an ongoing broadcast session**
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The agreements made by RAN2 require further discussions in RAN1. In particular, RAN2 would like to request RAN1 to investigate and provide feedback on the following aspects, considering the above agreements made by RAN2:1. Details of Common Search Space design for MCCH channel, e.g. is SS#0 allowed to be configured as a search space for MCCH, is search space other than SS#0 allowed to be configured as a search space for MCCH.
2. Details of the allowed transmission bandwidth/BWP configurations for MCCH transmission.
3. Details of the RNTI and DCI design for carrying MCCH change notifications.
	* NOTE: RAN2 is still discussing some aspects that may have an impact on this issue, e.g. whether or not to support multiple MCCH or whether or not a notification about the modification/stop of an ongoing session is needed, as indicated above. RAN2 will update RAN1 as soon as further agreements are made on these items.

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

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

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

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

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