**3GPP TSG RAN WG1 #108-e**  **R1-22xxxxx**

**e-Meeting, February 21st – March 3rd, 2022**

**Agenda item:** 8.12.1

**Source:** Moderator (CMCC)

**Title:** Summary# on mechanisms to support group scheduling for RRC\_CONNECTED UEs for NR MBS

**Document for:** Discussion/decision

# Introduction

The WI NR\_MBS was approved in RAN plenary #86 meeting [1], and the WID was revised in RAN plenary #88 e-meeting [2]. One of the objectives is to specify a group scheduling mechanism to allow UEs to receive Broadcast/Multicast service, and this objective also includes specifying necessary enhancements that are required to enable simultaneous operation with unicast reception.

The following email thread for group scheduling is announced by chairman in RAN1#108-e:

[108-e-R17-MBS-01] Email discussion for maintenance on mechanisms to support group scheduling for RRC\_CONNECTED UEs – Fei (CMCC)

* 1st check point: February 25
* Final check point: March 3

In this contribution, we summarized the related issues and proposals based on the contributions submitted in RAN1#108-e under the agenda item 8.12.1 [3]-[25]. As chairman’s guidance, potential response LS for R1-2200888 is to be discussed as part of email discussion in [108-e-R17-MBS-01] under agenda item 8.12.1, the related issues and proposals based on the contributions submitted in RAN1#108-e under the agenda item 5 [27]-[37] are also summarized in this document.

The following sections are structured as follows. From section 2 to 6, we categorized the key issues raised by contributions into 5 kinds and each section covers one kind of issues. In each section, we first provide the background and related proposals submitted in this meeting in sub-section X.1, then sub-issues and related proposals are identified by moderator in subsequent sub-sections. In each sub-section, one table is provided after proposals to collect company views during the email discussion. In section 7, some proposals will be selected for discussion in the GTW session.

If possible, please try to provide your replies within 24h. Moderator will try to update the proposals based on companies’ inputs on a daily basis.

# Issue#1: CFR and general issues for MBS

## Background and submitted proposal

### Issue#1-1) Support of CA for multicast

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| **Company** | **Proposals** |
| **Huawei** | **Proposal 5: Specification supports UE receiving multicast on SCell in addition to PCell or receiving on more than on SCell.**  **Proposal 6: Separate UE capability of CA for multicast can be defined in addition to reporting the capability of CA for unicast.**   * **The number of carriers UE supports to receive multicast can be part of UE capability reporting.** |
| **vivo** | Proposal 6：If UE supports carrier aggregation for unicast, multicast reception on an activated SCell with self-scheduling is supported subject to UE capability in Rel-17.   * **UE is not expected to be configured simultaneously with P(S)Cell and SCell or more than one component carrier for multicast reception.** * **Cross-carrier scheduling for multicast reception is not supported in Rel-17.** |
| **ZTE** | **Proposal 1: The following features of multicast reception in CA mode are supported by CA capable UE,**   * **Multicast reception on SCell with self-scheduling or cross-carrier scheduling.** * **Multicast reception on PCell and SCell or more than one SCell simultaneously.**   **Proposal 2: Adopt the following TPs for Clause 7.3.1.5.3 of TS38.212\_h00 and Clause 10.1 of TS38.213\_h00.**   |  | | --- | | TS 38.2127.3.1.5.3 Format 4\_2 DCI format 4\_2 is used for the scheduling of PDSCH in DL cell.  The following information is transmitted by means of the DCI format 4\_2 with CRC scrambled by G-RNTI configured by *G-RNTI-Config* or G-CS-RNTI:  - Carrier indicator – 0 or 3 bits as defined in Clause 10.1 of [5, TS 38.213].  **<Unchanged parts are omitted>** TS 38.21310.1 UE procedure for determining physical downlink control channel assignment **<Unchanged parts are omitted>**  - a Type3-PDCCH CSS set configured by *SearchSpace* in *PDCCH-Config* with *searchSpaceType* = *common* for DCI formats with CRC scrambled by INT-RNTI, SFI-RNTI, TPC-PUSCH-RNTI, TPC-PUCCH-RNTI, TPC-SRS-RNTI, ~~or~~ CI-RNTI, or configured by *SearchSpace-Multicast* in *PDCCH-Config-Multicast* for DCI formats with CRC scrambled by G-RNTI, or G-CS-RNTI and, only for the primary cell, C-RNTI, MCS-C-RNTI, CS-RNTI(s), or PS-RNTI~~, or configured by~~ *~~SearchSpace-Multicast~~* ~~in~~ *~~PDCCH-Config-Multicast~~* ~~for DCI formats with CRC scrambled by G-RNTI, or G-CS-RNTI~~ and  **<Unchanged parts are omitted>** | |
| **NTT DOCOMO** | **Proposal 1: Support multicast reception on SCell with self-scheduling.**  **Proposal 2: Cross carrier scheduling is not supported in Rel-17 multicast.**   * **Not include ‘Carrier indicator’ in DCI format 4\_2.** |
| **Intel** | **Proposal 3: If UE supports carrier aggregation for unicast, multicast reception on an activated SCell with self-scheduling is supported subject to UE capability and cross-carrier scheduling for multicast reception is not supported in Rel-17.** |
| **CMCC** | **Proposal 1. If UE supports carrier aggregation for unicast, multicast reception on an activated SCell with self-scheduling is supported subject to UE capability in Rel-17.**   * **UE is not expected to be configured simultaneously with more than one component carrier for multicast reception.** * **Cross-carrier scheduling for multicast reception is not supported in Rel-17.** * **The capability of supporting MBS multicast on SCell is a separate capability from the CA capability for unicast.**   + **Details of the capability can be discussed in UE feature.** |
| **MTK** | **Observation 1: MBS multicast reception on Scell and non-serving cell is out of the scope of Rel-17 MBS objective.**  **Observation 2: Rel-17 MBS as a first release for supporting 5G NR multicast broadcast services only focus on the basic function to fast commercial deployment.**  **Observation 3: Although some objectives are within the Rel-17 MBS scope, they have been deprioritized in Rel-17 due to limited time unit, e.g., multicast reception in RRC IDLE/INACTIVE state.**  **Observation 4: Considering multicast reception on Scell is out of Rel-17 MBS scope and some objectives within the Rel-17 MBS scope have been deprioritized, the reason and motivation for supporting multicast reception on Scell in the Rel-17 is not clear.**  **Observation 5: RAN2 workload is needed to check the feasibility of multicast reception on SCell.**  **Observation 6: The procedure of UE retunes its RF for multicast reception on Scell needs other WG’s discussion, e.g., RAN2/RAN4.**  **Observation 7: The RF glitch caused by RF returning and corresponding RF requirement issues need RAN4’s discussion and workload.**  **Observation 8: From RAN1 perspective, Rel-17 NR MBS with RAN1 objectives have been completed.**  **Proposal 1: Multicast reception on Scell is not supported for Rel-17 MBS.** |
| **Lenovo** | **Proposal 11: If UE supports carrier aggregation for unicast, multicast reception on a single SCell with self-scheduling is supported subject to UE capability in Rel-17.**   * **UE is not required to configured simultaneously with more than one component carrier for multicast reception.**   **Proposal 12: Cross-carrier scheduling for multicast reception is not supported in Rel-17.** |
| **Google** | **Proposal 1: Support MBS multicast reception on an activated SCell with self-scheduling, if the UE support CA for unicast.** |
| **LG** | Proposal 13: UE configured with SCell can support reception of multicast transmission on SCell depending on UE capability.  Proposal 14: Cross-carrier scheduling of PTM transmission is not supported in Rel-17.  Proposal 15: PTM transmission on a serving cell can be supported if UE is not configured with CCS for unicast.  Proposal 16: PTM transmission on SCell is not supported if UE is configured with CCS for unicast and the SCell is scheduled by the other cell for unicast transmission.  Proposal 17: PTM transmission on a serving cell can be supported if UE is configured with CCS for unicast and the serving cell schedules the other cell for unicast transmission. |
| **Ericsson** | Proposal 1 Introduce a UE capability for the number of CCs supported for MBS by the UE.  Proposal 2 Discuss whether the number of simultaneous unicast and multicast PDSCH for a CC should be unchanged from release 16 maximum number of simultaneous PDSCH for a CC.  Proposal 6 Cross carrier scheduling is not supported for group scheduling PDSCH in release 17. |

### Issue#1-2) BWP timer related issues

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| **Company** | **Proposals** |
| **vivo** | Proposal 2: If a UE is configured with a CFR in the active DL BWP, for timer-based active DL BWP switching to a default BWP, for option 1, it is proposed to support the following.   * **It is RRC configurable that whether UE will start or restart BWP-InactivityTimer when it successfully decodes a GC-PDCCH addressed to group-common RNTI (e.g., G-RNTI or G-CS-RNTI) for multicast.**   + **The configuration can be per group-common RNTI.** |

### Issue#1-3) Others (L)

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| **Company** | **Proposals** |
| **OPPO** | **Proposal 1: When CFR for broadcast MBS is not configured/defined within a dedicated BWP, UE in RRC\_CONNECTED state cannot receive broadcast MBS in this activated BWP.** |
| **Nokia** | **Observation-1: Broadcast and multicast or unicast can be on separate BWPs – with broadcast CFR associated with initial BWP / CORESET0, and multicast or unicast associated with UE’s dedicated unicast BWP, if a UE is receiving different services simultaneously.**  **Proposal-2: The configuration of CFRs and associated BWPs for simultaneous reception of broadcast and multicast / unicast could be left to network configuration and UE capabilities.**  **Proposal-3: Autonomous switching between broadcast CFR and unicast dedicated BWP which might also contain the multicast CFR could be left to UE implementation.**  **Proposal-4: Support for independent configuration of broadcast CFR and unicast BWP require enhanced signaling to avoid unnecessary BWP switching.** |
| **MTK** | **Proposal 5: For broadcast reception, the unified CFR is supported for RRC\_CONNECTED and RRC\_IDLE/INACTIVE UEs.** |
| **ASUSTeK** | **Proposal 1: If a UE’s active BWP is switched from an MBS-capable BWP to an MBS-incapable BWP, it needs some studies for the UE to resume multicast PDCCH/PDSCH receptions, e.g. the UE automatically switches back to the MBS-capable BWP after a certain time duration.**  **Proposal 2: CFR sharing mechanisms should be further studied to improve the multicast scheduling capability.** |
| **LG** | Proposal 5: If a CFR is confined within more than one UE active BWP with a same numerology, the CFR can be associated to more than one BWP.   * Upon unicast BWP switching between UE’s active BWPs associated to the same CFR, UE does not change CFR and continues to receive PTM/PTP (re-)transmissions on the CFR during/after unicast BWP switching. |
| **Ericsson** | Proposal 5 CFR is configured per cell, with a CFR ID. A BWP configured for multicast is indicated a CFR ID. |

## Issue#1-1) Support of CA for multicast

### Summary

This issue has been discussed in last two meetings without conclusion. Based on companies’ contributions submitted in this meeting, 10 companies support multicast reception on SCell, and most companies [vivo, NTT DOCOMO, CMCC, Lenovo, Google, LG, Ericsson] support only self-scheduling, while 1 company [MediaTek] doesn’t support multicast reception on SCell. Based on the final round email discussion in last meeting, moderator suggests the **initial proposal 1-1a**.

### 1st Round Proposals (Closed)

**Initial proposal 1-1a:**

If UE supports carrier aggregation for unicast, multicast reception on an activated SCell with self-scheduling is supported subject to UE capability in Rel-17.

* UE is not expected to be configured simultaneously with more than one component carrier for multicast reception.
* Cross-carrier scheduling for multicast reception is not supported in Rel-17.
* The capability of supporting MBS multicast on SCell is a separate capability from the CA capability for unicast.
  + Details of the capability can be discussed in UE feature

Companies are encouraged to provide comments in the table below.

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| --- | --- |
| **Company** | **Comment** |
| Spreadtrum | Support |
| vivo | Support the proposal |
| LG Electronics | OK |
| NTT DOCOMO | We are generally fine with the proposal. The number of CCs for multicast can be discussed in UE feature. |
| Huawei, HiSilicon | The situation for multicast is different from broadcast. Multicast is received only in Connected state and multicast CA can be supported by reporting the number of CC. We don’t see the need to restrict the CC for multicast and we don’t see the necessity to keep the same limitation as that for broadcast. |
| Xiaomi | We are fine with the proposal. |
| OPPO | OK with the proposal. |
| Lenovo, Motorola Mobility | Support |
| Apple | OK with this proposal |
| ZTE | Although we think MBS reception on multiple carriers and cross-carrier scheduling for MBS can be supported as well subject to UE capability, we can compromise to accept this proposal for progress. |
| Nokia, NSB | We are fine with the proposal |
| Samsung | OK either way but introduction of new UE capability (for CA-capable UE) needs justification. |
| Qualcomm | Ok with the proposal |
| Ericsson | Support |
| CATT | We are fine with the proposal. |
| MediaTek | As discussed in our contribution, supporting multicast reception on Scell is not necessary for Rel-17 MBS, in other words, although MBS reception on Scell is not supported, the Rel-17 MBS still can be workable. The detailed reasons are listed as following:   * Supporting the Scell for MBS reception is out of the scope of Rel-17 WID objective, instead, the Rel-17 MBS is targeting to design basic function for fast facilitating commercial deployment. * Although some objectives are within the Rel-17 MBS scope, they have been deprioritized in Rel-17 due to limited time unit, e.g., multicast reception in RRC IDLE/INACTIVE state. Therefore, we are confused why the issue out of scope is a critical issue. * Multicast services are targeted for a group UEs and not for dedicated UE, and the multicast session join process and session start process are different from that of unicast from high layer perspective, which needs to be discussed by RAN2. * In current proposal, we focus on the activated Scell, however, for the LTE eMBMS/SC-PTM, the UE will adjust the RF before the Scell is activated because multicast services are always transmitted no matter whether the current UE’s Scell exist or not. Therefore, it needs RAN2/RAN4 to discuss whether the activated Scell is suitable for multicast reception and corresponding RF glitch issue caused by RF retuning. * RAN1 has agreed that the G-RNTI is configured per serving cell and FDMed between one unicast PDSCH and one group common PDSCH case are supported. If multiple CC is supported for multicast reception, the G-RNTI number will be increased, which has larger UE hardware impact, and the FDMed case in each CC will finally make UE processing complexity. So, it against the Rel-17 MBS target objective that “In order to facilitate implementation and deployment of the feature, the overall implementation impact should be limited, and the UE complexity should be minimized (e.g. device hardware impact should be avoided).” * In the RAN1’s status report to RAN plenary, it states that “from RAN1 perspective, all NR SI/WIs (include Rel-17 NR\_MBS) led by other WGs with RAN1 objectives have been completed”, from our understanding, it aligns with our understanding that “supporting MBS reception on Scell is out of Rel-17 MBS scope”.   To sum up, from our perspective, supporting multicast reception on Scell needs more discussion and it is better to be discussed in future release. Considering the meeting progress and other companies’ strong view for supporting multicast reception on Scell, we can compromise to define a basic Scell capability for multicast reception if it can be accepted by other companies, i.e., one component carrier for multicast reception and the granularity of UE reporting the capability of supporting MBS multicast reception is per FSPC. Otherwise, MBS multicast reception on Scell is not supported in Rel-17 MBS and it can be further discussed in  future release, e.g., as a Rel-17 MBS leftover issue and further discussed in Rel-18. |
| TD Tech, Chengdu TD Tech | Ok |
| Moderator | Moderator suggests an update. I understand Huawei’s concern, but considering MTK still has concern on this proposal, this can be a compromise. |

### 2nd Round Proposals (Closed)

**Updated proposal 1-1a:**

If UE supports carrier aggregation for unicast, multicast reception on an activated SCell with self-scheduling is supported subject to UE capability in Rel-17.

* UE is not expected to be configured simultaneously with more than one component carrier for multicast reception.
* Cross-carrier scheduling for multicast reception is not supported in Rel-17.
* The capability of supporting MBS multicast on SCell is a separate capability from the CA capability for unicast.
  + The granularity of UE reporting the capability of supporting MBS multicast reception is per FSPC

Provide your comments only when you have concern on it.

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| **Company** | **Comment** |
| Moderator | There is no concern for at least 24 hours. I moved it to section 7. |

## Issue#1-2) BWP timer related issues

### Summary

In RAN1#107-e, the following was approved in the email thread [107-e-NR-MBS-01] at the last moment.

**Agreement**

For multicast, if a UE is configured with a CFR in the active DL BWP, for timer-based active DL BWP switching to a default BWP, option 1 is supported.

* Option 1: UE also starts or restarts BWP-InactivityTimer when it successfully decodes a GC-PDCCH addressed to group-common RNTI (e.g., G-RNTI or G-CS-RNTI) for multicast on/for the active BWP or when a MAC PDU for is received in a configured downlink assignment for multicast.
  + UE does not start or restart BWP-InactivityTimer when it successfully decodes a GC-PDCCH addressed to group-common RNTI (e.g., G-RNTI or G-CS-RNTI) for broadcast.

However, I just found in the final report of RAN1#107-e the above agreement was was incorrectly captured as the following with the second half part of the sub-bullet missed.

Agreement

For multicast, if a UE is configured with a CFR in the active DL BWP, for timer-based active DL BWP switching to a default BWP, option 1 is supported.

* Option 1: UE also starts or restarts BWP-InactivityTimer when it successfully decodes a GC-PDCCH addressed to group-common RNTI (e.g., G-RNTI or G-CS-RNTI) for multicast on/for the active BWP or when a MAC PDU for is received in a configured downlink assignment for multicast.
  + UE does not start or restart BWP-InactivityTimer when it successfully decodes a GC-PDCCH

Although it seems this does not impact the final specification, moderator suggests to update the agreement in RAN1#107-e.

In addition, in this meeting, 1 company [vivo] proposes an issue that there would be ambiguity on the running of the BWP-InactivityTimer if NACK only or no feedback is used, since gNB would not be able to know whether the GC-PDCCH is successfully decoded by a UE or not. The following two solutions are proposed by vivo:

* Solution 1: Only when ACK/NACK feedback mode is used, UE will start or restart BWP-InactivityTimer when it successfully decodes a GC-PDCCH addressed to group-common RNTI for multicast.
  + UE does not start or restart BWP-InactivityTimer when it successfully decodes a GC-PDCCH addressed to group-common RNTI when NACK-only feedback is configured or when HARQ-ACK feedback is disabled.
* Solution 2: It is RRC configurable that whether UE will start or restart BWP-InactivityTimer when it successfully decodes a GC-PDCCH addressed to group-common RNTI (e.g., G-RNTI or G-CS-RNTI) for multicast.
  + E.g. If the parameter is set to true, UE start or restart BWP-InactivityTimer when it successfully decodes a GC-PDCCH addressed to group-common RNTI when NACK-only feedback is configured or when HARQ-ACK feedback is disabled. Otherwise, UE does not start or restart BWP-InactivityTimer when it successfully decodes a GC-PDCCH addressed to group-common RNTI.

In my understanding, considering the ACK/NACK feedback can be enabled/disabled by DCI 4\_2, I think both solutions 1 and 2 may require UE to further check the “Enabling/disabling HARQ-ACK feedback indication” field of DCI format 4\_2 to decide whether to start or restart BWP-InactivityTimer if it successfully decodes a GC-PDCCH addressed to group-common RNTI. Moderator suggests **initial question 1-2a**.

### 1st Round Proposals (Closed)

**Initial question 1-2a:**

For multicast, if a UE is configured with a CFR in the active DL BWP, for timer-based active DL BWP switching to a default BWP, do you think further optimization is needed on top of the relevant agreement in RAN1#107-e? If the answer is yes, what’s your view on the following two alternatives or any other alternative?

* Alt 1: UE also starts or restarts BWP-InactivityTimer when it successfully decodes a GC-PDCCH addressed to group-common RNTI (e.g., G-RNTI or G-CS-RNTI) for multicast on/for the active BWP and ACK/NACK based feedback is used for the scheduling, or when a MAC PDU is received in a configured downlink assignment for multicast and ACK/NACK feedback is used for the corresponding multicast SPS PDSCH.
* Alt 2: Introduce an RRC parameter to configure whether UE will start or restart BWP-InactivityTimer when it successfully decodes a GC-PDCCH addressed to group-common RNTI (e.g., G-RNTI or G-CS-RNTI) for multicast on/for the active BWP or when a MAC PDU is received in a configured downlink assignment for multicast.

Companies are encouraged to provide comments in the table below.

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| **Company** | **Comment** |
| vivo | We do not think this is optimization. We think the current agreement cann’t work well when NACK-only or no feedback is used for GC-PDCCH. In that case, gNB would not be able to know whether it is successfully decoded by a UE or not. Therefore, it would cause ambiguity on the running of the BWP-InactivityTimer. For Alt 1, it can solve the issue with no new RRC parameter. For Alt 2, if UE can also receive the same MBS service on the initial DL BWP which has smaller bandwidth, there is no need to keep UE working on the active DL BWP if UE has no unicast service reception. and gNB can configured UE to not start or restart BWP-InactivityTimer when it successfully decodes a GC-PDCCH addressed to group-common RNTI even when ACK/NACK feedback is configured. Considering the pros and cons, we are fine to go with either way. |
| LG Electronics | This optimization is not necessary considering how *BWP-InactivityTimer* works for unicast reception. |
| NTT DOCOMO | We don’t think further optimization is necessary. |
| Huawei, HiSilicon | At least Alt2 is not needed. we thought Alt1 is supposed to the case that UE receives the DCI/DPSCH instead of decoding it correctly or should not depend on ack/nack based nor HARQ-ACK enabled. |
| Xiaomi | We don’t think further optimization is needed as we believe neither of the alternatives can really resolve the problem. We share the same views with FL. The key point is that gNB cannot make sure whether the UE successfully decodes MBS DCI when NACK-only is configured or no HARQ-ACK feedback is configured. However, either alt 1 or alt 2 cannot ease the issue as even ACK-NACK based feedback is configured, miss detection of PDCCH may occur as well. In the other word, gNB confront similar situation since Rel-15 and we don’t optimize it as it is really trivial and corner. |
| OPPO | Further optimization is not needed on top of the agreement on timer-based DL BWP switching mechanism for Rel-17 NR MBS. |
| Lenovo, Motorola Mobility | Agree with LG, DOCOMO, OPPO and Xiaomi that this optimization is not needed. |
| Apple | The Optimization seems not necessary according to Rel-15/16 *BWP-InactivityTimer* restarting rules. |
| ZTE | We don’t see strong motivation to address this issue by specification for the following reasons.  1) The issue can be left to network implementation. For example, if NACK-only based feedback is configured, network can avoid configuring BWP inactivity timer if there is mis-alignment issue;  2) For legacy unicast operation, there is also mis-alignment issue. For example, if UE reports NACK for type-1 codebook, network cannot determine whether UE has correctly decoded the PDCCH. |
| Nokia, NSB | We tend to agree with the companies that think that this optimization is not required. |
| Samsung | The issue is known since LTE – it also exists for unicast because NACK/DTX is a single state.  The overall problem is not a major one and does not need to be addressed specifically for multicast (and cannot be solved in general given the absence of NACK/DTX differentiation). |
| Qualcomm | We agree with other companies to deprioritize the optimization only for multicast here. |
| Ericsson | We propose a combination of Alt1 and Alt2:  For ACK/NACK feedback the UE always resets the timer when receiving a GC-PDCCH. This is the behaviour according to existing agreements. We wish to keep this.  For NACK-only or no feedback, the UE is RRC configured to either reset the timer or not when receiving a GC-PDCCH.  When the UE is RRC configured not to reset the timer, when receiving GC-PDCCH, it will fall back to the default BWP when the timer expires. If the multicast CFR fits within, and is also configured on, the default BWP the UE can safely continue receiving the multicast there (albeit with a short interruption) and the network will all the time know which BWP the UE uses.  The assumption that the multicast CFR matches the default BWP may however not always be valid. In such cases the UE may rather stay on the active BWP while receiving multicast and there is then a need to reset the inactivity timer. This could be useful also for the use case with no ACK/NACK feedback, despite the less-than-perfect timer synch between network and UE:  Consider e.g. a use case with a one second inactivity timer, no unicast and a UE receiving MCPTT voice with 50 PDCCHs per second. It is then very unlikely that the UE would miss all 50 PDCCHs, which would make the inactivity timer expire. The UE will therefore, with very high probability, stay in the active BWP throughout the MBS session, but when it is over (assuming still no unicast) the UE will move to the default BWP. There is therefore a clear benefit of the timer reset in this case.  There seems thus to be room for both type of configurations (resetting and not resetting the inactivity timer) for UEs without ACK/NACK feedback. |
| CATT | HARQ feedback disable is also supported for NTN, the BWP-InactiveTimer issue proposed by vivo will happen in unicast transmission as well. We suggest to follow the same design of BWP-InactiveTimer with the NTN. |
| TD Tech, Chengdu TD Tech | No further optimization is needed |
| Moderator | Based on comments,   * 2 companies [vivo, Ericsson] think further optimization is needed, * but most companies [LG, NTT DoCoMo, Huawei, Xiaomi, OPPO, Lenovo, Apple, ZTE, Nokia, Samsung, Qualcomm] think further optimization is not necessary.   Considering the situation, moderator suggests to stop the discussion. |
| vivo | We admit that the issue also exists in unicast because NACK/DTX share the same state, but we think the issue is much more serious for multicast with NACK-only or no feedback. During the previous discussion, companies argued that if there is no unicast reception for a long duration, UE will switch to default/initial BWP if option 1/2 is not supported. That will have impact on multicast reception. So option 1 is agreed. Then, in that case, if there is no unicast reception for a long duration, and multicast reception is configured with NACK only or no feedback. Then the network will not know which BWP the UE uses.  Some company comment that if NACK-only based feedback is configured, network can avoid configuring BWP inactivity timer if there is mis-alignment issue. However, the benefit of introducing BWP inactivity timer is lost. Even for unicast reception, timer-based BWP switching is not used, which will increase UE’s power consumption.  Some company suggest to follow the same design of BWP-InactiveTimer with the NTN. However, for all I know, there is no such discussion in NTN until now. the issue has to be discussed in either session of MBS or NTN. |

# Issue #2: Configurations for GC-PDCCH

## Background and submitted proposals

### Issue#2-1) RRC parameters

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| **Company** | **Proposals** |
| **Huawei** | **Proposal 1: Inform RAN2 that the following parameters are NOT needed for PDCCH-Config for multicast:**   * + **downlinkPreemption**   + **tpc-PUCCH**   + **tpc-PUSCH**   + **tpc-SRS**   + **uplinkCancellation-r16**   + **monitoringCapabilityConfig-r16 (the default is R15monitoringcapablity)**   + **searchSpaceSwitchConfig-r16** |

### Issue#2-2) DCI formats

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| --- | --- |
| **Company** | **Proposals** |
| **NTT DOCOMO** | **Proposal 3: priorityIndicatorDCI-4-2 can be configured for UEs that do not support priority indication for multicast in DCI.**   * **A UE that does not support priority indication for multicast in DCI ignores ‘priority indicator’ field in DCI format 4\_2.**   **Proposal 4: dl-DataToUL-ACK in PUCCH-Config-Multicast1 can be configured for UEs that do not support HARQ-ACK feedback for multicast**   * **A UE that does not support HARQ-ACK feedback for multicast ignores ‘PDSCH-to-HARQ\_feedback timing indicator’ field in DCI format 4\_2.**   **Proposal 5: The size of ‘Downlink assignment index’ in DCI format 4\_2 is explicitly configured in a CFR**   * **A UE not configured with Type-2 HARQ-ACK codebook for multicast ignores the field.** |
| **Intel** | **Proposal 4: When HARQ feedback is disabled by RRC, the following fields of DCI format 4\_1 can be assumed to be reserved:**   * + **PUCCH resource Indicator**   + **PDSCH-to-HARQ timing indicator**   + **TPC command for scheduled PUCCH**   + **HARQ Process Number**   + **New Data Indicator**   + **Redundancy Version** |
| **Xiaomi** | **Proposal 1: If HARQ feedback is disabled, UE ignores the following information fields when interprets DCI format 4\_2:**   * **HARQ process number** * **Downlink assignment index** * **PUCCH resource indicator** * **PDSCH-to-HARQ\_feedback timing indicator** |
| **MTK** | Proposal 3: A new field of “enabling/disabling HARQ-ACK feedback indication” should be defined for DCI format 4\_1. |
| **Lenovo** | **Proposal 1: HARQ process number in DCI format 4-1 comprises 4 bits to support maximum 16 HARQ processes.**  **Proposal 2: Support one-bit enabling/disabling HARQ-ACK feedback indication in multicast DCI format 4-1.**  **Proposal 3: For Type-1 HARQ-ACK codebook determination, DAI in multicast DCI format 4-1 is reserved.**  **Proposal 4: For Type-2 HARQ-ACK codebook determination, DAI in multicast DCI format 4-1 is used as counter DAI as legacy operation.** |

### Issue#2-3) DCI size alignment

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| **Company** | **Proposals** |
| **vivo** | Proposal 7: For DCI size alignment of the second DCI format for multicast, the size of the second DCI format for multicast can be configured by RRC signaling for RRC\_CONNECTED UEs (similar as the configuration for the size alignment among DCI format 2\_0/2\_1/2\_4/2\_5/2\_6).  **  If the size of the second DCI format for multicast configured by RRC signaling or derived based on RRC configurations equals the size of DCI format 2\_0/2\_1/2\_4/2\_5/2\_6 or none of the size of DCI format 2\_0/2\_1/2\_4/2\_5/2\_6 is configured, when the total number of different DCI sizes configured to monitor is more than 4, Alt 2 applies; otherwise, Alt 1-1 applies.**  **  Alt 1-1: G-RNTI is counted as “C-RNTI” when checking the “3+1” DCI size budget**  ** The size of DCI format 1\_1 or DCI format 1\_2 which has smaller DCI size difference with the size of second DCI is aligned to the size of the second DCI format for multicast by zero padding.**  **  Alt 2: G-RNTI is counted as “other RNTI” when checking the “3+1” DCI size budget.**  Proposal 8: To ensure different UEs in the same MBS group have the same understanding on the configurable DCI fields of the second DCI format for multicast, the size of some configurable fields of the second DCI format should be explicitly configured by gNB. |
| **CATT** | **Proposal 1:** **For the DCI size alignment of the DCI format 4\_2,** **the G-RNTI is counted as ‘C-RNTI’.**   * **Zeros shall be appended to DCI format 1\_1 or DCI format 1\_2, which has smaller size than DCI format 4\_2 and has smaller size difference with DCI format 4\_2, until its size equals the size of DCI format 4\_2.** |
| **Apple** | **Proposal 3: The DCI format 4\_2 can be configured with the same size as DCI format 2\_x.** |
| **MTK** | Proposal 4: “G-RNTI” is counted as “other RNTI” for multicast DCI format 4\_2. |
| **Lenovo** | **Proposal 6: For DCI size alignment,** **G-RNTI for the DCI format 4-1 is counted as C-RNTI.**  **Proposal 7: For DCI size alignment, G-RNTI for the DCI format 4-2** **is counted as other RNTI.** |
| **Ericsson** | **Proposal 7 The G-RNTI is counted as “C-RNTI” when considering the “3+1” DCI size budget rule for group-common PDCCH.**  **Proposal 8 Add the following steps 2B and 4D in the DCI alignment procedure:**  **Step 2B:**  **Determine DCI format 4\_2 monitored in a UE-specific search space according to clause 7.3.1.5.3**  **Step 4D:**  **If the total number of different DCI sizes configured to monitor is more than 4 for the cell after applying the above steps, or if the total number of different DCI sizes with C-RNTI or G-RNTI configured to monitor is more than 3 for the cell after applying the above steps**  **- If the number of information bits in the DCI format 0\_1 is less than the payload size of the DCI format 4\_2 for scheduling the same serving cell, a number of zero padding bits are generated for the DCI format 0\_1 until the payload size equals that of the DCI format 4\_2.**  **- If the number of information bits in the DCI format 1\_1 is less than the payload size of the DCI format 4\_2 for scheduling the same serving cell, a number of zero padding bits are generated for the DCI format 1\_1 until the payload size equals that of the DCI format 4\_2.**  **Proposal 9 The UE does not expect to be configured in a way where the DCI size for format 1\_1 is larger than DCI format 4\_2.** |

### Issue#2-4) Search space set for multicast

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| **Company** | **Proposals** |
| **Huawei** | **Observation: There is no need to support configuring DCI format 1\_0 in CSS for multicast.** |
| **vivo** | Proposal 5: For search space set of group-common PDCCH of PTM scheme 1 for multicast in RRC\_CONNECTED state, only DCI formats with CRC scrambled with g-RNTI for multicast scheduling can be monitored in type-x search space. |
| **OPPO** | 1. **DCI format 1\_0 scheduling PTP reTx of multicast or (re)Tx of unicast can be configured in the same CSS configuration with multicast DCI formats 4\_1/4\_2.** |
| **Samsung** | **Proposal 3: *searchSpace-Multicast* includes the optional configuration of *dci-Format0-0-AndFormat1-0*.**  **Proposal 4: *searchSpace-Multicast* includes one or both of DCI format 4\_1 and DCI format 4\_2.** |
| **MTK** | Proposal 2: Unicast DCI format (e.g., DCI 1\_0/0\_0) cannot be configured in the same CSS configuration with multicast DCI formats. |
| **Qualcomm** | **Proposal 5: For RRC\_CONNECTED UEs, Type-x CSS is configured for MBS DCI formats only.**   * DCI format 1\_0 with C-RNTI and MBS DCI formats are not configured in the same Type-x CSS   **Proposal 6: For RRC\_CONNECTED UEs, a multicast PDCCH to schedule a multicast PDSCH is counted as a unicast DCI to schedule a unicast PDSCH.**   * **Endorse TP#3 for TS38.213.**  TP#3 for TS38.213:10.1 UE procedure for determining physical downlink control channel assignment \*\*\* Unchanged text is omitted \*\*\*  For a scheduled cell and at any time, a UE expects to have received at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, G-RNTI, G-CS-RNTI or MCS-C-RNTI scheduling 16 PDSCH receptions for which the UE has not received any corresponding PDSCH symbol and at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, or MCS-C-RNTI scheduling 16 PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol.  \*\*\* Unchanged text is omitted \*\*\* |
| **Lenovo** | **Proposal 8: For multicast reception, DCI format 1\_0 scheduling PTP-based retransmission of multicast can be configured in the same CSS configuration with multicast DCI formats.**  **Proposal 9: DCI format 1\_0 scheduling initial transmission or retransmission of unicast can’t be configured in the same CSS configuration with multicast DCI formats.** |

### Issue#2-5) TCI states for GC-PDCCH

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| **Company** | **Proposals** |
| **Spreadtrum** | **Proposal 1: In overlapping PDCCH monitoring occasions in multiple CORESETs that have same or different QCL-TypeD properties on active DL BWP(s) of one or more cells, the monitoring priority of CORESET assocaited with Type-3 CSS for DCI format 4-1 and 4-2 is determined based on the search space set indexes of the Type-3 CSS set for DCI format 4-1 and 4-2 and USS sets for a serving cell.** |
| **Samsung** | **Proposal 5: The search space set prioritization for PDCCH monitoring is same for the overbooking procedure and for determining CORESETs with different TCI states.** |
| **LG** | **Observation 2: RAN1 should clarify whether the existing MAC CE for unicast PDCCH can be also applied to multicast PDCCH, especially when unicast CORESET is used for multicast PDCCH as well as unicast PDCCH.**  **Proposal 3: For a CORESET shared by unicast and multicast, the existing the TCI State Indication for UE-specific PDCCH MAC CE over unicast PDSCH can be also applied to multicast PDCCH on the CORESET.**  **Proposal 4: For a CORESET configured in PDCCH-Config-Multicast, if the TCI State Indication for UE-specific PDCCH MAC CE over unicast PDSCH indicates the CORESET ID,**   * **Option 1: UE expects that the existing the TCI State Indication for UE-specific PDCCH MAC CE does not indicate the CORESET ID for multicast.** * **Option 2: the existing the TCI State Indication for UE-specific PDCCH MAC CE can be also applied to the CORESET ID for multicast.** |
| **Ericsson** | **Proposal 14 The TCI state for PDCCH is configured via the TCI State Indication for UE-specific PDCCH MAC CE, using a group PDSCH scrambled by G-RNTI.** |

### Issue#2-6) TP corrections

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| **Company** | **Proposals** |
| **ZTE** | **Proposal 5: Adopt the following TP for Clause 7.3.1.5.2 in TS38.212\_h00.**   |  | | --- | | 7.3.1.5.2 Format 4\_1 **<Unchanged parts are omitted>**  - Reserved bits – 3 bits  ~~- Padding bits, if required~~  ~~Zeros shall be appended to DCI format 4\_1 until the payload size equals that of DCI format 1\_0 monitored in common search space in the same serving cell.~~  **<Unchanged parts are omitted>** | |
| **NTT DOCOMO** | **Proposal 7: Adopt the following text proposal in TS 38.212 Section 7.3.1.5.3 to correct the RRC parameter name and DCI format.**  --- **Start of Text proposal to 7.3.1.5.3 of 38.212** -----------------------------------------------  <Unchanged text omitted>  - Downlink assignment index – number of bits as defined in the following  - 4 bits if more than one serving cell are configured in the DL for multicast and the higher layer parameter *pdsch-HARQ-ACK-Codebook-Multicast=dynamic*, where the 2 MSB bits are the counter DAI and the 2 LSB bits are the total DAI;  - 2 bits if only one serving cell is configured in the DL for multicast and the higher layer parameter *pdsch-HARQ-ACK-Codebook-Multicast=dynamic*, where the 2 bits are the counter DAI;  - 0 bits otherwise.  If the UE is configured with a PUCCH-SCell, the number of serving cells is determined within a PUCCH group.  If the UE is configured with a PUCCH-SCell, *pdsch-HARQ-ACK-Codebook* is replaced by *pdsch-HARQ-ACK-Codebook-secondaryPUCCHgroup-r16* if present for the secondary PUCCH group.  If higher layer parameter *priorityIndicatorDCI-4-2~~1-1~~* is configured in *PDSCH-Config-Multicast*, if the bit width of the Downlink assignment index in DCI format 4\_2~~1\_1~~ for one HARQ-ACK codebook is not equal to that of the Downlink assignment index in DCI format 4\_2~~1\_1~~ for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller Downlink assignment index until the bit width of the Downlink assignment index in DCI format 4\_2~~1\_1~~ for the two HARQ-ACK codebooks are the same.  - PUCCH resource indicator – 3 bits as defined in Clause 9.2.3 of [5, TS 38.213]  - PDSCH-to-HARQ\_feedback timing indicator – 0, 1, 2, or 3 bits as defined in Clause 9.2.3 of [5, TS 38.213]. The bitwidth for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *dl-DataToUL-ACK* in *PUCCH-Config-Multicast1* if configured or *PUCCH-Config-Multicast2* if configured; otherwise, *I* is the number of entries in the higher layer parameter *dl-DataToUL-ACK* in *PUCCH-Config.*  If higher layer parameter *priorityIndicatorDCI-4-2~~1-1~~* is configured in *PDSCH-Config-Multicast*, if the bit width of the PDSCH-to-HARQ\_feedback timing indicator in DCI format 4\_2~~1\_1~~ for one HARQ-ACK codebook is not equal to that of the PDSCH-to-HARQ\_feedback timing indicator in DCI format 4\_2~~1\_1~~ for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller PDSCH-to-HARQ\_feedback timing indicator until the bit width of the PDSCH-to-HARQ\_feedback timing indicator in DCI format 4\_2~~1\_1~~ for the two HARQ-ACK codebooks are the same.  - Antenna port(s) – 4, 5, or 6 bits as defined by Tables 7.3.1.2.2-1/2/3/4, where the number of CDM groups without data of values 1, 2, and 3 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively. The antenna ports shall be determined according to the ordering of DMRS port(s) given by Tables 7.3.1.2.2-1/2/3/4.  If a UE is configured with both *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB*, the bitwidth of this field equals , where is the "Antenna ports" bitwidth derived according to *dmrs-DownlinkForPDSCH-MappingTypeA* and is the "Antenna ports" bitwidthderived according to *dmrs-DownlinkForPDSCH-MappingTypeB*. A number of zeros are padded in the MSB of this field, if the mapping type of the PDSCH corresponds to the smaller value of and .  - Transmission configuration indication – 0 bit if higher layer parameter *tci-PresentInDCI* in *PDCCH-Config-Multicast* is not enabled; otherwise 3 bits as defined in Clause 5.1.5 of [6, TS38.214].  - DMRS sequence initialization – 1 bit.  - Priority indicator – 0 bit if higher layer parameter *priorityIndicatorDCI-4-2~~1-1~~* is not configured in *PDSCH-Config-Multicast*; otherwise 1 bit as defined in Clause 9 in [5, TS 38.213].  - Enabling/disabling HARQ-ACK feedback indication –1 bit if higher layer parameter *harq-FeedbackEnabler-Multicast* indicates *dci-enabler*; 0 bit, otherwise.  <Unchanged text omitted>  ------------------------------------------------------------------- **End of Text proposal to 7.3.1.5.3 of 38.212** ------------------------------------------------ |
| **Spreadtrum** | **Proposal 2: Suggest to adopt the following text proposal in 38.213**  ------------------------------------------Start of Text Proposal#1 for TS 38.213-------------------------------------- 10.2 PDCCH validation for DL SPS and UL grant Type 2 A UE validates, for scheduling activation or scheduling release, a DL SPS assignment PDCCH or a configured UL grant Type 2 PDCCH if  - the CRC of a corresponding DCI format is scrambled with a CS-RNTI provided by *cs-RNTI*, or a  G-CS-RNTI provided by g-cs-RNTI, and  -----------------------------Unchanged part omitted--------------------------  Table 10.2-1: Special fields for single DL SPS or single UL grant Type 2 scheduling activation PDCCH validation when a UE is provided a single SPS PDSCH or UL grant Type 2 configuration in the active DL/UL BWP of the scheduled cell   |  |  |  |  | | --- | --- | --- | --- | |  | DCI format 0\_0/0\_1/0\_2 | DCI format 1\_0/1\_2/4\_1 | DCI format 1\_1/4\_2 | | HARQ process number | set to all '0's | set to all '0's | set to all '0's | | Redundancy version | set to all '0's | set to all '0's | For the enabled transport block: set to all '0's |   Table 10.2-2: Special fields for single DL SPS or single UL grant Type 2 scheduling release PDCCH validation when a UE is provided a single SPS PDSCH or UL grant Type 2 configuration in the active DL/UL BWP of the scheduled cell   |  |  |  | | --- | --- | --- | |  | DCI format 0\_0/0\_1/0\_2 | DCI format 1\_0/1\_1/1\_2/4\_1/4\_2 | | HARQ process number | set to all '0's | set to all '0's | | Redundancy version | set to all '0's | set to all '0's | | Modulation and coding scheme | set to all '1's | set to all '1's | | Frequency domain resource assignment | set to all '0's for FDRA Type 2 with  set to all '1's, otherwise | set to all '0's for FDRA Type 0 or for *dynamicSwitch*  set to all '1's for FDRA Type 1 |   Table 10.2-3: Special fields for a single DL SPS or single UL grant Type 2 scheduling activation PDCCH validation when a UE is provided multiple DL SPS or UL grant Type 2 configurations in the active DL/UL BWP of the scheduled cell   |  |  |  |  | | --- | --- | --- | --- | |  | DCI format 0\_0/0\_1/0\_2 | DCI format 1\_0/1\_2/4\_1 | DCI format 1\_1/4\_2 | | Redundancy version | set to all '0's | set to all '0's | For the enabled transport block: set to all '0's |   Table 10.2-4: Special fields for a single or multiple DL SPS and UL grant Type 2 scheduling release PDCCH validation when a UE is provided multiple DL SPS or UL grant Type 2 configurations in the active DL/UL BWP of the scheduled cell   |  |  |  | | --- | --- | --- | |  | DCI format 0\_0/0\_1/0\_2 | DCI format 1\_0/1\_1/1\_2/4\_1/4\_2 | | Redundancy version | set to all '0's | set to all '0's | | Modulation and coding scheme | set to all '1's | set to all '1's | | Frequency domain resource assignment | set to all '0's for FDRA Type 2 with  set to all '1's, otherwise | set to all '0's for FDRA Type 0 or for *dynamicSwitch*  set to all '1's for FDRA Type 1 |   ------------------------------------------End of Text Proposal#1 for TS 38.213-------------------------------------- |
| **CMCC** | **Proposal 2. The TP suggestion for TS 38.212 section 7.3.1.5.3 is as the following:**  7.3.1.5.3 Format 4\_2  **<**Unchanged text is omitted>  - Downlink assignment index – number of bits as defined in the following  - 4 bits if more than one serving cell are configured in the DL for multicast and the higher layer parameter *pdsch-HARQ-ACK-Codebook-Multicast=dynamic*, where the 2 MSB bits are the counter DAI and the 2 LSB bits are the total DAI;  - 2 bits if only one serving cell is configured in the DL for multicast and the higher layer parameter *pdsch-HARQ-ACK-Codebook-Multicast=dynamic*, where the 2 bits are the counter DAI;  - 0 bits otherwise.  If the UE is configured with a PUCCH-SCell, the number of serving cells is determined within a PUCCH group.  If the UE is configured with a PUCCH-SCell, *pdsch-HARQ-ACK-Codebook* is replaced by *pdsch-HARQ-ACK-Codebook-secondaryPUCCHgroup-r16* if present for the secondary PUCCH group.  If higher layer parameter *priorityIndicatorDCI-4-2* is configured in *PDSCH-Config-Multicast*, if the bit width of the Downlink assignment index in DCI format 4\_2 for one HARQ-ACK codebook is not equal to that of the Downlink assignment index in DCI format 4\_2 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller Downlink assignment index until the bit width of the Downlink assignment index in DCI format 4\_2 for the two HARQ-ACK codebooks are the same.  - PUCCH resource indicator – 3 bits as defined in Clause 9.2.3 of [5, TS 38.213]  - PDSCH-to-HARQ\_feedback timing indicator – 0, 1, 2, or 3 bits as defined in Clause 9.2.3 of [5, TS 38.213]. The bitwidth for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *dl-DataToUL-ACK* in *PUCCH-Config-Multicast1* if configured or *PUCCH-Config-Multicast2* if configured; otherwise, *I* is the number of entries in the higher layer parameter *dl-DataToUL-ACK* in *PUCCH-Config.*  If higher layer parameter *priorityIndicatorDCI-4-2* is configured in *PDSCH-Config-Multicast*, if the bit width of the PDSCH-to-HARQ\_feedback timing indicator in DCI format 4\_2 for one HARQ-ACK codebook is not equal to that of the PDSCH-to-HARQ\_feedback timing indicator in DCI format 4\_2 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller PDSCH-to-HARQ\_feedback timing indicator until the bit width of the PDSCH-to-HARQ\_feedback timing indicator in DCI format 4\_2 for the two HARQ-ACK codebooks are the same.  - Antenna port(s) – 4, 5, or 6 bits as defined by Tables 7.3.1.2.2-1/2/3/4, where the number of CDM groups without data of values 1, 2, and 3 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively. The antenna ports shall be determined according to the ordering of DMRS port(s) given by Tables 7.3.1.2.2-1/2/3/4.  If a UE is configured with both *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB*, the bitwidth of this field equals , where is the "Antenna ports" bitwidth derived according to *dmrs-DownlinkForPDSCH-MappingTypeA* and is the "Antenna ports" bitwidthderived according to *dmrs-DownlinkForPDSCH-MappingTypeB*. A number of zeros are padded in the MSB of this field, if the mapping type of the PDSCH corresponds to the smaller value of and .  - Transmission configuration indication – 0 bit if higher layer parameter *tci-PresentInDCI* in *PDCCH-Config-Multicast* is not enabled; otherwise 3 bits as defined in Clause 5.1.5 of [6, TS38.214].  - DMRS sequence initialization – 1 bit.  - Priority indicator – 0 bit if higher layer parameter *priorityIndicatorDCI-4-2* is not configured in *PDSCH-Config-Multicast*; otherwise 1 bit as defined in Clause 9 in [5, TS 38.213].  - Enabling/disabling HARQ-ACK feedback indication –1 bit if higher layer parameter *harq-FeedbackEnabler-Multicast* indicates *dci-enabler*; 0 bit, otherwise.  **<**Unchanged text is omitted> |
| **Qualcomm** | **Proposal 7: Type0B-CSS for *searchSpaceBroadcast* of MCCH/MTCH is configured on PCell.**  **Endorse TP#4 for TS38.213.** TP#4 for TS38.213:10.1 UE procedure for determining physical downlink control channel assignment A set of PDCCH candidates for a UE to monitor is defined in terms of PDCCH search space sets. A search space set can be a CSS set or a USS set. A UE monitors PDCCH candidates in one or more of the following search spaces sets  - a Type0-PDCCH CSS set on the primary cell of the MCG configured by  - *pdcch-ConfigSIB1* in *MIB* or by *searchSpaceSIB1* in *PDCCH-ConfigCommon* or by *searchSpaceZero* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a SI-RNTI, or  - *searchSpaceZero* in *PDCCH-ConfigCommon*, when *pdcch-Config-MCCH* and *pdcch-Config-MTCH* are provided, for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI  - a Type0A-PDCCH CSS set configured by *searchSpaceOtherSystemInformation* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a SI-RNTI on the primary cell of the MCG  - a Type0B-PDCCH CSS set configured by *searchSpaceBroadcast* in *pdcch-Config-MCCH* and *pdcch-Config-MTCH* for a DCI format with CRC scrambled by a MCCH-RNTI or a G-RNTI on the primary cell of the MCG  - a Type1-PDCCH CSS set configured by *ra-SearchSpace* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a RA-RNTI, a MsgB-RNTI, or a TC-RNTI on the primary cell  - a Type1A-PDCCH CSS set configured by *sdt-SearchSpace* in *PDCCH-ConfigCommon* for a DCI format with CRC scrambled by a C-RNTI or a CS-RNTI on the primary cell as described in clause 19.1  - a Type2-PDCCH CSS set configured by *pagingSearchSpace* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a P-RNTI on the primary cell of the MCG  - a Type2A-PDCCH CSS set configured by *peiSearchSpace* in *DownlinkConfigCommonSIB* for a DCI format 2\_7 with CRC scrambled by a RNTI on the primary cell of the MCG  - a Type3-PDCCH CSS set configured by  - *SearchSpace* in *PDCCH-Config* with *searchSpaceType* = *common* for DCI formats with CRC scrambled by INT-RNTI, SFI-RNTI, TPC-PUSCH-RNTI, TPC-PUCCH-RNTI, TPC-SRS-RNTI, or CI-RNTI and, only for the primary cell, C-RNTI, MCS-C-RNTI, CS-RNTI(s), or PS-RNTI, or  - *SearchSpace-Multicast* in *PDCCH-Config-Multicast* for DCI formats with CRC scrambled by G-RNTI, or G-CS-RNTI, or  - *searchSpaceBroadcast* in *pdcch-Config-MCCH* and *pdcch-Config-MTCH* on a secondary cell for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI, and  \*\*\* Unchanged text is omitted \*\*\*  If the active DL BWP and an MBS frequency resource provided by *cfr-Config-MCCH-MTCH* for a UE have same SCS and same CP length and the active DL BWP includes all RBs of the MBS frequency resource, and if the UE is provided *searchSpaceBroadcast*, the UE monitors PDCCH for *searchSpaceBroadcast* on the active DL BWP.  \*\*\* Unchanged text is omitted \*\*\* |
| **Google** | **Proposal 2: For the description of DCI format 4\_2, change the description of “*priorityIndicator*DCI-1-1” and “DCI format 1\_1” to “*priorityIndicatorDCI-4-2*” and “DCI format 4\_2”, respectively.**  < Start of text proposal >  7.3.1.5.3 Format 4\_2  DCI format 4\_2 is used for the scheduling of PDSCH in DL cell.  The following information is transmitted by means of the DCI format 4\_2 with CRC scrambled by G-RNTI configured by *G-RNTI-Config* or G-CS-RNTI:  \*\*\* Unchanged text omitted \*\*\*  - Downlink assignment index – number of bits as defined in the following  - 4 bits if more than one serving cell are configured in the DL for multicast and the higher layer parameter *pdsch-HARQ-ACK-Codebook-Multicast=dynamic*, where the 2 MSB bits are the counter DAI and the 2 LSB bits are the total DAI;  - 2 bits if only one serving cell is configured in the DL for multicast and the higher layer parameter *pdsch-HARQ-ACK-Codebook-Multicast=dynamic*, where the 2 bits are the counter DAI;  - 0 bits otherwise.  If the UE is configured with a PUCCH-SCell, the number of serving cells is determined within a PUCCH group.  If the UE is configured with a PUCCH-SCell, *pdsch-HARQ-ACK-Codebook* is replaced by *pdsch-HARQ-ACK-Codebook-secondaryPUCCHgroup-r16* if present for the secondary PUCCH group.  If higher layer parameter *priorityIndicatorDCI-4-2* is configured in *PDSCH-Config-Multicast*, if the bit width of the Downlink assignment index in DCI format 4\_2 for one HARQ-ACK codebook is not equal to that of the Downlink assignment index in DCI format 4\_2 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller Downlink assignment index until the bit width of the Downlink assignment index in DCI format 4\_2 for the two HARQ-ACK codebooks are the same.  - PUCCH resource indicator – 3 bits as defined in Clause 9.2.3 of [5, TS 38.213]  - PDSCH-to-HARQ\_feedback timing indicator – 0, 1, 2, or 3 bits as defined in Clause 9.2.3 of [5, TS 38.213]. The bitwidth for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *dl-DataToUL-ACK* in *PUCCH-Config-Multicast1* if configured or *PUCCH-Config-Multicast2* if configured; otherwise, *I* is the number of entries in the higher layer parameter *dl-DataToUL-ACK* in *PUCCH-Config.*  If higher layer parameter *priorityIndicatorDCI-4-2* is configured in *PDSCH-Config-Multicast*, if the bit width of the PDSCH-to-HARQ\_feedback timing indicator in DCI format 4\_2 for one HARQ-ACK codebook is not equal to that of the PDSCH-to-HARQ\_feedback timing indicator in DCI format 1\_1 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller PDSCH-to-HARQ\_feedback timing indicator until the bit width of the PDSCH-to-HARQ\_feedback timing indicator in DCI format 4\_2 for the two HARQ-ACK codebooks are the same.  - Antenna port(s) – 4, 5, or 6 bits as defined by Tables 7.3.1.2.2-1/2/3/4, where the number of CDM groups without data of values 1, 2, and 3 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively. The antenna ports shall be determined according to the ordering of DMRS port(s) given by Tables 7.3.1.2.2-1/2/3/4.  If a UE is configured with both *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB*, the bitwidth of this field equals , where is the "Antenna ports" bitwidth derived according to *dmrs-DownlinkForPDSCH-MappingTypeA* and is the "Antenna ports" bitwidthderived according to *dmrs-DownlinkForPDSCH-MappingTypeB*. A number of zeros are padded in the MSB of this field, if the mapping type of the PDSCH corresponds to the smaller value of and .  - Transmission configuration indication – 0 bit if higher layer parameter *tci-PresentInDCI* in *PDCCH-Config-Multicast* is not enabled; otherwise 3 bits as defined in Clause 5.1.5 of [6, TS38.214].  - DMRS sequence initialization – 1 bit.  - Priority indicator – 0 bit if higher layer parameter *priorityIndicatorDCI-4-2* is not configured in *PDSCH-Config-Multicast*; otherwise 1 bit as defined in Clause 9 in [5, TS 38.213].  - Enabling/disabling HARQ-ACK feedback indication –1 bit if higher layer parameter *harq-FeedbackEnabler-Multicast* indicates *dci-enabler*; 0 bit, otherwise.  < End of text proposal > |

### Issue#2-7) Others (L)

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| **OPPO** | 1. **The budget of BDs/CCEs of an unused CC can be used for group-common PDCCH to count the number of BDs/CCEs for UEs supporting CA capability based on configuration.** |
| **Xiaomi** | **Proposal 2: When UE monitors MBS DCI and unicast DCI in the same slot or same span, and the number of expected DCI is larger than the cap defined by the UE capability:**   * **UE processes DCI in CSS firstly.**   + **The CSS with lower SS ID has higher priority.**  1. **If the number of detected multicast DCI does not exceeds UE capability, UE continues PDCCH monitoring in USS.** |
| **Samsung** | **Proposal 6: RAN1 to conclude whether or not a UE performs the overbooking procedure for *searchSpace-Broadcast* in the RRC\_INACTIVE state.** |
| **LG** | Proposal 7: The maximum BD/CCE numbers are increased as R times and R times for a serving cell supporting multicast reception, where and  are defined in Table 10.1-2 and Table 10.1-3 in 38.213   * + R is a value reported by the UE as part of MBS related UE capability, regardless of whether UE supports CA capability. |

## Issue#2-1) RRC parameters

### Summary

1 company [Huawei] proposes to inform RAN2 which parameters are not needed in PDCCH-config for multicast, the reason is quoted as the following:

“*RAN2 has already implemented in the TS38.331 running CR [1] that some parameters are noted that they are not configured in the case of PDCCH configuration for MBS multicast, e.g., tpc-PUCCH, tpc-PUSCH, tpc-SRS, etc. However, such parameters are not included in the RRC parameters list sent to RAN2 [2].*

*As concluded in RAN1, if parameters are not included in the RRC parameters list, they are the ones with the same default values as that in dedicated unicast BWP.*

|  |
| --- |
| ***Conclusion***  *For the RRC parameters that can be configured in PDSCH-Config / PDCCH-Config / SPS-Config in Rel-15/16, they can also be configured in PDSCH-Config-Multicast / PDCCH-Config-Multicast / SPS-Config-Multicast.*   * *If some of these RRC parameters need changes for multicast reception (e.g., modify the default values, delete some useless parameters), RAN1 will list them explicitly in the RRC parameter list that will be sent to RAN2.* * *For other RRC parameters that do not need changes for multicast reception, RAN1 will not list them with postfix ‘-Multicast’ one by one in the RRC parameter list that will be sent to RAN2, and the default values of these parameters are the same as the default values of the corresponding parameters in dedicated unicast BWP.* |

*However, from RAN2 perspective, given they have identified some parameters are clearly NOT needed for multicast but not included in the RRC parameters list sent to RAN2, it is not clear to RAN2,* *among those parameters not included in the RRC parameters list, what parameters are not needed and what parameters are needed but without special default values.”*

Moderator suggests the **initial proposal 2-1a**. If we make such agreement, we can send an LS to RAN2. It should be noted that, as guided by Chairman, the Rel-17 related outgoing LS needs to be finalized before the end of 1st Week of RAN1#108-e meeting.

### 1st Round Proposals (Closed)

**Initial proposal 2-1a:**

Send an LS to inform RAN2 that the following parameters are NOT needed for PDCCH-Config-Multicast:

* + downlinkPreemption
  + tpc-PUCCH
  + tpc-PUSCH
  + tpc-SRS
  + uplinkCancellation-r16
  + monitoringCapabilityConfig-r16 (the default is *R15monitoringcapablity*)
  + searchSpaceSwitchConfig-r16

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Spreadtrum | Support |
| vivo | Ok with the proposal. |
| NTT DOCOMO | Support |
| Huawei, HiSilicon | agree |
| Xiaomi | We are fine with the proposal. |
| OPPO | OK with the proposal. |
| Lenovo, Motorola Mobility | OK |
| Apple | OK with this proposal |
| ZTE | OK |
| Nokia, NSB | We are fine with the proposal |
| Samsung | OK |
| Qualcomm | Ok in principle |
| Ericsson | Support |
| CATT | We are OK with the initial proposal 2-1a. |
| MediaTek | Support |
| No further optimization is needed | Ok |
| Moderator | Stable.  I moved the proposal to section 7. |

## Issue#2-2) DCI formats

### Summary

2 companies [Intel, Xiaomi] propose the HARQ related fields are reserved when HARQ-ACK feedback is disabled and UE ignores these fields. Moderator thinks it should be the common understanding, and suggests **initial proposal 2-2a** to clarify it as a conclusion.

1 company [NTT DOCOMO] raises that, priority indication for multicast in DCI is supported subject to UE capability, and the presence of ‘priority indicator’ in DCI format 4\_2 depends on *priorityIndicatorDCI-4-2*, so the position of ‘Enabling/disabling HARQ-ACK feedback indication’ in DCI format 4\_2 depends on the presence of ‘priority indicator’. If *priorityIndicatorDCI-4-2* can be configured only for UEs that support priority indication for multicast in DCI, gNB may have to send two DCI format 4\_2, one with ‘priority indicator’ and one without, to UEs that support and do not support priority indication for multicast in DCI. To avoid the problem, *priorityIndicatorDCI-4-2* should also be configurable for UEs that do not support priority indication for multicast in DCI. UEs that do not support priority indication for multicast in DCI should just ignore the field. Similar proposals are also proposed regarding ‘PDSCH-to-HARQ\_feedback timing indicator’ and ‘Downlink assignment index’ fields.

However, in my understanding, there are three kinds of UEs: 1) UEs that support priority indication and are configured with *priorityIndicatorDCI-4-2*; 2) UEs that support priority indication but are not configured with *priorityIndicatorDCI-4-2*;(3)UEs that do not support priority indication. For the 1st kind of UEs, the ‘priority indicator’ in DCI format 4\_2 is present, and for both 2nd and 3rd kinds of UEs, the ‘priority indicator’ in DCI format 4\_2 is not present. Even *priorityIndicatorDCI-4-2* is allowed to be configurable for UEs that do not support priority indication for multicast in DCI, there may still be UEs that support priority indication but are not configured with *priorityIndicatorDCI-4-2*, for which the ‘priority indicator’ in DCI format 4\_2 is not present. More views on the necessity of this kind of optimization are needed. Moderator suggests **initial question 2-2b.** Regarding the proposal that the size of ‘Downlink assignment index’ in DCI format 4\_2 is explicitly configured in a CFR, and a UE not configured with Type-2 HARQ-ACK codebook for multicast ignores the field, it seems the proposal is based on a prerequisite that different codebook types can be configured for different UEs in the same group, which needs to be first agreed.

2 companies [Lenovo, MediaTek] propose to introduce 1-bit ‘Enabling/disabling HARQ-ACK feedback indication’ in multicast DCI format 4-1. Moderator suggests to discuss this issue in AI 8.12.2.

### 1st Round Proposals (Closed)

**Initial proposal 2-2a (for conclusion):**

When HARQ feedback is disabled, the following fields of DCI format 4\_1/4\_2 can be assumed to be reserved and UE ignores them:

* New Data Indicator
* Redundancy Version
* HARQ Process Number
* PUCCH resource Indicator
* PDSCH-to-HARQ\_feedback timing indicator

**Initial question 2-2b:**

What’s your views on the following proposals?

* *priorityIndicatorDCI-4-2* can be configured for UEs that do not support priority indication for multicast in DCI.
  + A UE that does not support priority indication for multicast in DCI ignores ‘priority indicator’ field in DCI format 4\_2.
* *dl-DataToUL-ACK* in PUCCH-Config-Multicast1 can be configured for UEs that do not support HARQ-ACK feedback for multicast.
  + A UE that does not support HARQ-ACK feedback for multicast ignores ‘PDSCH-to-HARQ\_feedback timing indicator’ field in DCI format 4\_2.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Spreadtrum | Initial proposal 2-2a: fine with the last 2 bullets. More clarification is needed for the first 3 bullets why they should be ignored when HARQ feedback disabled.  Initial question 2-2b: support both. |
| vivo | Initial proposal 2-2a: Share the same view with Spreadtrum. In addition, considering some of the fields can be absent, it is suggested to modify the main bullet as:  When HARQ feedback is disabled, the following fields (if any) of DCI format 4\_1/4\_2 can be assumed to be reserved and UE ignores them:  Initial question 2-2b: generally fine with the proposal. we are also fine to explicitly configure the size of each field of DCI 4\_2. |
| LG Electronics | Initial proposal 2-2a: the first 3 bullets should not be ignored. |
| NTT DOCOMO | proposal 2-2a: Support  question 2-2b: We believe that these parameters should be able to be configured regardless of UE capability in order to align the recognition of DCI field positions in DCI format 4\_2 among UEs in the same group. |
| Huawei, HiSilicon | Share the same wonder as spreadtrum about the first three bullest for proposal 2-2a.  Regarding the question, we seem to face the same issues as those discussed in AI8.12.2, for example, if UE does not support “enabling/disabling HARQ by DCI”, should the DCI includes the field? As discussed finally to this issue, it ended up gNB implementation to make a proper configuration. |
| Xiaomi | **Initial proposal 2-2a (for conclusion):** support.  **Initial question 2-2b:** we don’t see the necessity of these two proposals. Basically we think it is a UE classification issue, i.e. gNB can make a wise configuration when it scheduling a group of UE. |
| OPPO | Proposal 2-2a: The last two bullets are supported. For the first three bullets, similar view as Spreadtrum, more clarification may be needed. Furthermore, besides ignorance, whether the first three information fields can be interpreted by the UEs for other use?  Question 2-2b: Not necessary. |
| Lenovo, Motorola Mobility | 2-2a: when HARQ-ACK feedback is disabled, only PRI and HARQ timing indicator are useless which can be ignored. For other three fields, they are useful.  2-2b: Agree with two proposals in general. |
| Apple | Ok with proposal 2-2a for conclusion.  For question 2-2b, the proposal sounds reasonable. The two sub-bullet can be updated further   * + A UE that does not support priority indication for multicast in DCI ignores ‘priority indicator’ field in DCI format 4\_2, if *priorityIndicatorDCI-4-2* is configured.   A UE that does not support HARQ-ACK feedback for multicast ignores ‘PDSCH-to-HARQ\_feedback timing indicator’ field in DCI format 4\_2, if *dl-DataToUL-ACK* is configured. |
| ZTE | For initial proposal 2-2a, the NDI, RV and HPN field can still be used even when the HARQ feedback is disabled. For example, network can retransmit one PDSCH without any feedback from UE. Besides, RV is also useful for PDSCH repetition, it is clear RV should not be included in the list.  For Initial question 2-2b: we believe these issue can be left to implementation. For example, network can configure all the UEs supporting prioritization indication in one group. |
| Nokia, NSB | Proposal 2-2a: We also think that the last two fields can be ignored if HARQ feedback is disabled for a UE. We were wondering about the scenario where some other UE sent one NACK and gNB retransmits the TB with the same HARQ process ID, NDI = 0 etc. Can the UE with HARQ disabled decode the retransmission?  Proposal 2-2b: We are fine with the proposal |
| Samsung | No apparent need for proposal 2-2a.  No apparent need for proposal/question 2-2b.  For the first part (priority), what would a UE do if priority is 1? Probably ignore the DCI but then why can’t such UE have a different G-RNTI since the UE does not support the service with priority 1? Similar for the second part (PDSCH-to-HARQ\_feedback timing indicator). |
| Qualcomm | proposal 2-2a: In principle, it is not necessary to discuss whether UE ignore the unused fields or not. Similar as group DCI format 2\_0 or 2-6, which is for multiple UEs, we don’t specify the UE behaviour for ignoring the unused fields.  question 2-2b: We think these fields can be configured to let UE know whether gNB transmitted or not. However, we don’t need to specify the UE behaviour for ignoring the unused fields. |
| Ericsson | 2-2a: Three first fields: Not support. We do not see these fields as “unusued” by a UE not transmitting HARQ. These three fields are very useful also for UEs not sending HARQ feedback. HARQ retransmission via PTM that are triggered by other UEs sending HARQ feedback can still be exploited by a UE not sending HARQ feedback.  Also, with all UEs in a no feedback mode support of these three fields is essential since it allows the network to send multiple transmissions of a TB for enhanced robustness. It should be noted that the time diversity in this way can be much better than with slot-level repetition.  Two last fields: Support  2-2b: Support |
| CATT | **Initial proposal 2-2a:** Share same view with spreadtrum. Only PUCCH resource Indicator and PDSCH-to-HARQ fields of DCI format 4\_1/4\_2 can be reserved and UE ignores them.  Assuming one case that the initial transmission of a TB is scheduled by DCI format 4\_1/4\_2 with enabling HARQ feedback and the retransmission of the TB is scheduled by DCI format 4\_1/4\_2 with disabling HARQ feedback, the MBS UEs require the information of New Data Indicator, Redundancy Version and HARQ Process Number fields to combine the received data with the data in the soft buffer. Therefore, we recommend that the information of New Data Indicator, Redundancy Version and HARQ Process Number fields of DCI format 4\_1/4\_2 will still be transmitted when HARQ feedback is disabled.  **Initial proposal 2-2b:** OK |
| MediaTek | Initial proposal 2-2a: considering the multiple G-RNTI and PDSCH repetition will be configured for multicast reception, we think the first 3 bullets are needed even if the HARQ-ACK is disabled.  Initial question 2-2b: Since the RRC parameter is configured per UE, we think the issue can be avoided by NW configuration. |
| TD Tech, Chengdu TD Tech | **Proposal 2-2a: same view as Spreadtrum, Huawei, ZTE, CATT and so on.**  **Proposal 2-2b: ok** |
| Moderator | **Proposal 2-2a**: Most companies support the last two sub-bullets, but not support the first three sub-bullets. 2 companies [QC, Samsung] think this proposal is not necessary. Moderator suggests to delete the first three sub-bullets. If some companies still think it is not necessary and prefer to not have it, we will stop the discussion.  **Question 2-2b**: 6 companies [Huawei, Xiaomi, OPPO, ZTE, Samsung, MTK] think it can be up to gNB implementation to make a proper configuration. [Qualcomm] does not think we need to specify the UE behaviour for ignoring the unused fields. Considering the situation, Moderator suggests to stop the discussion. |

### 2nd Round Proposals (Closed)

**Updated proposal 2-2a (for conclusion):**

When HARQ feedback is disabled, the following fields (if present) of DCI format 4\_1/4\_2 can be assumed to be reserved and UE ignores them:

* ~~New Data Indicator~~
* ~~Redundancy Version~~
* ~~HARQ Process Number~~
* PUCCH resource Indicator
* PDSCH-to-HARQ\_feedback timing indicator

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Lenovo | Agree. |
| OPPO | Support the proposal. |
| LG Electronics | OK |
| CATT | Agree |
| ZTE | OK |
| vivo | Ok |
| Nokia, NSB | We are fine with the proposal |
| Qualcomm | Our understanding is that the proposal can be a conclusion without spec impact needed. |
| Huawei, HiSilicon | ok |
| NTT DOCOMO | Support |
| Xiaomi | Support |
| MediaTek | Support |
| Spreadtrum | Support |
| Moderator | Stable for more than 24 hours. I moved it to section 7. |

## Issue#2-3) DCI size alignment

### Summary

During RAN1#107bis-e discussion, moderator proposed the following proposal, but companies’ views are divergent. Some companies think the proposal provides more flexibility for network and better performance compared to only supporting Alt-1 or Alt-2, some other companies think that if we don’t have any agreement for this proposal, it basically means Alt.2 is used. Considering that we have agreed that the size of DCI format 4\_2 is configured by RRC signaling, and network can at least align the size of DCI format 4\_2 and DCI format 2\_0/2\_1/2\_4/2\_5/2\_6 if needed by implementation.

**Initial proposal 2-3b (RAN1#107b):**

For DCI size alignment, if the size of the DCI format 4-2 configured by RRC signaling equals the size of DCI format 2\_0/2\_1/2\_4/2\_5/2\_6 or none of the size of DCI format 2\_0/2\_1/2\_4/2\_5/2\_6 is configured, Alt 2 applies; otherwise, Alt 1 applies.

* Alt 1: G-RNTI is counted as “C-RNTI”.
  + Zeros shall be appended to DCI format 1\_1 or DCI format 1\_2, which has smaller size than DCI format 4\_2 and has smaller size difference with DCI format 4\_2, until its size equals the size of DCI format 4\_2.
* Alt 2: G-RNTI is counted as “other RNTI”.

In this meeting, companies’ views are summarized as below based on contributions. The situation does not change much, so moderator suggests no discussion on this.

* Alt 1: G-RNTI is counted as “C-RNTI”
  + Support: CATT, Ericsson
* Alt 2: G-RNTI is counted as “other RNTI”
  + Support: Lenovo, MediaTek, Apple
* Alt 3: G-RNTI is counted as “C-RNTI” or “other RNTI” depending on DCI size conditions
  + Support: vivo

## Issue#2-4) Search space set for multicast

### Summary

It has been discussed in several meetings whether to support configuring DCI format 1\_0 in the same CSS for multicast, but with no conclusion. Based on the contributions submitted in this meeting, 4 companies [Huawei, vivo, MediaTek, Qualcomm] propose DCI format 1\_0 cannot be configured in the CSS for multicast, 2 companies [OPPO, Samsung] propose DCI format 1\_0 scheduling PTP reTx of multicast or (re)Tx of unicast can be configured in the same CSS with multicast, 1 company [Lenovo] proposes only DCI format 1\_0 scheduling PTP-based retransmission of multicast can be configured in the same CSS with multicast. The situation does not change much, moderator suggests deprioritize the discussion. In my understanding, if there is no conclusion on this issue at last, it basically implies that DCI format 1\_0 cannot be configured in the same CSS configuration with multicast DCI formats based on the current 38.331 signalling structure.

1 company [Qualcomm] proposes if a UE is monitoring both unicast and multicast, a multicast PDCCH to schedule a multicast PDSCH can be counted as a unicast DCI and the total number of monitored PDCCH candidates and non-overlapped CCEs is within the Rel-15 UE capability. Moderator suggests the **initial proposal 2-4a**.

### 1st Round Proposals (Closed)

**Initial proposal 2-4a:**

For RRC\_CONNECTED UEs, a multicast PDCCH to schedule a multicast PDSCH is counted as a unicast DCI to schedule a unicast PDSCH.

* Adopt the following TP for Clause 10.1 in TS 38.213:

----------------- Start of TP ----------------

10.1 UE procedure for determining physical downlink control channel assignment

**<**Unchanged text is omitted>

For a scheduled cell and at any time, a UE expects to have received at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, G-RNTI, G-CS-RNTI or MCS-C-RNTI scheduling 16 PDSCH receptions for which the UE has not received any corresponding PDSCH symbol and at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, or MCS-C-RNTI scheduling 16 PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Spreadtrum | Support |
| vivo | ok |
| NTT DOCOMO | OK |
| Huawei, HiSilicon | ok |
| Xiaomi | We are fine with the proposal.  Furthermore, the proposed TP is relevant to the maximum number of buffered DCIs if UE doesn’t receive or transmit any corresponding data channel. The agreement achieved in the last meeting that a multicast DCI should be counted as unciast DCI is more relevant to the number of DCI that a UE can process within a slot or span, which should be reflected in the FG 33-2. |
| OPPO | OK with the proposal. We also share the similar view with Xiaomi on the clarification of the number of DCI that can be processed. |
| Lenovo, Motorola Mobility | Support |
| Apple | OK with the TP |
| ZTE | One question for clarification. Does this include both multicast and broadcast?  If the intention is only for multicast here, then we propose to update ‘G-RNTI’ to ‘G-RNTI for multicast’.  If the intention is for both multicast and broadcast, then the TP seems fine. |
| Nokia, NSB | We are fine with the proposal |
| Samsung | OK in principle.  The case of broadcast should be discussed – we think broadcast should also be included. |
| Qualcomm | Support. |
| Ericsson | Support. Agree with Samsung that the broadcast case should be discussed. |
| CATT | We are ok with the initial proposal 2-4a. For the TP, one thing for clarification is that the G-RNTI is used for scrambling multicast PDCCH. If the Initial proposal 2-4a is supported, we’d like to update the TP as following:  For a scheduled cell and at any time, a UE expects to have received at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, G-RNTI for multicast, G-CS-RNTI or MCS-C-RNTI scheduling 16 PDSCH receptions for which the UE has not received any corresponding PDSCH symbol and at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, or MCS-C-RNTI scheduling 16 PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol. |
| MediaTek | Support the proposal. |
| TD Tech, Chengdu TD Tech | ok |
| Moderator | I’m not sure whether companies are also OK to extend the proposal and TP to the broadcast case (including MCCH-RNTI, G-RNTI for MTCH), so I still keep the proposal for multicast only, and more companies’ views are invited regarding broadcast case (including MCCH-RNTI, G-RNTI for MTCH). If all companies think the proposal and TP can be extended to broadcast case, then I will update the TP correspondingly. |

### 2nd Round Proposals (Closed)

**Initial proposal 2-4a:**

For RRC\_CONNECTED UEs, a multicast PDCCH to schedule a multicast PDSCH is counted as a unicast DCI to schedule a unicast PDSCH.

* Adopt the following TP for Clause 10.1 in TS 38.213:

----------------- Start of TP ----------------

10.1 UE procedure for determining physical downlink control channel assignment

**<**Unchanged text is omitted>

For a scheduled cell and at any time, a UE expects to have received at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, G-RNTI for multicast, G-CS-RNTI or MCS-C-RNTI scheduling 16 PDSCH receptions for which the UE has not received any corresponding PDSCH symbol and at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, or MCS-C-RNTI scheduling 16 PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Lenovo | OK |
| OPPO | OK with the updated TP. |
| CATT | Support |
| ZTE | Ok, broadcast needs more discussion. |
| vivo | Ok |
| Nokia, NSB | We are fine with this proposal and TP |
| Qualcomm | support |
| Huawei, HiSilicon | Fine with the proposal. Also accept to extend it to broadcast which does not have to be discussed in AI8.12.3 |
| NTT DOCOMO | OK |
| Xiaomi | OK |
| MediaTek | Ok with the proposal. We also prefer the broadcast case can be included in the TP. |
| Spreadtrum | OK. |
| LG Electronics | OK |
| Moderator | Stable for multicast. I moved the current proposal to section 7.  I also provide a new TP to extend it to broadcast for next round email discussion, but I’m not sure whether companies are OK with it. It seems some companies have concern on extending it to broadcast. Let’s further discuss it. |

### 3rd Round Proposals (Closed)

**Initial TP 2-4b:**

Adopt the following TP for Clause 10.1 in TS 38.213:

----------------- Start of TP ----------------

10.1 UE procedure for determining physical downlink control channel assignment

**<**Unchanged text is omitted>

For a scheduled cell and at any time, a UE expects to have received at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, MCCH-RNTI, G-RNTI for MTCH, G-RNTI for multicast, G-CS-RNTI or MCS-C-RNTI scheduling 16 PDSCH receptions for which the UE has not received any corresponding PDSCH symbol and at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, or MCS-C-RNTI scheduling 16 PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung | We prefer to remove “G-RNTI for multicast” for now or, preferably, remove the “for multicast”. We do not want to end up in a situation where broadcast cannot be agreed. For broadcast received in RRC\_CONNECTED, there is no difference from multicast for the UE capability addressed here. There is also no difference in RRC IDLE/INACTIVE although the restriction of 16 PDSCHs is unnecessary in that case. |
| Nokia, NSB | We are fine with the current proposal. In case “for multicast” is removed, perhaps it is better to remove “G-RNTI for MTCH” as well. |
| Qualcomm | Here ‘max 16 PDSCH receptions’ is to say no larger than max HARQ processes, per our understanding. Since slot-repetition is not supported for MCCH, it is not clear whether MCCH-RNTI should be counted here to use one of HARQ processes for soft-combining.  We are fine to just add ‘G-RNTI, G-CS-RNTI’ here. |
| Ericsson | We have the same comment regarding G-RNTI for MTCH, G-RNTI for multicast, which can be simplified with “G-RNTI”. Regarding MCCH, we agree that it can be removed since it does not rely on combining. |
| Moderator | Companies please check if it is OK to use “G-RNTI, G-CS-RNTI” instead of “MCCH-RNTI, G-RNTI for MTCH, G-RNTI for multicast, G-CS-RNTI” in the TP, with the understanding that it covers both G-RNTI for broadcast and multicast. |
| ZTE | Our understanding is that, for IDLE/INACTIVE UEs, network is impossible to know how many DCIs the UE has received. If we want to include broadcast here, we should limit it to “RRC\_CONNECTED mode”.  Thus, we propose the following updates. Note that “if a UE is provided a C-RNTI” is commonly used in 38.213 to reflect that UE is in RRC\_CONNECTED. We are open to other description as well.  **Updated TP:**  For a scheduled cell and at any time, if a UE is provided a C-RNTI, ~~a~~the UE expects to have received at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, G-RNTI, G-CS-RNTI or MCS-C-RNTI scheduling 16 PDSCH receptions for which the UE has not received any corresponding PDSCH symbol and at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, or MCS-C-RNTI scheduling 16 PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol. |
| Huawei, HiSilicon | Since we have agreed to share the total number of HARQ processes for broadcast, we don’t have to debate again the HPID is used for MTCH only or used for both MCCH and MTCH but up to implementation.  For the wording, we could be ok to have “MCCH-RNTI, G-RNTI, G-CS-RNTI” with the understanding that G-RNTI includes both multicast and broadcast cases but make it clearer would be more preferable. Ok to have “if a UE is provided a C-RNTI” |
| Xiaomi | We are fine with extending to MCCH-RNTI and G-RNTI for broadcast, hence the wording from FL is fine to us. Regarding to ‘if a UE is provided a C-RNTI’ from ZTE, it seems that the intention is to cover cases of broadcast and multicast simultaneously in RRC CONNECTED state. If I understand correctly, “if a UE is provided a C-RNTI” should be added on top of FL’s version. Otherwise, there is no need of such modification. |
| OPPO | We are OK with FL’s suggestion on using “G-RNTI, G-CS-RNTI” instead of the previous version. Furthermore, to limit it only within RRC-CONNECTED state, “if a UE is provided a C-RNTI” should be the prerequisite of this TP. |
| MediaTek | We support the intention of the proposal. Regarding the HARQ process issue, we have agreed that HARQ process ID is not indicated in DCI format 4\_0 for both MCCH and MTCH, and how to use the HARQ buffer for broadcast reception is up to UE implementation. The wording of “G-RNTI for MTCH” should be replaced by “G-RNTI for broadcast” since MTCH also can be used for multicast logical channel. We are also ok with Moderator’s suggestion. |
| Spreadtrum | Support moderator’s updated proposal. It could reflect well the previous agreement we have had that broadcast, multicast and unicast share 16 HARQ process.  Regarding ZTE’s concern, we think the issue also exists in RRC connected sate since HARQ-ACK is not the basic feature for multicast. But whatever, since the specification is written from the perspective of UE, the restriction also should be applied for UE in idle sate. |
| LG Electronics | We could extend to broadcast MCCH/MTCH on SCell. So, adding MCCH-RNTI is fine to us. We are also fine to limit to UE in RRC\_CONNECTED.  However, we are not sure if we can extend this paragraph to broadcast on non-serving cell. We should make sure that this paragraph is limited to broadcast on SCell/PCell. |
| CATT | Share same view with Qualcomm and Ericsson. We support to extend to G-RNTI for MTCH and remove MCCH-RNTI*.* It hasn’t achieve an consensus to support slot-level repetition for MCCH until now. Per our understanding, there is no need to allocate HARQ resource to MCCH for broadcast reception. In additional, We are OK with using G-RNTI instead of ‘G-RNTI for MTCH and G-RNTI for multicast’ and also OK to have if a UE is provided a C-RNTI”. |
| Nokia, NSB | We are fine with removing MCCH-RNTI, and clarifying that this is applicable only to RRC\_CONNECTED UEs. |
| Samsung | OK with the FL suggestion.  No need to limit it to RRC\_CONNECTED – a UE capability for the present case does not depend on the RRC state although the issue will not exist in practice in other RRC states. But OK if a majority prefers limitation to RRC\_CONNECTED. |
| Moderator | Based on comments, all companies are OK to include G-RNTI for MTCH for RRC\_CONNECTED UEs, but some companies have concern to include MCCH-RNTI, the reason is that slot-repetition is not supported for MCCH yet. Moderator suggests updated TP 2-4b. |

### 4th Round Proposals (Open)

**Updated TP 2-4b:**

Adopt the following TP for Clause 10.1 in TS 38.213:

----------------- Start of TP ----------------

10.1 UE procedure for determining physical downlink control channel assignment

**<**Unchanged text is omitted>

For a scheduled cell and at any time, if a UE is provided a C-RNTI, ~~a~~the UE expects to have received at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, G-RNTI, G-CS-RNTI or MCS-C-RNTI scheduling 16 PDSCH receptions for which the UE has not received any corresponding PDSCH symbol and at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, or MCS-C-RNTI scheduling 16 PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

Provide comments in the table below only when you have a concern.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Xiaomi | Support. Regarding the concerns on HARQ process, we don’t think it is an issue as we already achieved a conclusion that it is up to implementation to sharing the HARQ process among broadcast, multicast and unicast. Even repetition is not supported for MCCH, a HARQ process need to be allocated to it, same way as the legacy broadcast. |
| Qualcomm | LTE MBSFN does not support soft combining.  We are not sure why a HARQ process is needed for MCCH without repetition. Could Xiaomi explain a bit? |
| CATT | We agree with the updated TP 2-4b. |
| Huawei, HiSilicon | Prefer to keep MCCH-RNTI. As discussed, agreeing on sharing the total number of HARQ process for broadcast was motivated by not affecting hardware. Even though MCCH does not support repetition, no need to further differentiate MCCH and MTCH because MTCH can be configured with 0 repetition. |
| Samsung | Agree with Huawei to include MCCH-RNTI. This relates to the number of PDSCHs that a UE can have ongoing processing for. The number in Rel-15 was same as the number of HARQs in RRC\_CONNECTED because the UE reported HARQ-ACK for every HARQ. This does not hold in Rel-17 for MBS. |
| ZTE | We are fine with the current proposal.  Regarding MCCH, same view as Qualcomm, more clarification is needed. |
| vivo | Support the updated proposal. |
| Spreadtrum | Share the same view with Huawei/Samsung that MCCH-RNTI should be included. |
| Xiaomi2 | @Qualcomm Thanks for the follow-up. Here is our understanding:  In the current running CR for TS38.331, the following IE is endorsed.  MCCH-Config-r17 ::= SEQUENCE {  mcch-RepetitionPeriodAndOffset-r17 MCCH-RepetitionPeriodAndOffset-r17,  mcch-WindowStartSlot-r17 INTEGER (0..79),  mcch-WindowDuration-r17 ENUMERATED {sl2, sl4, sl8, sl10, sl20, sl40,sl80, sl160} OPTIONAL, -- NEED S  mcch-ModificationPeriod-r17 ENUMERATED {rf2, rf4, rf8, rf16, rf32, rf64, rf128, rf256,  rf512, rf1024, r2048, rf4096, rf8192, rf16384, rf32768, rf65536}  }  Within the mcch-ModificationPeriod, soft combining for MCCH is still available. It is same as legacy broadcast PDSCH, which there is a dedicated HARQ process. Considering we have agreed that the HARQ process can be shared between broadcast and unicast, we think the current TP is OK. |
| OPPO | Support the new proposal by FL. |
| MediaTek | We share the similar view with Huawei/Samsung/Spreadtrum to include the MCCH-RNTI. As agreed in last meeting, the HARQ process are shared between, unicast, multicast and broadcast, which also cover the broadcast PDSCH scheduled by DCI scrambled by MCCH-RNTI. |
| Lenovo | Agree with MediaTek. |
| LG Electronics | OK with this proposal. |
| ZTE | Sorry for the late comments. After further checking the previous agreements, it seems we can NOT apply this TP to MCCH/MTCH for broadcast. The reason is that, network will configure beam sweeping for MCCH/MTCH, and it is up to UE to receive one or more than one repetition. The network even doesn’t know how many PDCCHs that UE will monitor for MCCH/MTCH in each periodicity.  We have to first address this issue. Otherwise it is problematic to apply this TP for MCCH/MTCH for broadcast.  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 |

## Issue#2-5) TCI states for GC-PDCCH

### Summary

For search space set dropping in case of overbooking in Rel-17 MBS, prioritization among multicast/broadcast CSS sets and USS sets depends on the indexes of search space sets. 2 companies [Spreadtrum, Samsung] propose a same prioritization is also needed for a UE to determine CORESETs to receive PDCCH if the TCI state is ‘typeD’. Currently in Rel-16, if a UE is configured for single cell or intra-band CA and monitors PDCCH in overlapping occasions in multiple CORESETs with *qcl-Type* set to ‘typeD’, the UE monitors PDCCHs only in a CORESET, and in any other CORESET from the multiple CORESETs with *qcl-Type* set to same ‘typeD’ properties as the CORESET, where the CORESET corresponds to the CSS set with the lowest index in the cell with the lowest index containing CSS, if any; otherwise, to the USS set with the lowest index in the cell with lowest index. That is to say, based on current specification, the CSS sets for multicast/broadcast are always prioritized over the USS sets, which can lead to cases where multicast/broadcast CSS sets are dropped and USS are prioritized for overbooking (e.g. high priority unicast traffic) but then the UE cannot monitor PDCCH in the USS sets because CORESETs for multicast/broadcast CSS sets are prioritized. The two companies propose that for a UE to determine CORESETs with qcl-Type set to ‘typeD’ for PDCCH monitoring, the search space set prioritization for PDCCH monitoring is the same as for the overbooking procedure, i.e., the UE monitors PDCCHs only in CORESETs with *qcl-Type* set to same ‘typeD’ properties as the CORESET which corresponds to the USS set or CSS set for multicast with the lowest index. Moderator recommends the **initial proposal 2-5a** regarding this issue.

1 company [Ericsson] proposes that TCI States Activation/Deactivation for CORESET MAC CE can also be conveyed by group-common PDSCH. Considering the similar issue of TCI states for GC-PDSCH are under discussion, the issue can be further discussed after the conclusion is made for GC-PDSCH.

### 1st Round Proposals (Closed)

**Initial proposal 2-5a:**

In Rel-17 multicast, if a UE is configured for single cell or intra-band CA and monitors PDCCH in overlapping occasions in multiple CORESETs with qcl-Type set to ‘typeD’, the search space set prioritization for determining the CORESET(s) that UE monitors PDCCHs is similar as for the overbooking procedure.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Spreadtrum | Support |
| LG Electronics | OK |
| NTT DOCOMO | Support |
| Xiaomi | In our view, the current mechanism on beam selection for PDCCH is sufficient. Beam selection procedure is something before overbooking/SS dropping. After UE and gNB determines a CORESET, USS and CSS can still be transmitted in the same CORESET if overbooking doesn’t happen. In the other words, CSS and USS can be configured with the same CORESET if gNB wants to make sure there is no USS dropping because of beam selection. |
| ZTE | More clarification is needed. For example, if a UE is configured/scheduled to receive multicast, CORESET#1 and CORESET#2 are for unicast scheduling and CORESET#3 is for multicast scheduling, do we need to use this new prioritization rule in the monitoring occasion where only CORESETs for unicast are overlapped (i.e., MO#1 in the following figure). If yes, this seems to change the legacy operation.    Overall, we would propose not to do further optimization for FR2in the maintenance phase since the MBS WID says FR2 is with lower priority. |
| Nokia, NSB | We are fine with the proposal, however agree with ZTE that FR2 has lower priority and would prefer to avoid any further optimizations during the maintenance phase. |
| Samsung | Support.  As is, RAN1 specifications have different prioritization of multicast CSS sets with respect to overbooking and with respect to TCI state collisions of CORESETs. That makes no sense, cannot be explained to the industry, and results to poor specification quality. |
| Qualcomm | Generally fine. |
| Ericsson | Support |
| CATT | We support the initial proposal 2-5a. |
| TD Tech, Chengdu TD Tech | ok |
| Moderator | Considering some companies propose to not do further optimization for FR2 in the maintenance phase since the MBS WID says FR2 is with lower priority, moderator suggests to stop the discussion. |
| Spreadtrum | @ZTE, for your listed example, the proposal is applied for MO#2 and MO#4 under my assumption that resources marked purple denotes CORESET#3 for MBS. If w/o the proposal, according to current specification, when QCL-type D property of CORESET for unicast is(are) different from CORESET for multicast, it means that UE always monitor CORESET for MBS, not CORESET for unicast. In the example, if collision happens, for MO#2, UE only monitors PDCCH associated with CORESET#3.  @Xiaomi, in our understanding, if gNB always configure one CORESET associated with CSS for MBS and USS, yes, there is no problem. But in turn it also bring impact and restrict for the CORESET configuration for unicast. It would limit gNB’configuration flexibility. |

## Issue#2-6) TP corrections

### Summary

1 company [ZTE] proposes the TP about DCI bitlength of DCI format 4\_1 in TS 38.212, moderator suggests **initial TP 2-6-1**.

1. companies [NTT DOCOMO, CMCC, Google] propose the TP to correct the RRC parameter name and DCI format in DCI format 4\_2 in TS 38.212, moderator suggests **initial TP 2-6-2**.

1 company [Spreadtrum] proposes the TP to clarify the multicast SPS activation/deactivation ignaling in TS 38.213, moderator suggests **initial TP 2-6-3**.

1 company [Qualcomm] proposes the TP to clarify the broadcast search space configuration in CA case, i.e. Type3-CSS for *searchSpaceBroadcast* configured by unicast RRC signaling is to support UE monitoring the MBS broadcast on Scell, and the Type0B-CSS should be configured via SIBx/MCCH on Pcell, moderator suggests the **initial TP 2-6-4**.

### 1st Round Proposals (Closed)

**Initial TP 2-6-1:**

Adopt the following TP for Clause 7.3.1.5.2 in TS 38.212:

----------------- Start of TP ----------------

7.3.1.5.2 Format 4\_1

**<**Unchanged text is omitted>

- Reserved bits – 3 bits

~~- Padding bits, if required~~

~~Zeros shall be appended to DCI format 4\_1 until the payload size equals that of DCI format 1\_0 monitored in common search space in the same serving cell.~~

**<**Unchanged text is omitted>

----------------- End of TP ----------------

**Initial TP 2-6-2:**

Adopt the following TP for Clause 7.3.1.5.3 in TS 38.212:

----------------- Start of TP ----------------

7.3.1.5.3 Format 4\_2

**<**Unchanged text is omitted>

- Downlink assignment index – number of bits as defined in the following

- 4 bits if more than one serving cell are configured in the DL for multicast and the higher layer parameter *pdsch-HARQ-ACK-Codebook-Multicast=dynamic*, where the 2 MSB bits are the counter DAI and the 2 LSB bits are the total DAI;

- 2 bits if only one serving cell is configured in the DL for multicast and the higher layer parameter *pdsch-HARQ-ACK-Codebook-Multicast=dynamic*, where the 2 bits are the counter DAI;

- 0 bits otherwise.

If the UE is configured with a PUCCH-Scell, the number of serving cells is determined within a PUCCH group.

If the UE is configured with a PUCCH-Scell, *pdsch-HARQ-ACK-Codebook* is replaced by *pdsch-HARQ-ACK-Codebook-secondaryPUCCHgroup-r16* if present for the secondary PUCCH group.

If higher layer parameter *priorityIndicatorDCI-~~1-1~~4-2* is configured in *PDSCH-Config-Multicast*, if the bit width of the Downlink assignment index in DCI format ~~1\_1~~4\_2 for one HARQ-ACK codebook is not equal to that of the Downlink assignment index in DCI format ~~1\_1~~4\_2 for the other HARQ-ACK codebook, a number of most significant bits with value set to ‘0’ are inserted to smaller Downlink assignment index until the bit width of the Downlink assignment index in DCI format ~~1\_1~~4\_2 for the two HARQ-ACK codebooks are the same.

- PUCCH resource indicator – 3 bits as defined in Clause 9.2.3 of [5, TS 38.213]

- PDSCH-to-HARQ\_feedback timing indicator – 0, 1, 2, or 3 bits as defined in Clause 9.2.3 of [5, TS 38.213]. The bitwidth for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *dl-DataToUL-ACK* in *PUCCH-Config-Multicast1* if configured or *PUCCH-Config-Multicast2* if configured; otherwise, *I* is the number of entries in the higher layer parameter *dl-DataToUL-ACK* in *PUCCH-Config.*

If higher layer parameter *priorityIndicatorDCI-~~1-1~~4-2* is configured in *PDSCH-Config-Multicast*, if the bit width of the PDSCH-to-HARQ\_feedback timing indicator in DCI format ~~1\_1~~4\_2 for one HARQ-ACK codebook is not equal to that of the PDSCH-to-HARQ\_feedback timing indicator in DCI format ~~1\_1~~4\_2 for the other HARQ-ACK codebook, a number of most significant bits with value set to ‘0’ are inserted to smaller PDSCH-to-HARQ\_feedback timing indicator until the bit width of the PDSCH-to-HARQ\_feedback timing indicator in DCI format ~~1\_1~~4\_2 for the two HARQ-ACK codebooks are the same.

- Antenna port(s) – 4, 5, or 6 bits as defined by Tables 7.3.1.2.2-1/2/3/4, where the number of CDM groups without data of values 1, 2, and 3 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively. The antenna ports shall be determined according to the ordering of DMRS port(s) given by Tables 7.3.1.2.2-1/2/3/4.

If a UE is configured with both *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB*, the bitwidth of this field equals , where is the “Antenna ports” bitwidth derived according to *dmrs-DownlinkForPDSCH-MappingTypeA* and is the “Antenna ports” bitwidthderived according to *dmrs-DownlinkForPDSCH-MappingTypeB*. A number of zeros are padded in the MSB of this field, if the mapping type of the PDSCH corresponds to the smaller value of and .

- Transmission configuration indication – 0 bit if higher layer parameter *tci-PresentInDCI* in *PDCCH-Config-Multicast* is not enabled; otherwise 3 bits as defined in Clause 5.1.5 of [6, TS38.214].

- DMRS sequence initialization – 1 bit.

- Priority indicator – 0 bit if higher layer parameter *priorityIndicatorDCI-~~1-1~~4-2* is not configured in *PDSCH-Config-Multicast*; otherwise 1 bit as defined in Clause 9 in [5, TS 38.213].

- Enabling/disabling HARQ-ACK feedback indication –1 bit if higher layer parameter *harq-FeedbackEnabler-Multicast* indicates *dci-enabler*; 0 bit, otherwise.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

**Initial TP 2-6-3:**

Adopt the following TP for Clause 10.2 in TS 38.213:

----------------- Start of TP ----------------

**<**Unchanged text is omitted>

* 1. PDCCH validation for DL SPS and UL grant Type 2

A UE validates, for scheduling activation or scheduling release, a DL SPS assignment PDCCH or a configured UL grant Type 2 PDCCH if

- the CRC of a corresponding DCI format is scrambled with a CS-RNTI provided by *cs-RNTI*, or a

G-CS-RNTI provided by g-cs-RNTI, and

**<**Unchanged text is omitted>

Table 10.2-1: Special fields for single DL SPS or single UL grant Type 2 scheduling activation PDCCH validation when a UE is provided a single SPS PDSCH or UL grant Type 2 configuration in the active DL/UL BWP of the scheduled cell

|  |  |  |  |
| --- | --- | --- | --- |
|  | DCI format 0\_0/0\_1/0\_2 | DCI format 1\_0/1\_2/4\_1 | DCI format 1\_1/4\_2 |
| HARQ process number | set to all ‘0’s | set to all ‘0’s | set to all ‘0’s |
| Redundancy version | set to all ‘0’s | set to all ‘0’s | For the enabled transport block: set to all ‘0’s |

Table 10.2-2: Special fields for single DL SPS or single UL grant Type 2 scheduling release PDCCH validation when a UE is provided a single SPS PDSCH or UL grant Type 2 configuration in the active DL/UL BWP of the scheduled cell

|  |  |  |
| --- | --- | --- |
|  | DCI format 0\_0/0\_1/0\_2 | DCI format 1\_0/1\_1/1\_2/4\_1/4\_2 |
| HARQ process number | set to all ‘0’s | set to all ‘0’s |
| Redundancy version | set to all ‘0’s | set to all ‘0’s |
| Modulation and coding scheme | set to all ‘1’s | set to all ‘1’s |
| Frequency domain resource assignment | set to all ‘0’s for FDRA Type 2 with  set to all ‘1’s, otherwise | set to all ‘0’s for FDRA Type 0 or for *dynamicSwitch*  set to all ‘1’s for FDRA Type 1 |

Table 10.2-3: Special fields for a single DL SPS or single UL grant Type 2 scheduling activation PDCCH validation when a UE is provided multiple DL SPS or UL grant Type 2 configurations in the active DL/UL BWP of the scheduled cell

|  |  |  |  |
| --- | --- | --- | --- |
|  | DCI format 0\_0/0\_1/0\_2 | DCI format 1\_0/1\_2/4\_1 | DCI format 1\_1/4\_2 |
| Redundancy version | set to all ‘0’s | set to all ‘0’s | For the enabled transport block: set to all ‘0’s |

Table 10.2-4: Special fields for a single or multiple DL SPS and UL grant Type 2 scheduling release PDCCH validation when a UE is provided multiple DL SPS or UL grant Type 2 configurations in the active DL/UL BWP of the scheduled cell

|  |  |  |
| --- | --- | --- |
|  | DCI format 0\_0/0\_1/0\_2 | DCI format 1\_0/1\_1/1\_2/4\_1/4\_2 |
| Redundancy version | set to all ‘0’s | set to all ‘0’s |
| Modulation and coding scheme | set to all ‘1’s | set to all ‘1’s |
| Frequency domain resource assignment | set to all ‘0’s for FDRA Type 2 with  set to all ‘1’s, otherwise | set to all ‘0’s for FDRA Type 0 or for *dynamicSwitch*  set to all ‘1’s for FDRA Type 1 |

----------------- End of TP ----------------

**Initial TP 2-6-4:**

Adopt the following TP for Clause 10.1 in TS 38.213:

----------------- Start of TP ----------------

* 1. UE procedure for determining physical downlink control channel assignment

**<**Unchanged text is omitted>

A set of PDCCH candidates for a UE to monitor is defined in terms of PDCCH search space sets. A search space set can be a CSS set or a USS set. A UE monitors PDCCH candidates in one or more of the following search spaces sets

- a Type0-PDCCH CSS set on the primary cell of the MCG configured by

- *pdcch-ConfigSIB1* in *MIB* or by *searchSpaceSIB1* in *PDCCH-ConfigCommon* or by *searchSpaceZero* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a SI-RNTI, or

- *searchSpaceZero* in *PDCCH-ConfigCommon*, when *pdcch-Config-MCCH* and *pdcch-Config-MTCH* are provided, for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI

- a Type0A-PDCCH CSS set configured by *searchSpaceOtherSystemInformation* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a SI-RNTI on the primary cell of the MCG

- a Type0B-PDCCH CSS set configured by *searchSpaceBroadcast* in *pdcch-Config-MCCH* and *pdcch-Config-MTCH* for a DCI format with CRC scrambled by a MCCH-RNTI or a G-RNTI on the primary cell of the MCG

- a Type1-PDCCH CSS set configured by *ra-SearchSpace* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a RA-RNTI, a MsgB-RNTI, or a TC-RNTI on the primary cell

- a Type1A-PDCCH CSS set configured by *sdt-SearchSpace* in *PDCCH-ConfigCommon* for a DCI format with CRC scrambled by a C-RNTI or a CS-RNTI on the primary cell as described in clause 19.1

- a Type2-PDCCH CSS set configured by *pagingSearchSpace* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a P-RNTI on the primary cell of the MCG

- a Type2A-PDCCH CSS set configured by *peiSearchSpace* in *DownlinkConfigCommonSIB* for a DCI format 2\_7 with CRC scrambled by a RNTI on the primary cell of the MCG

- a Type3-PDCCH CSS set configured by

- *SearchSpace* in *PDCCH-Config* with *searchSpaceType* = *common* for DCI formats with CRC scrambled by INT-RNTI, SFI-RNTI, TPC-PUSCH-RNTI, TPC-PUCCH-RNTI, TPC-SRS-RNTI, or CI-RNTI and, only for the primary cell, C-RNTI, MCS-C-RNTI, CS-RNTI(s), or PS-RNTI, or

- *SearchSpace-Multicast* in *PDCCH-Config-Multicast* for DCI formats with CRC scrambled by G-RNTI, or G-CS-RNTI, or

- *searchSpaceBroadcast* in *pdcch-Config-MCCH* and *pdcch-Config-MTCH* on a secondary cell for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI, and

**<**Unchanged text is omitted>

If the active DL BWP and an MBS frequency resource provided by *cfr-Config-MCCH-MTCH* for a UE have same SCS and same CP length and the active DL BWP includes all RBs of the MBS frequency resource, and if the UE is provided *searchSpaceBroadcast* ~~for Type0B-PDCCH CSS set~~, the UE monitors PDCCH for *searchSpaceBroadcast* ~~for Type0B-PDCCH CSS set~~ on the active DL BWP.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Spreadtrum | Initial 2-6-1: Seems not necessary  Initial 2-6-2: Support  Initial 2-6-3: Support  Initial 2-6-4:   * For the first revision, we prefer to wait until we have clear conclusion on whether broadcast MBS can be supported on Scell. But if it is the majority, we can live with it. * For the second revision, we are fine. |
| Vivo | Ok with the TPs. |
| Xiaomi | **Initial TP 2-6-1:** support.  **Initial TP 2-6-2:** support.  **Initial TP 2-6-3:** OK |
| Lenovo, Motorola Mobility | Initial 2-6-1: Support  Initial 2-6-2: Support  Initial 2-6-3: Support  Initial 2-6-4: Support |
| Apple | OK with TP 2-6-1 and TP 2-6-2.  For TP 2-6-3, seem we have no agreements on joint release of multiple MBS SPS configurations. If joint release SPS is agreeable, it needs to clarify the release is only for MBS SPS configurations or release unicast SPS configurations as well. |
| ZTE | Ok with the above TPs |
| Nokia, NSB | We are fine with the TPs |
| Samsung | OK with all above TPs. |
| Qualcomm | Generally fine with the TPs. |
| Ericsson | Support |
| CATT | We are ok with the above TPs. |
| MediaTek | **Initial TP 2-6-4: Not support the proposal. Whether to support broadcast reception on Scell is not decided, and it will be discussed in RAN2. So, we suggest to delete the sentence that “***searchSpaceBroadcast* in *pdcch-Config-MCCH* and *pdcch-Config-MTCH* on a secondary cell for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI, and**”.** |
| TD Tech, Chengdu TD Tech | Ok with all TPs. |
| Moderator | No update for these TPs. Please continue if companies still have concerns.  TP 2-6-1: Most companies are OK except Spreadtrum think it is not necessary.  TP 2-6-2: All companies are OK. I moved it to section 7.  TP 2-6-3: Most companies are OK. @Apple, I think this TP does not talk about supporting joint SPS release for MBS, I think everyone is on the same page that joint release for MBS has not been supported.  TP 2-6-4: Most companies are OK. @Spreadtrum, we have agreed in last RAN1 meeting that, from RAN1 perspective, it is feasible for UE in RRC\_CONNECTED state to receive MBS broadcast on an activated Scell as long as UE has capability of supporting MBS broadcast on Scell. Actually, according to [20] (cited as below), the reason for this whole TP is due to supporting MBS broadcast in Scell.  *“If the reason to introduce Typ3-CSS for searchSpaceBroadcast configured by unicast RRC signaling is to support UE monitoring the MBS broadcast in Scell, the Type0B-CSS should be configured via SIBx/MCCH in Pcell.”* |

### 2nd Round Proposals (Closed)

**Initial TP 2-6-1:**

Adopt the following TP for Clause 7.3.1.5.2 in TS 38.212:

----------------- Start of TP ----------------

7.3.1.5.2 Format 4\_1

**<**Unchanged text is omitted>

- Reserved bits – 3 bits

~~- Padding bits, if required~~

~~Zeros shall be appended to DCI format 4\_1 until the payload size equals that of DCI format 1\_0 monitored in common search space in the same serving cell.~~

**<**Unchanged text is omitted>

----------------- End of TP ----------------

**Initial TP 2-6-3:**

Adopt the following TP for Clause 10.2 in TS 38.213:

----------------- Start of TP ----------------

**<**Unchanged text is omitted>

* 1. PDCCH validation for DL SPS and UL grant Type 2

A UE validates, for scheduling activation or scheduling release, a DL SPS assignment PDCCH or a configured UL grant Type 2 PDCCH if

- the CRC of a corresponding DCI format is scrambled with a CS-RNTI provided by *cs-RNTI*, or a

G-CS-RNTI provided by g-cs-RNTI, and

**<**Unchanged text is omitted>

Table 10.2-1: Special fields for single DL SPS or single UL grant Type 2 scheduling activation PDCCH validation when a UE is provided a single SPS PDSCH or UL grant Type 2 configuration in the active DL/UL BWP of the scheduled cell

|  |  |  |  |
| --- | --- | --- | --- |
|  | DCI format 0\_0/0\_1/0\_2 | DCI format 1\_0/1\_2/4\_1 | DCI format 1\_1/4\_2 |
| HARQ process number | set to all ‘0’s | set to all ‘0’s | set to all ‘0’s |
| Redundancy version | set to all ‘0’s | set to all ‘0’s | For the enabled transport block: set to all ‘0’s |

Table 10.2-2: Special fields for single DL SPS or single UL grant Type 2 scheduling release PDCCH validation when a UE is provided a single SPS PDSCH or UL grant Type 2 configuration in the active DL/UL BWP of the scheduled cell

|  |  |  |
| --- | --- | --- |
|  | DCI format 0\_0/0\_1/0\_2 | DCI format 1\_0/1\_1/1\_2/4\_1/4\_2 |
| HARQ process number | set to all ‘0’s | set to all ‘0’s |
| Redundancy version | set to all ‘0’s | set to all ‘0’s |
| Modulation and coding scheme | set to all ‘1’s | set to all ‘1’s |
| Frequency domain resource assignment | set to all ‘0’s for FDRA Type 2 with  set to all ‘1’s, otherwise | set to all ‘0’s for FDRA Type 0 or for *dynamicSwitch*  set to all ‘1’s for FDRA Type 1 |

Table 10.2-3: Special fields for a single DL SPS or single UL grant Type 2 scheduling activation PDCCH validation when a UE is provided multiple DL SPS or UL grant Type 2 configurations in the active DL/UL BWP of the scheduled cell

|  |  |  |  |
| --- | --- | --- | --- |
|  | DCI format 0\_0/0\_1/0\_2 | DCI format 1\_0/1\_2/4\_1 | DCI format 1\_1/4\_2 |
| Redundancy version | set to all ‘0’s | set to all ‘0’s | For the enabled transport block: set to all ‘0’s |

Table 10.2-4: Special fields for a single or multiple DL SPS and UL grant Type 2 scheduling release PDCCH validation when a UE is provided multiple DL SPS or UL grant Type 2 configurations in the active DL/UL BWP of the scheduled cell

|  |  |  |
| --- | --- | --- |
|  | DCI format 0\_0/0\_1/0\_2 | DCI format 1\_0/1\_1/1\_2/4\_1/4\_2 |
| Redundancy version | set to all ‘0’s | set to all ‘0’s |
| Modulation and coding scheme | set to all ‘1’s | set to all ‘1’s |
| Frequency domain resource assignment | set to all ‘0’s for FDRA Type 2 with  set to all ‘1’s, otherwise | set to all ‘0’s for FDRA Type 0 or for *dynamicSwitch*  set to all ‘1’s for FDRA Type 1 |

----------------- End of TP ----------------

**Initial TP 2-6-4:**

Adopt the following TP for Clause 10.1 in TS 38.213:

----------------- Start of TP ----------------

* 1. UE procedure for determining physical downlink control channel assignment

**<**Unchanged text is omitted>

A set of PDCCH candidates for a UE to monitor is defined in terms of PDCCH search space sets. A search space set can be a CSS set or a USS set. A UE monitors PDCCH candidates in one or more of the following search spaces sets

- a Type0-PDCCH CSS set on the primary cell of the MCG configured by

- *pdcch-ConfigSIB1* in *MIB* or by *searchSpaceSIB1* in *PDCCH-ConfigCommon* or by *searchSpaceZero* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a SI-RNTI, or

- *searchSpaceZero* in *PDCCH-ConfigCommon*, when *pdcch-Config-MCCH* and *pdcch-Config-MTCH* are provided, for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI

- a Type0A-PDCCH CSS set configured by *searchSpaceOtherSystemInformation* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a SI-RNTI on the primary cell of the MCG

- a Type0B-PDCCH CSS set configured by *searchSpaceBroadcast* in *pdcch-Config-MCCH* and *pdcch-Config-MTCH* for a DCI format with CRC scrambled by a MCCH-RNTI or a G-RNTI on the primary cell of the MCG

- a Type1-PDCCH CSS set configured by *ra-SearchSpace* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a RA-RNTI, a MsgB-RNTI, or a TC-RNTI on the primary cell

- a Type1A-PDCCH CSS set configured by *sdt-SearchSpace* in *PDCCH-ConfigCommon* for a DCI format with CRC scrambled by a C-RNTI or a CS-RNTI on the primary cell as described in clause 19.1

- a Type2-PDCCH CSS set configured by *pagingSearchSpace* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a P-RNTI on the primary cell of the MCG

- a Type2A-PDCCH CSS set configured by *peiSearchSpace* in *DownlinkConfigCommonSIB* for a DCI format 2\_7 with CRC scrambled by a RNTI on the primary cell of the MCG

- a Type3-PDCCH CSS set configured by

- *SearchSpace* in *PDCCH-Config* with *searchSpaceType* = *common* for DCI formats with CRC scrambled by INT-RNTI, SFI-RNTI, TPC-PUSCH-RNTI, TPC-PUCCH-RNTI, TPC-SRS-RNTI, or CI-RNTI and, only for the primary cell, C-RNTI, MCS-C-RNTI, CS-RNTI(s), or PS-RNTI, or

- *SearchSpace-Multicast* in *PDCCH-Config-Multicast* for DCI formats with CRC scrambled by G-RNTI, or G-CS-RNTI, or

- *searchSpaceBroadcast* in *pdcch-Config-MCCH* and *pdcch-Config-MTCH* on a secondary cell for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI, and

**<**Unchanged text is omitted>

If the active DL BWP and an MBS frequency resource provided by *cfr-Config-MCCH-MTCH* for a UE have same SCS and same CP length and the active DL BWP includes all RBs of the MBS frequency resource, and if the UE is provided *searchSpaceBroadcast* ~~for Type0B-PDCCH CSS set~~, the UE monitors PDCCH for *searchSpaceBroadcast* ~~for Type0B-PDCCH CSS set~~ on the active DL BWP.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

Provide your comments only when you have concern on it.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| MediaTek | **Initial TP 2-6-4:**  The TP needs to be further modified. Regarding whether to support the broadcast reception on Scell, it is clearly stated that “whether to support MBS broadcast reception on Scell and supporting MBS broadcast reception on non-serving cell will be up to RAN2” in last meeting’s LS (R1-2200798). From our understanding, this issue has not been decided by RAN2, we are confused why the corresponding TPs has been added. We suggest deleting the corresponding Scell description in the **Initial TP 2-6-4** and wait for RAN2’s decision.  *~~searchSpaceBroadcast~~* ~~in~~ *~~pdcch-Config-MCCH~~* ~~and~~ *~~pdcch-Config-MTCH~~* ~~on a secondary cell for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI, and~~ |
| Qualcomm | It seems that MTK’s concern is not directly on the proposed TP 2-6-4 itself, but on the current 38.213 text:  ‘*searchSpaceBroadcast* in *pdcch-Config-MCCH* and *pdcch-Config-MTCH* on a secondary cell for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI, and’. |
| Huawei, HiSilicon | Agree with this TP. Regarding MediaTek’s comment, it should not be a big concern. In case of RAN2 decided to not support it, removing it from the spec seems natural. |
| Vivo | **Initial TP 2-6-3**  Regarding joint SPS release, we are open to discuss. For multicast SPS design, our basic principle is to reuse that of unicast. Joint SPS release is support in R16. There is no need to additionally preclude this for multicast SPS. Technically, we don’t see any issue to support joint SPS release only for MBS SPS configurations like that of unicast SPS release. If joint SPS release for multicast is supported, the parameter of sps-ConfigDeactivationStateList may need to be included in CFR configuration. |
| Spreadtrum | Agree with FL that initial TP2-6-3 is not related to joint SPS release. Joint SPS release is another issue, and we are open for further discussion on joint SPS release. |
| Moderator | TP 2-6-1 and TP2-6-3 are stable for more than 24 hours.  I noticed MTK’s concern is not directly on the proposed TP 2-6-4 itself. Let’s see if MTK still have concern on TP2-6-4 in the next round. |

### 3rd Round Proposals (Open)

**Initial TP 2-6-4:**

Adopt the following TP for Clause 10.1 in TS 38.213:

----------------- Start of TP ----------------

* 1. UE procedure for determining physical downlink control channel assignment

**<**Unchanged text is omitted>

A set of PDCCH candidates for a UE to monitor is defined in terms of PDCCH search space sets. A search space set can be a CSS set or a USS set. A UE monitors PDCCH candidates in one or more of the following search spaces sets

- a Type0-PDCCH CSS set on the primary cell of the MCG configured by

- *pdcch-ConfigSIB1* in *MIB* or by *searchSpaceSIB1* in *PDCCH-ConfigCommon* or by *searchSpaceZero* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a SI-RNTI, or

- *searchSpaceZero* in *PDCCH-ConfigCommon*, when *pdcch-Config-MCCH* and *pdcch-Config-MTCH* are provided, for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI

- a Type0A-PDCCH CSS set configured by *searchSpaceOtherSystemInformation* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a SI-RNTI on the primary cell of the MCG

- a Type0B-PDCCH CSS set configured by *searchSpaceBroadcast* in *pdcch-Config-MCCH* and *pdcch-Config-MTCH* for a DCI format with CRC scrambled by a MCCH-RNTI or a G-RNTI on the primary cell of the MCG

- a Type1-PDCCH CSS set configured by *ra-SearchSpace* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a RA-RNTI, a MsgB-RNTI, or a TC-RNTI on the primary cell

- a Type1A-PDCCH CSS set configured by *sdt-SearchSpace* in *PDCCH-ConfigCommon* for a DCI format with CRC scrambled by a C-RNTI or a CS-RNTI on the primary cell as described in clause 19.1

- a Type2-PDCCH CSS set configured by *pagingSearchSpace* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a P-RNTI on the primary cell of the MCG

- a Type2A-PDCCH CSS set configured by *peiSearchSpace* in *DownlinkConfigCommonSIB* for a DCI format 2\_7 with CRC scrambled by a RNTI on the primary cell of the MCG

- a Type3-PDCCH CSS set configured by

- *SearchSpace* in *PDCCH-Config* with *searchSpaceType* = *common* for DCI formats with CRC scrambled by INT-RNTI, SFI-RNTI, TPC-PUSCH-RNTI, TPC-PUCCH-RNTI, TPC-SRS-RNTI, or CI-RNTI and, only for the primary cell, C-RNTI, MCS-C-RNTI, CS-RNTI(s), or PS-RNTI, or

- *SearchSpace-Multicast* in *PDCCH-Config-Multicast* for DCI formats with CRC scrambled by G-RNTI, or G-CS-RNTI, or

- *searchSpaceBroadcast* in *pdcch-Config-MCCH* and *pdcch-Config-MTCH* on a secondary cell for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI, and

**<**Unchanged text is omitted>

If the active DL BWP and an MBS frequency resource provided by *cfr-Config-MCCH-MTCH* for a UE have same SCS and same CP length and the active DL BWP includes all RBs of the MBS frequency resource, and if the UE is provided *searchSpaceBroadcast* ~~for Type0B-PDCCH CSS set~~, the UE monitors PDCCH for *searchSpaceBroadcast* ~~for Type0B-PDCCH CSS set~~ on the active DL BWP.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

This table is to check whether MTK is OK with the TP.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Ericsson | Support |
| Xiaomi | Support. One editorial modification, it should be ‘*CFR-ConfigMCCH-MTCH*’ instead of ‘*cfr-Config-MCCH-MTCH*’. |
| OPPO | OK |
| MediaTek | Regarding the modification part, we are fine. However, we are not ok with the Scell description since broadcast reception on Scell has not been agreed yet. We suggest deleting the following description:  *searchSpaceBroadcast* in *pdcch-Config-MCCH* and *pdcch-Config-MTCH* on a secondary cell for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI, and |
| Spreadtrum | Fine at the moment. If broadcast on Scell is supported by RAN2, we can come back to revise it again. |
| CATT | Support. |
| Nokia, NSB | We are fine with this TP |
| Samsung | OK |
| Moderator | @MTK, regarding your concern, I think it can be discussed separately. I also share the same view with other companies that, if broadcast on Scell is not supported by RAN2, we can come back to revise it again. Please confirm if you are OK with the current TP. |
| Huawei, HiSilicon | Ok with the TP. |
| ZTE | Ok with the TP. |
| vivo | OK |
| MediaTek | Considering we have received an LS from RAN2, broadcast reception on Scell has not been agreed and it needs more discussion on how to receive the MCCH for broadcast reception on Scell. We suggest to delete the corresponding broadcast Scell description, and we can further discuss or revise the description when there are explicit agreements and conclusion.  *~~searchSpaceBroadcast~~* ~~in~~ *~~pdcch-Config-MCCH~~* ~~and~~ *~~pdcch-Config-MTCH~~* ~~on a secondary cell for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI, and~~  **Question 2:** Can the UE receive MCCH directly from SCell or should MCCH be provided to the UE with dedicated signalling as well? Is there a dependency between SIBx reception method for SCell (i.e. directly reading from SCell vs. dedicated RRC signalling) and MCCH provision method (i.e. dedicated signalling vs. directly reading from SCell)? |
| Lenovo | OK |

## Issue#2-7) DCI processing capability (newly added from AI8.12.3)

### Summary (from AI8.12.3)

* In [R1-2200950, Huawei]
  + *Discuss*: Regarding the capability of processing MBS broadcast DCI, as proposed to sharing the maximum number of HARQ processes for unicast and broadcast to avoid potential impact to UE hardware, it is preferred from UE perspective to treat the broadcast DCI as unicast DCI following the FG3-1/3-5a/3-5b [2] especially for UE in RRC\_CONNECTED state.
  + Proposal 3: Regarding the number of DCIs that a UE can process in a slot or span, MBS broadcast DCI is treated as unicast DCI scheduling DL following the current feature group 3-1/3-5a/3-5b.

### 1st Round Proposals (Closed)

**Initial proposal 2-7a:**

Regarding the number of DCIs that a UE can process in a slot or span, MBS broadcast DCI is treated as unicast DCI scheduling DL following the current feature group 3-1/3-5a/3-5b.

Companies are encouraged to provide comments in the table below.

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| **Company** | **Comment** |
| Moderator | After coordination with AI8.12.3, the issue 7 in AI 8.12.3 is added here for discussion. I copied some comments below from AI 8.12.3 on this issue (some comments may be missed). I noticed at least [ZTE, Lenovo] have concerns on this proposal, and some other companies also mentioned that detailed solution needs more discussion, so I suggest proponents try to resolve the concerns at first. |
| Huawei (AI8.12.3) | It is critical since we are targeting to address the similar concern as for multicast for which last meeting we have agreed the following:  **Agreement**  Regarding the number of DCIs that a UE can process in a slot or span, multicast DCI is treated as unicast DCI scheduling DL following the current feature group 3-1/3-5a/3-5b.  ----further comment:  Likewise, there should be no problem for IDLE/INACTIVE UEs but the issue is for connected Ues with unicast/multicast to be scheduled. The point is again to avoid affecting UE implementation or existing capability |
| OPPO (AI8.12.3) | This issue can be discussed because it is related to the number of DCI that can be processed by a UE, as Huawei/HiSi mentioned, especially for UEs in RRC\_CONN state. More clarification/discussion is needed among companies about how to treat DCI used to schedule broadcast MBS.  Based on the discussion on the related issues in AI 8.12.1 during last meeting, some companies suggested to have separated UE capability on broadcast MBS DCI. It is because that broadcast MBS can be received by UEs in both RRC\_CONN and RRC\_IDLE/RRC\_INACT, it may not be a proper way by just treat broadcast MBS DCI as unicast DCI |
| Xiaomi(AI8.12.3) | We agree with HW that the DCI processing issue is critical. Regarding the detail solution, we are open to further discussion. |
| ZTE(AI8.12.3) | From our perspective, it may not be possible for network to know which UEs are receiving broadcast for UEs in IDLE. In this case, it is not possible for network to guarantee the budget of DCI number. Any further clarification from proponents? |
| Lenovo(AI 8.12.3) | We are open to further discuss this issue. We don’t agree to treat broadcast DCI as unicast DCI especially in case of overbooking. Support of broadcast reception for RRC connected UEs is best effort and unicast reception should not be impacted by receiving broadcast |
| Huawei, HiSilicon | As clarified, the main concern originates from connected states. The motivation is to avoid affecting UE too much. With this said, the broadcast DCI should be treated as unicast DCI so as to not affect unicast DCI scheduling. |
| vivo | We are open to further discuss this issue. If the proposal is agreed, that means for UE in RRC connected state, it is forced for the UE to report MI for broadcast. Otherwise, additional capability may need to process DCI for broadcast. Of course, it can be up to UE implementation, if UE does not have the additional capability, it reports MI. and then gNB knows the UE will receive the broadcast. |
| CATT | We are open to further discuss this issue. We have the same concern to treat the MBS broadcast DCI as unicast DCI scheduling DL for the RRC\_CONN UE. |
| MediaTek | We support the proposal. As clarified by HW, this proposal focuses on the RRC CONNECTED state. There are some solutions for NW to know whether some UEs are receiving broadcast, e.g., the MII assistance information reporting, report the FG 33-1 with capability signaling. |
| Moderator | I updated the proposal based on comments, but I see some companies have concern on it. |

### 2nd Round Proposals (Closed)

**Updated proposal 2-7a:**

Regarding the number of DCIs that a UE can process in a slot or span, MBS broadcast DCI is treated as unicast DCI scheduling DL following the current feature group 3-1/3-5a/3-5b for RRC\_CONNECTED UEs.

Companies are encouraged to provide comments in the table below.

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| **Company** | **Comment** |
| Samsung | Support |
| Qualcomm | We are fine with the proposal by clarifying the broadcast DCI monitored by the CONN UE. For the MCCH-RNTI or G-RNTI for MTCH, if not interested by the UE, it is not related.  **Initial proposal 2-7a:**  Regarding the number of DCIs that a UE can process in a slot or span, MBS broadcast DCI monitored by the UE is treated as unicast DCI scheduling DL following the current feature group 3-1/3-5a/3-5b for RRC\_CONNECTED UEs. |
| Ericsson | Support |
| ZTE | Support the revision from Qualcomm. |
| vivo | OK |
| Huawei, HiSilicon | Ok and also fine with the version from Qualcomm. |
| Xiaomi | We are fine with the updated version from Qualcomm. There would be three type DCIs which are treated as unicast DCI   1. Unicast DCI scheduling unicast PDSCH 2. Multicast DCI scheduling multicast transmission 3. Broadcast DCI scheduling broadcast transmission   However, the budget of DCI a UE can process is limited, e.g. UE can only process 1 unicast DCI within a span in FDD band. It will introduce significant restriction for scheduling if leaves gNB to guarantee only one nominal unicast DCI can be transmitted per slot. We would like to more views from companies on this issue. |
| OPPO | We are OK with the updated proposal by Qualcomm.  Regarding the issue raised by Xiaomi, we have the similar understanding. The UE capability of processing the number of DCI is not supposed to be increased. If DCI used for MBS broadcast is also counted as unicast DCI by a UE in RRC\_CONN, the original unicast DCI processing number will be consumed. If companies think that such issue/impact on unicast DCI processing is not significant, we can live with it. |
| MediaTek | Support the proposal, and also OK with QC’ version. |
| LG Electronics | OK with QC’s version. |
| CATT | We are OK with the revision from Qualcomm. |
| Nokia, NSB | We are fine with the proposal, we think it is implicitly understood that the DCIs meant here are the ones monitored by the UE. |
| Ericsson | OK with QC’s version. |
| Samsung | OK with the proposal. QC’s update is unnecessary but no issue with it. |
| Moderator | Based on comments, I think QC’s suggestion is acceptable to everyone. I take the following as stable proposal, and move it to section 8 (2nd set of stable proposals/TPs). If you have any concern, please raise it directly in the email thread.  **Updated proposal 2-7a:**  Regarding the number of DCIs that a UE can process in a slot or span, MBS broadcast DCI monitored by the UE is treated as unicast DCI scheduling DL following the current feature group 3-1/3-5a/3-5b for RRC\_CONNECTED UEs. |

## Issue#2-8) Other TPs

### Summary

In [20], it is proposed that, for multicast RRC\_CONNECTED UEs, the size of ‘ZP CSI-RS trigger’ field in DCI format 4\_2 is determined by the number of aperiodic ZP CSI-RSs configured in PDSCH-Config-Multicast. [20] suggests the corresponding TP for this.

### 1st Round Proposals (Closed)

**Initial TP 2-8-1:**

Adopt the following TP for Clause 7.3.1.5.3 in TS 38.212:

----------------- Start of TP ----------------

7.3.1.5.3 Format 4\_2

**<**Unchanged text is omitted>

- Rate matching indicator – 0, 1, or 2 bits according to higher layer parameters *rateMatchPatternGroup1* and *rateMatchPatternGroup2* in *PDSCH-Config-Multicast*, where the MSB is used to indicate *rateMatchPatternGroup1* and the LSB is used to indicate *rateMatchPatternGroup2* when there are two groups.

- ZP CSI-RS trigger – 0, 1, or 2 bits as defined in Clause 5.1.4.2 of [6, TS 38.214]. The bitwidth for this field is determined as bits, where is the number of aperiodic ZP CSI-RS resource sets configured in PDSCH-Config-Multicast by higher layer.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

Companies are encouraged to provide comments in the table below.

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| **Company** | **Comment** |
| ZTE | It seems this TP is conflicting with the following proposal under discussion.  **Initial proposal 3-1b:**  Send an LS to inform RAN2 that the following parameters are NOT needed for PDSCH-Config-Multicast:   * *zp-CSI-RS-ResourceToAddModList, zp-CSI-RS-ResourceToReleaseList* * *sp-ZP-CSI-RS-ResourceSetsToAddModList, sp-ZP-CSI-RS-ResourceSetsToReleaseList* * *p-ZP-CSI-RS-ResourceSet*   If zp-CSI-RS-ResourceToAddModList and zp-CSI-RS-ResourceToReleaseList are NOT included in PDSCH-Config-Multicast, then how to determine the bit size for this field? |
| NTT DOCOMO | Generally fine. It seems that the term “by higher layer” is no longer necessary. Also, it would be better to italicize “PDSCH-Config-Multicast”.  The size of ZP CSI-RS trigger is determined by *aperiodic-ZP-CSI-RS-ResourceSetsToAddModList*. So we don’t see any conflict with proposal 3-1b. |
| Nokia, NSB | We are fine with the proposal and agree with NTT DOCOMO that “by higher layer” could be removed. |
| Ericsson | OK with the proposal. |
| Qualcomm2 | Support |
| Samsung | OK |
| Moderator | Regarding ZTE’s comment, NTT DoCoMo has made the answer. I think all companies are OK with the TP with the following update. I moved it to section 8 (2nd set of stable proposals/TPs). If you have any concern, please raise it directly in the email thread.  **Initial TP 2-8-1:**  Adopt the following TP for Clause 7.3.1.5.3 in TS 38.212:  ----------------- Start of TP ----------------  7.3.1.5.3 Format 4\_2  **<**Unchanged text is omitted>  - Rate matching indicator – 0, 1, or 2 bits according to higher layer parameters *rateMatchPatternGroup1* and *rateMatchPatternGroup2* in *PDSCH-Config-Multicast*, where the MSB is used to indicate *rateMatchPatternGroup1* and the LSB is used to indicate *rateMatchPatternGroup2* when there are two groups.  - ZP CSI-RS trigger – 0, 1, or 2 bits as defined in Clause 5.1.4.2 of [6, TS 38.214]. The bitwidth for this field is determined as bits, where is the number of aperiodic ZP CSI-RS resource sets configured in *PDSCH-Config-Multicast* ~~by higher layer~~.  **<**Unchanged text is omitted>  ----------------- End of TP ---------------- |

# Issue #3: Configurations for GC-PDSCH

## Background and submitted proposals

### Issue#3-1) RRC parameters

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| **Company** | **Proposals** |
| **Huawei** | **Proposal 2: Inform RAN2 that the following parameters are NOT needed for PDSCH-Config for multicast:**   * ***tci-StatesToAddModList*** * ***zp-CSI-RS-ResourceToAddModList, zp-CSI-RS-ResourceToReleaseList, sp-ZP-CSI-RS-ResourceSetsToAddModList, sp-ZP-CSI-RS-ResourceSetsToReleaseList, p-ZP-CSI-RS-ResourceSet*** * ***minimumSchedulingOffsetK0-r16*** * ***antennaPortsFieldPresenceDCI-1-2-r16, aperiodicZP-CSI-RS-ResourceSetsToAddModListDCI-1-2-r16, aperiodicZP-CSI-RS-ResourceSetsToReleaseListDCI-1-2-r16, dmrs-DownlinkForPDSCH-MappingTypeA-DCI-1-2-r16, dmrs-DownlinkForPDSCH-MappingTypeB-DCI-1-2-r16, dmrs-SequenceInitializationDCI-1-2-r16, harq-ProcessNumberSizeDCI-1-2-r16, mcs-TableDCI-1-2-r16, numberOfBitsForRV-DCI-1-2-r16, pdsch-TimeDomainAllocationListDCI-1-2-r16, prb-BundlingTypeDCI-1-2-r16, priorityIndicatorDCI-1-2-r16, rateMatchPatternGroup1DCI-1-2-r16, rateMatchPatternGroup2DCI-1-2-r16, resourceAllocationType1GranularityDCI-1-2-r16, vrb-ToPRB-InterleaverDCI-1-2-r16, referenceOfSLIVDCI-1-2-r16, resourceAllocationDCI-1-2-r16,*** * ***dataScramblingIdentityPDSCH2-r16*** * ***repetitionSchemeConfig-r16, repetitionSchemeConfig-v1630*** |
| **Qualcomm** | **Proposal 1: For multicast RRC\_CONNECTED UEs, ZP CSI-RS can be configured in *PDSCH-Config-Multicast* for GC-PDSCH rate matching, subject to UE capability. For PDSCH resource mapping with RE level granularity,**   * **The procedure for PDSCH scheduled by PDCCH with DCI format 4\_1 is similar as that of DCI format 1\_0 and the procedure for PDSCH scheduled by PDCCH with DCI format 4\_2 is similar as that of DCI format 1\_1, by applying the parameters of *aperiodic-ZP-CSI-RS-ResourceSetsToAddModList*, *sp-ZP-CSI-RS-ResourceSetsToAddModList* and *p-ZP-CSI-RS-ResourceSet* configured in PDSCH-Config-Multicast.** * **ZP CSI-RS configured in *PDSCH-Config* for unicast do not apply for GC-PDSCHs.** * **ZP CSI-RS configured in *PDSCH-Config-Multicast* for multicast do not apply for unicast PDSCHs.** * **Endorse TP#1 for TS38.214.**  TP#1 for TS38.214:5.1.4.2 PDSCH resource mapping with RE level granularity The procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 1\_2, by applying the parameters of *aperiodicZP-CSI-RS-ResourceSetsToAddModListDCI-1-2* instead of *aperiodic-ZP-CSI-RS-ResourceSetsToAddModList*.  The procedures for PDSCH scheduled by PDCCH with DCI format 1\_0 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 4\_1 and the procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 4\_2, by applying the parameters of higher layer parameters *aperiodic-ZP-CSI-RS-ResourceSetsToAddModList,*  *sp-ZP-CSI-RS-ResourceSetsToAddModList* and *p-ZP-CSI-RS-ResourceSet* configured in *PDSCH-Config-Multicast instead of those configured in PDSCH-Config*.  \*\*\* Unchanged text is omitted \*\*\*  **Proposal 2: For multicast RRC\_CONNECTED UEs, the size of ‘ZP CSI-RS trigger’ field in DCI format 4\_2 is determined by the number of aperiodic ZP CSI-RSs configured in *PDSCH-Config-Multicast*.**   * **Endorse TP#2 for TS38.212.**  TP#2 for TS38.212:7.3.1.5.3 Format 4\_2 < Unchanged parts are omitted >  - Rate matching indicator – 0, 1, or 2 bits according to higher layer parameters *rateMatchPatternGroup1* and *rateMatchPatternGroup2* in *PDSCH-Config-Multicast*, where the MSB is used to indicate *rateMatchPatternGroup1* and the LSB is used to indicate *rateMatchPatternGroup2* when there are two groups.  - ZP CSI-RS trigger – 0, 1, or 2 bits as defined in Clause 5.1.4.2 of [6, TS 38.214]. The bitwidth for this field is determined as bits, where is the number of aperiodic ZP CSI-RS resource sets configured in *PDSCH-Config-Multicast* by higher layer.  < Unchanged parts are omitted >  **Proposal 3: For multicast RRC\_CONNECTED UEs, if SP ZP CSI-RS is configured in *PDSCH-Config-Multicast* for GC-PDSCH rate matching, support both alternatives:**   * **Alt1: SP ZP CSI-RS configured in PDSCH-Config-Multicast can be activated by MAC-CE in multicast GC-PDSCH**   **Alt2: SP ZP CSI-RS configured in PDSCH-Config-Multicast can be activated by MAC-CE in unicast PDSCH** |

### Issue#3-2) TCI states for GC-PDSCH

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| **Company** | **Proposals** |
| **Huawei** | **Proposal 3: No need to configure the UE with a list of up to M’ TCI-State configurations within the higher layer parameter *PDSCH-Config-Multicast*.**  **Proposal 4: Adopt the following text proposal to TS38.212 v17.0.0:**  --------------------------------Text proposal to TS38.212 v17.0.0 Starts--------------------------------------------  7.3.1.5.3 Format 4\_2  DCI format 4\_2 is used for the scheduling of PDSCH in DL cell.  **< Unchanged parts are omitted >**  - DMRS sequence initialization – 1 bit.  - Priority indicator – 0 bit if higher layer parameter *priorityIndicatorDCI-1-1* is not configured in *PDSCH-Config-Multicast*; otherwise 1 bit as defined in Clause 9 in [5, TS 38.213].  --------------------------------Text proposal to TS38.212 v17.0.0 Ends--------------------------------------------- |
| **vivo** | Proposal 1: For TCI states activation/deactivation for multicast GC-PDSCH, Alt-1 is supported.   * **Alt-1: The unicast PDSCH carrying a ‘TCI States Activation/Deactivation for UE-specific PDSCH MAC CE’ is received by the UE to map up to 8 TCI states configured in *PDSCH-Config* to the TCI codepoints in both unicast DCI format and DCI format 4\_2. The following text in Clause 5.1.5 of TS38.214 is deleted.**   + **“The UE can be configured with a list of up to *M’* *TCI-State*configurations within the higher layer parameter *PDSCH-Config-Multicast* to decode PDSCH associated with a G-RNTI or a G-CS-RNTI according to a detected PDCCH with DCI intended for the UE and the given serving cell, where M’ depends on the UE capability.”** |
| **Nokia** | **Proposal-1: Support Alt-1 for TCI state activation/deactivation for multicast group common PDSCH for Release-17.** |
| **CATT** | **Proposal 6: For group common PDCCH scheduling, when one or more TCI states containing QCL type D are configured for multicast PDSCH, the Rel-15/Rel-16 scheme on beam management can be reused as baseline and some further enhancements shall be discussed as following:**   * **Considering different UEs have different UE capabilities on *timeDurationForQCL*, how to determine the threshold of *timeDurationForQCL* for the UE group can be discussed.** * **When the offset between the reception of the DCI and the corresponding group PDSCH is less than the threshold *timeDurationForQCL*, how to ensure the same default TCI state for a UE group.** |
| **NTT DOCOMO** | **Proposal 6: Adopt the following text proposal in TS 38.214 Section 5.1.5 to clarify the condition for the existence of TCI field in DCI format 4\_2.**  ----------------------------------- **Start of Text proposal to 5.1.5 of 38.214** ------------------------------------------------  <Unchanged text omitted>  If a UE is configured with the higher layer parameter *tci-PresentInDCI* that is set as ‘enabled’for the CORESET scheduling the PDSCH, the UE assumes that the TCI field is present in the DCI format 1\_1 of the PDCCH transmitted on the CORESET. If a UE is configured with the higher layer parameter *tci-PresentDCI-1-2* for the CORESET scheduling the PDSCH, the UE assumes that the TCI field with a DCI field size indicated by *tci-PresentDCI-1-2* is present in the DCI format 1\_2 of the PDCCH transmitted on the CORESET. If a UE is configured with the higher layer parameter *tci-PresentInDCI* that is set as ‘enabled’for the CORESET scheduling the multicast PDSCH, the UE assumes that the TCI field is present in the DCI format 4\_2 of the PDCCH transmitted on the CORESET. If the PDSCH is scheduled by a DCI format not having the TCI field present, and the time offset between the reception of the DL DCI and the corresponding PDSCH of a serving cell is equal to or greater than a threshold *timeDurationForQCL* if applicable, where the threshold is based on reported UE capability [13, TS 38.306], for determining PDSCH antenna port quasi co-location, the UE assumes that the TCI state or the QCL assumption for the PDSCH is identical to the TCI state or QCL assumption whichever is applied for the CORESET used for the PDCCH transmission within the active BWP of the serving cell.  <Unchanged text omitted>  ----------------------------------- **End of Text proposal to 5.1.5 of 38.214** ------------------------------------------------  **Proposal 8: For activating/deactivating TCI-states for multicast, not support MAC CE sent over GC-PDSCH.** |
| **Intel** | **Proposal 5: For TCI states activation/deactivation for multicast GC-PDSCH, the unicast PDSCH carrying a ‘TCI States Activation/Deactivation for UE-specific PDSCH MAC CE’ is received by the UE to map up to 8 TCI states configured in PDSCH-Config to the TCI codepoints in both unicast DCI format and DCI format 4\_2.**  **Proposal 6: The default beam for MBS PDSCH scheduled by DCI 4\_1/4\_2 should follow the beam of the CORESET with the lowest index in the active BWP which contains the CFR in which the MBS is scheduled.** |
| **Spreadtrum** | **Observation 1: Introducing separated TCI state configuration/activation/deactivation for MBS is beneficial for some scenarios, e.g., single cell with multiple TRPs operation**  **Conclusion 1:**  **The maximum number of configured TCI states per cell, currently supported for unicast, is kept unchanged for UE to additionally support multicast reception.**   * **How to allocate configured TCI state between unicast and multicast is up to gNB.**   **Conclusion 2:**  **The maximum number of active TCI states per BWP, currently supported for unicast, is kept unchanged for UE to additionally support multicast reception.** |
| **Qualcomm** | **Proposal 4: For multicast RRC\_CONNECTED UEs, if TCI-state(s) is(are) configured in *PDSCH-Config-Multicast*, support both alternatives:**   * **Alt1: TCI-state(s) configured in PDSCH-Config-Multicast can be activated by MAC-CE in multicast GC-PDSCH** * **Alt2: TCI-state(s) configured in PDSCH-Config-Multicast can be activated by MAC-CE in unicast PDSCH** |
| **LG** | Proposal 1: For aligning the application time of the mapping between TCI states and the TCI codepoints in DCI format 4\_2 for different UEs in the same MBS group, if the unicast PDSCH carrying a ‘TCI States Activation/Deactivation for UE-specific PDSCH MAC CE’ has been received, if the legacy condition is met, all UEs in the group apply the activation command upon receiving DCI format 4\_2 indicating a new or existing toggled bit e.g. NDI.  Observation 1: If the UE can be configured with a list of up to M TCI-State configurations within the higher layer parameter PDSCH-Config as in Alt 1 of FL’s proposal, a specific TCI state codepoint of DCI 4\_2 can indicate a deactivated TCI state for one UE but still an activated TCI state for the other UE.  Proposal 2: If a specific TCI state codepoint of DCI 4\_2 indicates a deactivated TCI state for a UE, the UE ignores the corresponding multicast PDSCH, and then the UE sends NACK.  Proposal 6: For reception of GC-PDSCH scheduled by GC-PDCCH, UE determines whether the time offset between the reception of the DL DCI and the corresponding PDSCH of a serving cell is equal to or greater than a threshold timeDurationForQCL if applicable, as specified in clause 5.1.5 of 38.214, where the threshold is configured per G-RNTI by gNB (based on the worst reported UE capability).   * + If the threshold is not configured, the worst value of the threshold in the current specification is used. |
| **Ericsson** | Proposal 10 The TCI states codepoints in DCI 4\_2 are configured by a “TCI States Activation/Deactivation for UE-specific PDSCH” MAC CE  Proposal 11 The “TCI States Activation/Deactivation for UE-specific PDSCH” MAC CE may activate up to 8 TCI states for multicast PDSCH, in addition to up to 8 states in unicast PDSCH  Proposal 12 The TCI states IDs for unicast and multicast TCI state lists do not overlap, and the total number of TCI states across unicast and multicast in a cell does not exceed the currently specified maxNrofTCI-States=128  Proposal 13 Whether the MAC CE configuring the TCI states for multicast is sent over unicast or multicast, is left to the gNB implementation. |

### Issue#3-3) GC-PDSCH Rate matching

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| **Company** | **Proposals** |
| **ZTE** | **Proposal 4: Regarding rate matching of GC-PDSCH reception,**   * **the UE shall assume that the PRBs containing SS/PBCH block transmission resources are not available for PDSCH when receiving the PDSCH scheduled with MCCH-RNTI or G-RNTI for MTCH.** * **the UE shall assume that both of indicated resources in clauses 5.1.4.1, 5.1.4.2 and the PRBs containing SS/PBCH block transmission resources are not available for the PDSCH scheduled with G-RNTI for multicast.** * **Adopt the following TP for Clause 5.1.4 of TS38.214\_h00.**  |  | | --- | | 5.1.4 PDSCH resource mapping When receiving the PDSCH scheduled with SI-RNTI and the system information indicator in DCI is set to 0, the UE shall assume that no SS/PBCH block is transmitted in REs used by the UE for a reception of the PDSCH.  When receiving the PDSCH scheduled with SI-RNTI and the system information indicator in DCI is set to 1, RA-RNTI, MSGB-RNTI, P-RNTI, ~~or~~ TC-RNTI, MCCH-RNTI or G-RNTI for MTCH, the UE assumes SS/PBCH block transmission according to *ssb-PositionsInBurst*, and if the PDSCH resource allocation overlaps with PRBs containing SS/PBCH block transmission resources the UE shall assume that the PRBs containing SS/PBCH block transmission resources are not available for PDSCH in the OFDM symbols where SS/PBCH block is transmitted.  A UE expects a configuration provided by *ssb-PositionsInBurst* in *ServingCellConfigCommon* to be same as a configuration provided by *ssb-PositionsInBurst* in *SIB1*.  When receiving PDSCH scheduled by PDCCH with CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI, G-RNTI for multicast or PDSCHs with SPS, the REs corresponding to the configured or dynamically indicated resources in Clauses 5.1.4.1, 5.1.4.2 are not available for PDSCH. Furthermore, the UE assumes SS/PBCH block transmission according to *ssb-PositionsInBurst* if the PDSCH resource allocation overlaps with PRBs containing SS/PBCH block transmission resources, the UE shall assume that the PRBs containing SS/PBCH block transmission resources are not available for PDSCH in the OFDM symbols where SS/PBCH block is transmitted.  **<Unchanged parts are omitted>** | |

### Issue#3-4) GC-PDSCH processing capability

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| **Company** | **Comment** |
| **Intel** | **Proposal 1: When a UE does not support reception of FDM’ed unicast and MBS PDSCH, when scheduled with a MBS PDSCH scheduled by DCI 4\_0/4\_1/4\_2, in a cell configured with UE PDSCH processing capability 2, a UE may not expected to be scheduled by DCI 1\_1/1\_2 with a unicast PDSCH which is within X symbols of the last symbol of the MBS PDSCH where X is given by UE PDSCH processing capability 1. Otherwise, if scheduled, the UE should drop the MBS PDSCH**  **Proposal 2: When a UE indicates support of reception of FDM’ed unicast and MBS PDSCH and is scheduled with a MBS PDSCH by DCI 4\_0/4\_1/4\_2, in a cell configured with UE PDSCH processing capability 2, a UE may not expected to be scheduled by DCI 1\_1/1\_2 with more than 1 unicast PDSCH which is within X symbols of the last symbol of the MBS PDSCH where X is given by UE PDSCH processing capability 1** |
| **Qualcomm** | **Proposal 11: Endorse TP#9 for TS38.214 to capture the agreement that PDSCH processing capability 2 is not applied to PDSCH scheduled by PDCCH with DCI format 4\_0/4\_1/4\_2.** TP#9 for TS38.214:5.3 UE PDSCH processing procedure time \*\*\* Unchanged text is omitted \*\*\*  - For UE processing capability 2 with scheduling limitation when *µPDSCH* = 1, if the scheduled RB allocation exceeds 136 RBs, the UE defaults to capability 1 processing time. The UE may skip decoding a number of PDSCHs with last symbol within 10 symbols before the start of a PDSCH that is scheduled to follow Capability 2, if any of those PDSCHs are scheduled with more than 136 RBs with 30kHz SCS and following Capability 1 processing time.  - For a UE that supports capability 2 on a given cell, the processing time according to UE processing capability 2 is applied if the high layer parameter *processingType2Enabled* in *PDSCH-ServingCellConfig* is configured for the cell and set to ‘enable’.  - The UE processing capability 2 is not applied to PDSCH scheduled by PDCCH with DCI format 4\_0/4\_1/4\_2.  \*\*\* Unchanged text is omitted \*\*\* |

### Issue#3-5) Others

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| --- | --- |
| **Company** | **Proposals** |
| **CMCC** | **Proposal 6. For RRC\_CONNECTED UEs, a UE can support reception of FDMed one broadcast MCCH/MTCH PDSCH and one multicast PDSCH in one slot based on UE capability.**  **Proposal 7. For RRC\_CONNECTED UEs, a UE is not required to support reception of FDMed broadcast MCCH PDSCH and broadcast MTCH PDSCH in one slot.**  **Proposal 8. For RRC\_CONNECTED UEs, a UE is not required to support reception of FDMed multiple broadcast MTCH PDSCHs in one slot.**  **Proposal 9. For RRC\_CONNECTED UEs, reuse the Rel-16 PDSCH reception restriction between unicast dynamic grant and unicast SPS for Rel-17 multicast and broadcast.**  **The TP suggestion for TS 38.214 section 5.1 is as the following:**  **<**Unchanged text is omitted>  The UE is not expected to decode a PDSCH in a serving cell scheduled by a PDCCH with C-RNTI, CS-RNTI, MCS-C-RNTI, G-RNTI, G-CS-RNTI or MCCH-RNTI and one or multiple PDSCH(s) required to be received according to this Clause in the same serving cell without a corresponding PDCCH transmission if the PDSCHs partially or fully overlap in time except if the PDCCH scheduling the PDSCH ends at least 14 symbols before the earliest starting symbol of the PDSCH(s) without the corresponding PDCCH transmission, where the symbol duration is based on the smallest numerology between the scheduling PDCCH and the PDSCH, in which case the UE shall decode the PDSCH scheduled by the PDCCH.  **Proposal 10. For RRC\_CONNECTED UEs, reuse the Rel-16 PDSCH reception restriction between unicast and RAR for Rel-17 multicast and broadcast.**  **The TP suggestion for TS 38.214 section 5.1 is as the following:**  **<**Unchanged text is omitted>  The UE is not expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, CS-RNTI, G-RNTI, G-CS-RNTI or MCCH-RNTI if another PDSCH in the same cell scheduled with RA-RNTI or MSGB-RNTI partially or fully overlap in time.  **Proposal 11. For RRC\_CONNECTED UEs, reuse the Rel-16 PDSCH reception restriction between unicast and SIB for Rel-17 multicast and broadcast.**  **The TP suggestion for TS 38.214 section 5.1 is as the following:**  **<**Unchanged text is omitted>  On a frequency range 1 cell, the UE shall be able to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, CS-RNTI, G-RNTI, G-CS-RNTI or MCCH-RNTI and, during a process of P-RNTI triggered SI acquisition, another PDSCH scheduled with SI-RNTI that partially or fully overlap in time in non-overlapping PRBs, unless the PDSCH scheduled with C-RNTI, MCS-C-RNTI, CS-RNTI, G-RNTI, G-CS-RNTI or MCCH-RNTI requires Capability 2 processing time according to clause 5.3 in which case the UE may skip decoding of the scheduled PDSCH with C-RNTI, MCS-C-RNTI, CS-RNTI, G-RNTI, G-CS-RNTI or MCCH-RNTI.  On a frequency range 2 cell, the UE is not expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, CS-RNTI, G-RNTI, G-CS-RNTI or MCCH-RNTI if in the same cell, during a process of P-RNTI triggered SI acquisition, another PDSCH scheduled with SI-RNTI partially or fully overlap in time.  The UE is expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, CS-RNTI, G-RNTI, G-CS-RNTI or MCCH-RNTI during a process of autonomous SI acquisition. |
| **Ericsson** | **Proposal 3 Include G-RNTI as part of reception type D4 in 38.202 and add DL-SCH as the associated channel.**  **Proposal 4 Include G-RNTI as part of a separate reception type for broadcast PDCCH in 38.202 and add DL-SCH as the associated channel.** |
| **ETRI** | **Proposal1: Adopt following text proposal for TS 38.214 clause 5.1.2.3.**  =============== Text proposal for TS 38.214 clause 5.1.2.3 ====================== 5.1.2.3 Physical resource block (PRB) bundling The PRB bundling procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 1\_2, by applying the parameters of *prb-BundlingTypeDCI-1-2* instead of *prb-BundlingType* as well as *vrb-ToPRB-InterleaverDCI-1-2* instead of *vrb-ToPRB-Interleaver*.  A UE may assume that precoding granularity is  consecutive resource blocks in the frequency domain.  can be equal to one of the values among {2, 4, wideband}.  If  is determined as “wideband”, the UE is not expected to be scheduled with non-contiguous PRBs and the UE may assume that the same precoding is applied to the allocated resource associated with a same TCI state or a same QCL assumption.  If  is determined as one of the values among {2, 4}, Precoding Resource Block Group (PRGs) partitions the bandwidth part *i* with  consecutive PRBs. Actual number of consecutive PRBs in each PRG could be one or more.  The first PRG size is given by  and the last PRG size given by  if , and the last PRG size is if . For PDSCH scheduled by PDCCH with DCI scrambled using G-RNTI or G-CS-RNTI, is the starting PRB of the CFR and is the size of the CFR.  The UE may assume the same precoding is applied for any downlink contiguous allocation of PRBs in a PRG. < Unchanged parts are omitted > =================================================================== |

## Issue#3-1) RRC parameters

### Summary

Similar to issue#2-1, 1 company [Huawei] also proposes to inform RAN2 the RRC parameters which are not needed in PDSCH-config for multicast. After going through all the RRC parameters listed in Huawei’s proposal, moderator thinks the RRC parameters introduced by URLLC DCI format 1\_2, mTRP and minimum K0 offset can be first discussed. Moderator suggests **initial proposal 3-1a**.

Regarding *tci-StatesToAddModList*, since itis related to the discussion in issue#3-2, moderator suggests to discuss it after we have conclusion for issue#3-2.

Regarding *zp-CSI-RS-ResourceToAddModList* and *zp-CSI-RS-ResourceToReleaseList,* in RAN1#107b-e, it was agreed that *aperiodicZP-CSI-RS-ResourceSetsToAddModList* can be in *PDSCH-Config-Multicast*, considering each element of *aperiodicZP-CSI-RS-ResourceSetsToAddModList* contains one or more *ZP-CSI-RS-Resources* defined in the *zp-CSI-RS-ResourceToAddModList*, it seems straightforward that *zp-CSI-RS-ResourceToAddModList* and *zp-CSI-RS-ResourceToReleaseList* can be configured in *PDSCH-Config-Multicast*.

Regarding *sp-ZP-CSI-RS-ResourceSetsToAddModList, sp-ZP-CSI-RS-ResourceSetsToReleaseList* and *p-ZP-CSI-RS-ResourceSet,* another company [Qualcomm] proposes *sp-ZP-CSI-RS-ResourceSetsToAddModList* and *p-ZP-CSI-RS-ResourceSet* can be configured in *PDSCH-Config-Multicast* for GC-PDSCH rate matching.Moderator thinks more views are needed on this issue. Therefore, moderator suggests **initial question 3-1b**.

It should be noted that the Rel-17 related outgoing LS needs to be finalized before the end of 1st Week of RAN1#108-e meeting, we need to make decision on this issue as soon as possible.

### 1st Round Proposals (Closed)

**Initial proposal 3-1a:**

Send an LS to inform RAN2 that the following parameters are NOT needed for PDSCH-Config-Multicast:

* *minimumSchedulingOffsetK0-r16*
* *antennaPortsFieldPresenceDCI-1-2-r16, aperiodicZP-CSI-RS-ResourceSetsToAddModListDCI-1-2-r16, aperiodicZP-CSI-RS-ResourceSetsToReleaseListDCI-1-2-r16, dmrs-DownlinkForPDSCH-MappingTypeA-DCI-1-2-r16, dmrs-DownlinkForPDSCH-MappingTypeB-DCI-1-2-r16, dmrs-SequenceInitializationDCI-1-2-r16, harq-ProcessNumberSizeDCI-1-2-r16, mcs-TableDCI-1-2-r16, numberOfBitsForRV-DCI-1-2-r16, pdsch-TimeDomainAllocationListDCI-1-2-r16, prb-BundlingTypeDCI-1-2-r16, priorityIndicatorDCI-1-2-r16, rateMatchPatternGroup1DCI-1-2-r16, rateMatchPatternGroup2DCI-1-2-r16, resourceAllocationType1GranularityDCI-1-2-r16, vrb-ToPRB-InterleaverDCI-1-2-r16, referenceOfSLIVDCI-1-2-r16, resourceAllocationDCI-1-2-r16,*
* *dataScramblingIdentityPDSCH2-r16*
* *repetitionSchemeConfig-r16, repetitionSchemeConfig-v1630*

**Initial question 3-1b:**

Whether the following parameters are needed or not for PDSCH-Config-Multicast?

* *zp-CSI-RS-ResourceToAddModList, zp-CSI-RS-ResourceToReleaseList*
* *sp-ZP-CSI-RS-ResourceSetsToAddModList, sp-ZP-CSI-RS-ResourceSetsToReleaseList*
* *p-ZP-CSI-RS-ResourceSet*

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| vivo | Initial proposal 3-1a: fine  Initial question 3-1b: we think it is similar as the TCI state for PDSCH. We think it can be no these parameters in PDSCH-Config-Multicast. |
| NTT DOCOMO | proposal 3-1a: Support  question 3-1b: Based on the current specification, these parameters for unicast are also applied to multicast PDSCH. So it seems to us that they are not needed in PDSCH-Config-Multicast. |
| Huawei, HiSilicon | Agree with 3-1a,  Question 3-1b, we tend to agree not support these configuration. Moreover, even though we agreed these can be configured, we may need to restrict the total number for UE to support or configured should be kept the same as that for unicast. In this case, maybe it is equivalent to not support configuring these in the configuration for multicast specifically. |
| Xiaomi | **Initial proposal 3-1a: OK**  **Initial question 3-1b:** we are OK following the same mechanism as the RB-symbol level RMR configuration. One thing needs to be clarified is whether the RE-level RMR can be applied to unicast PDSCH? |
| OPPO | Proposal 3-1a: OK with it.  Question 3-1b: Not needed. |
| Lenovo, Motorola Mobility | 3-1a: We are not sure why *minimumSchedulingOffsetK0-r16*is not needed. Can you clarify it?  3-1b: We are Ok to not include above parameters. |
| ZTE | Ok with Initial proposal 3-1a.  Regarding Initial question 3-1b:  At least zp-CSI-RS-ResourceToAddModList and zp-CSI-RS-ResourceToReleaseList are needed to allow correct configuration of aperiodic ZP CSI-RS.  For p-ZP-CSI-RS-ResourceSet, we think it is ok to have it since it won’t cause much specification overhead.  For sp-ZP-CSI-RS-ResourceSetsToAddModList and sp-ZP-CSI-RS-ResourceSetsToReleaseList, a MAC-CE may be needed to support the activation/deactivation, at this stage, we suggest not to include the SP ZP CSI-RS here. |
| Nokia, NSB | 3-1a: We are fine with this proposal  3-1b: We think the unicast parameters can be applied for multicast and it is not required to be configured in PDSCH-Config-Multicast |
| Samsung | Proposal 3-1a: Support.  Question 3-1b: Not needed. |
| Qualcomm | Proposal 3-1a: OK  Question 3-1b: We think the ZP CSI-RS list including periodic, aperiodic and SP should be configured in a multicast CFR, where the RE-level RM is to consider for a group of Ues instead of a single UE. For example, ZP CSI-RS-1 for UE1 is applied to unicast PDSCH1 scheduled in a dedicated BWP1; ZP CSI-RS-2 for UE2 is applied to unicast PDSCH2 scheduled in a dedicated BWP2. For a CFR in the overlapped subband of dedicated BWP1 and dedicated BWP2, ZP CSI-RS3 for multicast GC-PDSCH should be configured to include both Res in ZP CSI-RS-1 and ZP CSI-RS-2. But, the ZP CSI-RS3 is not applied to unicast PDSCH1 or PDSCH2.  For aperiodic ZP CSI-RS, we propose to endorse the TP for TS 38.212 to specify the ZP CSI-RS trigger is based on the aperiodic ZP CSI-RS in PDSCH-Config-Multicast for DCI format 4\_2. |
| Ericsson | 3-1a: Support  3-1b: All three bullet points are needed for rate matching purposes |
| CATT | **Initial proposal 3-1a:** OK.  **Initial question 3-1b:** The parameters in first bullet can be configured in PDSCH-Config-Multicast. The parameters in the last second bullet are not needed for PDSCH-Config-Multicast. |
| TD Tech, Chengdu TD Tech | **3-1a:ok**  **3-1b: not needed** |
| Moderator | **Proposal 3-1a**: No update. Most companies are OK except Lenovo raised a question for *minimumSchedulingOffsetK0-r16*.  @Lenovo, we have the following agreement in RAN1#107-e.  Agreement  Multicast DCI format 1\_1 includes all configurable fields of unicast DCI format 1\_1 except   * Identifier for DCI formats, TPC command for scheduled PUCCH, SRS request * FFS: Scell dormancy indication * One-shot HARQ-ACK request, PDSCH group index, New feedback indicator, Number of requested PDSCH group(s), ChannelAccess-Cpext * CBGTI, CBGFI * Minimum applicable scheduling offset indicator * FFS: Carrier indicator, BWP indicator, ZP CSI-RS trigger * FFS: MCS/NDI/RV for TB2   **Proposal 3-1b:**   * [vivo, NTT DoCoMo, Huawei, OPPO, Lenovo, Nokia, Samsung] think these parameters are not needed for PDSCH-Config-Multicast, * [ZTE, CATT] thinks *zp-CSI-RS-ResourceToAddModList* and *zp-CSI-RS-ResourceToReleaseList* are needed to allow correct configuration of aperiodic ZP CSI-RS, while *sp-ZP-CSI-RS-ResourceSetsToAddModList* and *sp-ZP-CSI-RS-ResourceSetsToReleaseList* are not needed. [ZTE] thinks *p-ZP-CSI-RS-ResourceSet* can be configured in PDSCH-Config-Multicast. * [QC, Ericsson] think all these parameters are needed.   After reviewing all companies’ comments, in my understanding,   * For *zp-CSI-RS-ResourceToAddModList* and *zp-CSI-RS-ResourceToReleaseList*, even they are not configured in PDSCH-Config-Multicast, the *zp-CSI-RS-ResourceToAddModList* and *zp-CSI-RS-ResourceToReleaseList* configured in PDSCH-Config for unicast can be used for multicast (i.e. used for the *aperiodicZP-CSI-RS-ResourceSetsToAddModList* in PDSCH-Config-Multicast). It can be up to gNB to ensure the appropriate configuration. From this perspective, it is still workable even *zp-CSI-RS-ResourceToAddModList* and *zp-CSI-RS-ResourceToReleaseList* are not configured in PDSCH-Config-Multicast. * For *sp-ZP-CSI-RS-ResourceSetsToAddModList*, *sp-ZP-CSI-RS-ResourceSetsToReleaseList*, *p-ZP-CSI-RS-ResourceSet*, it seems also workable without configuring them specifically in PDSCH-Config-Multicast. It can be up to gNB to configure them appropriately for a group of UEs.   Based on this understanding, moderator suggests initial proposal 3-1b. |

### 2nd Round Proposals (Closed)

**Initial proposal 3-1a:**

Send an LS to inform RAN2 that the following parameters are NOT needed for PDSCH-Config-Multicast:

* *minimumSchedulingOffsetK0-r16*
* *antennaPortsFieldPresenceDCI-1-2-r16, aperiodicZP-CSI-RS-ResourceSetsToAddModListDCI-1-2-r16, aperiodicZP-CSI-RS-ResourceSetsToReleaseListDCI-1-2-r16, dmrs-DownlinkForPDSCH-MappingTypeA-DCI-1-2-r16, dmrs-DownlinkForPDSCH-MappingTypeB-DCI-1-2-r16, dmrs-SequenceInitializationDCI-1-2-r16, harq-ProcessNumberSizeDCI-1-2-r16, mcs-TableDCI-1-2-r16, numberOfBitsForRV-DCI-1-2-r16, pdsch-TimeDomainAllocationListDCI-1-2-r16, prb-BundlingTypeDCI-1-2-r16, priorityIndicatorDCI-1-2-r16, rateMatchPatternGroup1DCI-1-2-r16, rateMatchPatternGroup2DCI-1-2-r16, resourceAllocationType1GranularityDCI-1-2-r16, vrb-ToPRB-InterleaverDCI-1-2-r16, referenceOfSLIVDCI-1-2-r16, resourceAllocationDCI-1-2-r16,*
* *dataScramblingIdentityPDSCH2-r16*
* *repetitionSchemeConfig-r16, repetitionSchemeConfig-v1630*

**Initial proposal 3-1b:**

Send an LS to inform RAN2 that the following parameters are NOT needed for PDSCH-Config-Multicast:

* *zp-CSI-RS-ResourceToAddModList, zp-CSI-RS-ResourceToReleaseList*
* *sp-ZP-CSI-RS-ResourceSetsToAddModList, sp-ZP-CSI-RS-ResourceSetsToReleaseList*
* *p-ZP-CSI-RS-ResourceSet*

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Lenovo | Support |
| OPPO | OK with the two proposals. |
| CATT | Initial proposal 3-1a: Support  Initial proposal 3-1b:   * For *zp-CSI-RS-ResourceToAddModList* and *zp-CSI-RS-ResourceToReleaseList* , both of two parameters should be configured in PDSCH-Config-Multicast to align the configuration of *aperiodic-zp-CSI-RS-ResourceRetsToAddModList* and *aperiodic-ZP-CSI-RS-ResourceSetsToReleaseList* in PDSCH-Config-Multicast among MBS Ues. In additional, for PDSCH resource mapping with RB symbol level granularity, it was agreed that the related parameters configured for unicast( rateMatchPatternToAddModList, rateMatchPatternGroup1 and rateMatchPatternGroup2 ) do not apply for GC-PDSCHs. We think similar rule should be followed by *zp-CSI-RS-ResourceToAddModList* and *zp-CSI-RS-ResourceToReleaseList* of multicast. * For the second bullet and third bullet, if these parameters are not configured in PDSCH-Config-Multicast, we think it means the PDSCH resource mapping with RE level for GC-PDSCH doesn’t support periodic ZP-CSI-RS resource set and semi-persistent ZP CSI-RS resource set for GC-PDSCH. |
| ZTE | Initial proposal 3-1a: OK  Initial proposal 3-1b: We can live with it. |
| Vivo | Support. For Initial proposal 3-1b, we share the same understanding with FL. |
| Nokia, NSB | We are fine with the proposals |
| Qualcomm | On proposal 3-1b, we share similar concern as CATT. We think p/ap/sp ZP CSI-RS for multicast should be configured in PDSCH-Config-Multicast, separate from unicast. If a ZP CSI-RS is always applied to both unicast and multicast PDSCH, it means the RE-level rate matching has to consider aligning the available resources for a group of Ues instead of one UE, which will jeopardize the unicast PDSCH performance. |
| Huawei, HiSilicon | Ok |
| NTT DOCOMO | Support |
| Xiaomi | OK |
| MediaTek | Ok |
| Moderator | Initial proposal 3-1a is stable for more than 24 hours, and I moved it to section 7. Companies can still discuss Initial proposal 3-1b in this table. |
| Ericsson | OK with both proposal. we have the same understanding as QC and CATT above that a separate set of ZP CSI-RS resources are needed for multicast in order to not impact the RM of unicast. |
| Samsung | OK |
| Moderator | @QC/CATT, as I explained earlier, my understanding is as below. Please confirm if you are OK with proposal 3-1b now.   * For *zp-CSI-RS-ResourceToAddModList* and *zp-CSI-RS-ResourceToReleaseList*, even they are not configured in PDSCH-Config-Multicast, the *zp-CSI-RS-ResourceToAddModList* and *zp-CSI-RS-ResourceToReleaseList* configured in PDSCH-Config for unicast can be used for multicast (i.e. used for the *aperiodicZP-CSI-RS-ResourceSetsToAddModList* in PDSCH-Config-Multicast). It can be up to gNB to ensure the appropriate configuration. From this perspective, it is still workable even *zp-CSI-RS-ResourceToAddModList* and *zp-CSI-RS-ResourceToReleaseList* are not configured in PDSCH-Config-Multicast. * For *sp-ZP-CSI-RS-ResourceSetsToAddModList*, *sp-ZP-CSI-RS-ResourceSetsToReleaseList*, *p-ZP-CSI-RS-ResourceSet*, it seems also workable without configuring them specifically in PDSCH-Config-Multicast. It can be up to gNB to configure them appropriately for a group of UEs. |
| Qualcomm | For *zp-CSI-RS-ResourceToAddModList* and *zp-CSI-RS-ResourceToReleaseList*, we can be ok that they are only configured in PDSCH-Config.  But for *p-ZP-CSI-RS-ResourceSet*, as long as it is configured in PDSCH-Config, it is always applied to unicast PDSCH and multicast GC-PDSCH. We shared concern before, it means the unicast PDSCH will have to rate match around the zero power REs in the same way as GC-PDSCH for for a group of UEs.  For *sp-ZP-CSI-RS-ResourceSetsToAddModList*, *sp-ZP-CSI-RS-ResourceSetsToReleaseList*, if it is activated (e.g., by using unicast PDSCH MAC-CE), it is applied to unicast PDSCH and multicast PDSCH, similar issue as *p-ZP-CSI-RS-ResourceSet*.  Similar as rate matching pattern configuration, separate p/sp/a-ZP-CSI-RS should be applied to unicast PDSCH and GC-PDSCH.   * if p/sp/a-ZP-CSI-RS are configured in PDSCH-Config, it is applied to unicast PDSCH only. * if p/sp/a-ZP-CSI-RS are configured in PDSCH-Config-Multicast, it is applied to GC-PDSCH only.   So we propose to deleted p/sp-ZP-CSI-RS in proposal 3-1b.  **Initial proposal 3-1b:**  Send an LS to inform RAN2 that the following parameters are NOT needed for PDSCH-Config-Multicast:   * *zp-CSI-RS-ResourceToAddModList, zp-CSI-RS-ResourceToReleaseList* |
| CATT | For the sake of compromise, we can live with Qualcomm’s version.  But, for the second and third bullet, we have different understanding with FL’s clarification. In our view, the design of the aperiodic/semi-persistent/periodic ZP CSI-RS resource set configuration for multicast should follow the same design principle.   * If semi-persistent and periodic ZP CSI-RS resource set configuration will be supported for multicast, we think at least *sp-ZP-CSI-RS-ResourceSetsToAddModList, sp-ZP-CSI-RS-ResourceSetsToReleaseList, p-ZP-CSI-RS-ResourceSet* are needed for multicast, similar as introduction of *aperiodicZP-CSI-RS-ResourceSetsToAddModList and aperiodicZP-CSI-RS-ResourceSetsToReleaseList* in PDSCH-Config-multicast. In this case, we share same view as Qualcomm. * If semi-persistent and periodic ZP CSI-RS resource set configuration will not be supported for multicast, then *sp-ZP-CSI-RS-ResourceSetsToAddModList, sp-ZP-CSI-RS-ResourceSetsToReleaseList, p-ZP-CSI-RS-ResourceSet* are not needed in PDSCH-Config-multicast. |
| Moderator | Based on comments from QC and CATT, the proposal 3-1b was updated.   * Regarding *p-ZP-CSI-RS-ResourceSet*, I understand QC and CATT’ concern. If we only consider unicast, different UEs may have different periodic ZP CSI-RS resource configurations for unicast. For multicast, the periodic ZP CSI-RS resource configuration(s) used for multicast should be common for different UEs in the same group, i.e. within the CFR, the REs of periodic ZP CSI-RS resource configuration(s) used for multicast should be a super set of the REs of periodic ZP CSI-RS resource configuration(s) used for unicast of different UEs in the same group. If there is no dedicated *p-ZP-CSI-RS-ResourceSet* configured in *PDSCH-Config-Multicast*, that means the unicast PDSCH will have to rate match around the REs in the periodic ZP CSI-RS resource configuration(s) used for multicast when the unicast PDSCH occupies the frequency resources in the CFR. I think it still works, although it will cause some inefficiency for unicast PDSCH, since the unicast PDSCH has to rate match around the REs used for rate matching of other UE’s unicast PDSCH. It seems QC and CATT suggest to optimize it as below:   + **Initial proposal 3-1c:** For multicast RRC\_CONNECTED UEs, *p-ZP-CSI-RS-ResourceSet* can be configured in *PDSCH-Config-Multicast* for GC-PDSCH rate matching, subject to UE capability. For PDSCH resource mapping with RE symbol level granularity,     - the REs indicated by *p-ZP-CSI-RS-ResourceSet* configured in *PDSCH-Config-Multicast* are declared as not available for GC-PDSCH.     - *p-ZP-CSI-RS-ResourceSet* configured in *PDSCH-Config* for unicast do not apply for GC-PDSCHs.     - *p-ZP-CSI-RS-ResourceSet* in *PDSCH-Config-Multicast* for multicast do not apply for unicast PDSCHs. * However, for *sp-ZP-CSI-RS-ResourceSetsToAddModList*, considering companies have concern on supporting using GC-PDSCH to deliver SP ZP CSI-RS Resource Set Activation/Deactivation MAC CE, since it will have larger RAN2 spec impact, I’m not sure we can easily support *sp-ZP-CSI-RS-ResourceSetsToAddModList* and *sp-ZP-CSI-RS-ResourceSetsToReleaseList* to be configured in *PDSCH-Config-Multicast*. Maybe one way is we do not optimize for this case, and *sp-ZP-CSI-RS-ResourceSetsToAddModList/sp-ZP-CSI-RS-ResourceSetsToReleaseList* cannot be configured in PDSCH-Config-Multicast, and just let gNB to handle it by implementation. |

### 3rd Round Proposals (Open)

**Updated proposal 3-1b:**

Send an LS to inform RAN2 that the following parameters are NOT needed for PDSCH-Config-Multicast:

* *zp-CSI-RS-ResourceToAddModList, zp-CSI-RS-ResourceToReleaseList*
* *sp-ZP-CSI-RS-ResourceSetsToAddModList,* *sp-ZP-CSI-RS-ResourceSetsToReleaseList*
* *~~p-ZP-CSI-RS-ResourceSet~~*

**Initial proposal 3-1c:** For multicast RRC\_CONNECTED UEs, *p-ZP-CSI-RS-ResourceSet* can be configured in *PDSCH-Config-Multicast* for GC-PDSCH rate matching, subject to UE capability. For PDSCH resource mapping with RE symbol level granularity,

* the REs indicated by *p-ZP-CSI-RS-ResourceSet* configured in *PDSCH-Config-Multicast* are declared as not available for GC-PDSCH.
* *p-ZP-CSI-RS-ResourceSet* configured in *PDSCH-Config* for unicast do not apply for GC-PDSCHs.
* *p-ZP-CSI-RS-ResourceSet* in *PDSCH-Config-Multicast* for multicast do not apply for unicast PDSCHs.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Qualcomm | Support proposal 3-1c.  For proposal 3-1b, one question for clarification on “sp-ZP-CSI-RS is not configured in PDSCH-Config-Multicast”: Which alternative should UE assume?  Alt1: sp-ZP-CSI-RS is supported for multicast PDSCH.   * sp-ZP-CSI-RS in PDSCH-Config if activated is applied to both unicast PDSCH and multicast PDSCH   Alt2: sp-ZP-CSI-RS is NOT supported for multicast PDSCH.   * sp-ZP-CSI-RS in PDSCH-Config if activated is only applied to unicast PDSCH but not multicast PDSCH.   If no sp-ZP-CSI-RS is configured in PDSCH-Config-Multicast, we prefer Alt2 instead of Alt1 to keep separate rate matching for unicast and multicast.  Regarding FL’s concern on GC-PDSCH carrying MAC-CE, actually we think unicast PDSCH can be used to Activation/Deactivation MAC CE for SP-ZP-CSI-RS configured in PDSCH-Config-Multicast. |
| CATT | Updated proposal 3-1b: We are ok with the proposal.  Initial proposal 3-1c: Support. |
| LG Electronics | If RAN1 agrees that sp-ZP-CSI-RS can be configured in PDSCH-Config-Multicast for multicast PDSCH, we think that the MAC CE for PDSCH-Config-Multicast could be transmitted over unicast PDSCH. In this case, UE should be able to associate the MAC CE over unicast PDSCH to *PDSCH-Config-Multicast*, even though the existing MAC CE structure (i.e. SP ZP CSI-RS Resource Set Activation/Deactivation MAC CE) could be reused for multicast. |

## Issue#3-2) TCI states for GC-PDSCH

### Summary

During the discussion in RAN1#107b-e, the following two alternatives were discussed for TCI states activation/deactivation for multicast GC-PDSCH.

* Alt-1: The unicast PDSCH carrying a ‘TCI States Activation/Deactivation for UE-specific PDSCH MAC CE’ is received by the UE to map up to 8 TCI states configured in *PDSCH-Config* to the TCI codepoints in both unicast DCI format and DCI format 4\_2. The following text in Clause 5.1.5 of TS38.214 is deleted.
  + “The UE can be configured with a list of up to *M’* *TCI-State*configurations within the higher layer parameter *PDSCH-Config-Multicast* to decode PDSCH associated with a G-RNTI or a G-CS-RNTI according to a detected PDCCH with DCI intended for the UE and the given serving cell, where M’ depends on the UE capability.”
* Alt-2: The UE can be configured with a list of up to M’ TCI-State configurations within the higher layer parameter PDSCH-Config-Multicast for multicast, but the *TCI-StateIds* of the list of up to M’ TCI-State configurations in PDSCH-Config-Multicast for multicast cannot be the same as the *TCI-StateIds* of the list of up to M TCI-State configurations in PDSCH-Config for unicast. In this alternative, separate unicast PDSCHs carrying the existing ‘TCI States Activation/Deactivation for UE-specific PDSCH MAC CE’ can be used to map separate TCI states to the TCI codepoints in unicast DCI format and the TCI codepoints in DCI format 4\_2 respectively.

Based on the contributions submitted in this meeting, 4 companies [Huawei, vivo, Nokia, Intel] prefer Alt 1, and 1 company [Spreadtrum] prefer Alt 2. 2 companies [Qualcomm, Ericsson] propose to support TCI-state(s) configured in PDSCH-Config-Multicast can be activated by MAC-CE in multicast GC-PDSCH and unicast PDSCH. Considering majority view is Alt 1 in the last round discussion in RAN1#107bis-e, moderator suggests to take Alt 1 as in **initial proposal 3-2a**.

### 1st Round Proposals (Closed)

**Initial proposal 3-2a:**

For TCI states activation/deactivation for multicast GC-PDSCH, Alt-1 is supported.

* Alt-1: The unicast PDSCH carrying a ‘TCI States Activation/Deactivation for UE-specific PDSCH MAC CE’ is received by the UE to map up to 8 TCI states configured in *PDSCH-Config* to the TCI codepoints in both unicast DCI format and DCI format 4\_2. The following text in Clause 5.1.5 of TS38.214 is deleted.
  + “The UE can be configured with a list of up to *M’* *TCI-State*configurations within the higher layer parameter *PDSCH-Config-Multicast* to decode PDSCH associated with a G-RNTI or a G-CS-RNTI according to a detected PDCCH with DCI intended for the UE and the given serving cell, where M’ depends on the UE capability.”

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Spreadtrum | Although we prefer to separated TCI state configuration for MBS, but we can live with initial proposal 3-2a, if it is the majority. |
| vivo | Support. |
| LG Electronics | OK |
| NTT DOCOMO | Support |
| Huawei, HiSilicon | Ok with this. |
| Xiaomi | Support. |
| OPPO | OK. |
| Apple | We support the proposal. In addition, we consider the TCI field in DCI format 4\_2 can be removed. The group common PDSCH beam is the same as the GC-PDCCH beam. |
| ZTE | OK with Alt-1. |
| Nokia, NSB | We are fine with this proposal |
| Samsung | OK. |
| Qualcomm | Not support.  We think the TCI state(s) can be configured in a CFR for multicast. The UE-specific PDSCH or GC-PDSCH can be used for its activation/deactivation. |
| Ericsson | For the sake of compromise we can support the proposal, even if we tend to agree with Qualcomm that the TCI state framework could be extended to multicast without much complexity. |
| CATT | We are ok with the initial proposal 3-2a. |
| MediaTek | Support the proposal |
| TD Tech, Chengdu TD Tech | ok |
| Moderator | No update. Qualcomm still has concern on the proposal. |

### 2nd Round Proposals (Open)

**Initial proposal 3-2a:**

For TCI states activation/deactivation for multicast GC-PDSCH, Alt-1 is supported.

* Alt-1: The unicast PDSCH carrying a ‘TCI States Activation/Deactivation for UE-specific PDSCH MAC CE’ is received by the UE to map up to 8 TCI states configured in *PDSCH-Config* to the TCI codepoints in both unicast DCI format and DCI format 4\_2. The following text in Clause 5.1.5 of TS38.214 is deleted.
  + “The UE can be configured with a list of up to *M’* *TCI-State*configurations within the higher layer parameter *PDSCH-Config-Multicast* to decode PDSCH associated with a G-RNTI or a G-CS-RNTI according to a detected PDCCH with DCI intended for the UE and the given serving cell, where M’ depends on the UE capability.”

Provide your comments only when you have concern on it.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Qualcomm | The TCI-state(s) configured in PDSCH-Config-Multicast captured in 38.214 is anyway subject to UE capability. As a compromise, we can support unicast PDSCH for activation/deactivation of TCI-state in PDSCH-Config-Multicast.  **Initial proposal 3-2a:**  For TCI states activation/deactivation for multicast GC-PDSCH, Alt-1 is supported.   * Alt-1: The unicast PDSCH carrying a ‘TCI States Activation/Deactivation for UE-specific PDSCH MAC CE’ is received by the UE to map up to 8 TCI states configured in *PDSCH-Config* or *PDSCH-Config-Multicast* to the TCI codepoints in both unicast DCI format and DCI format 4\_2. |
| Moderator | Based on the discussions so far, I’m not sure whether it is acceptable for other companies. |
| Ericsson | Support the QC proposal. we note that the impact on specification is minor. For differentiation between unicast and multicast, one of the reserved bits in the MAC CE could be used, or the differentiation could be done by the RNTI. |
| ZTE | Question for clarification for Qualcomm’s proposal above.  If the MAC-CE can be used to map up to 8 TCI states configured in PDSCH-Config or PDSCH-Config-Multicast, if TCI states are configured in both PDSCH-Config and PDSCH-Config-Multicast, how can the UE know whether it should use the TCI states in PDSCH-Config or PDSCH-Config-Multicast? |
| vivo | For QC’s proposal. It seems 8 TCI states can be activated for unicast and multicast totally. If so, what’s the benefit of this proposal comparing with Initial proposal 3-2a? we think it is even worse. In Initial proposal 3-2a, the 8 TCI states can be dynamically shared (DCI-level) or semi-statically shared (RRC-level or MAC CE level). But in the proposal given by QC, the 8 TCI states can be semi-statically shared based (RRC-level or MAC CE level). Note that the TCI state for unicast and multicast may be the same, in that case, one TCI state is enough in Initial proposal 3-2a, but two TCI states are needed in the proposal given by QC. |
| Huawei, HiSilicon | We would prefer the initial version. Since multicast is scheduled in a CFR contained in UE active BWP and assuming the total number of TCI states will be kept unchanged as that for unicast, it seems simpler and to ease both UE and NW implementation for manipulating the TCI operations. |
| Xiaomi | We share similar views with companies that the initial version is better. |
| Spreadtrum | Fine with initial version. |
| CATT | We prefer to support the initial version. If the unicast PDSCH carrying a ‘TCI States Activation/Deactivation for UE-specific PDSCH MAC CE’ can be used to activate the TCI states configured in PDSCH-Config-Multicast, whether a MAC CE can be used for both PDSCH and GC-PDSCH? Then, whether the total number of activated TCI stated in a UE is still 8? Moreover, the benefit to support the updated version is not clear for us. |
| Qualcomm2 | We have one concern on the sharing unicast and multicast TCI states by using unicast PDSCH-Config.  For sake of simplicity, let’s say max 4 TCI-states can be activated and 3 UEs with each monitor 2 multicast G-RNTIs plus per UE’s C-RNTI.   |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | G-RNTI1 | G-RNTI2 | G-RNTI3 | C-RNTI | | UE1 | x | x |  | x | | UE2 |  | x | x | x | | UE3 | x |  | x | x |   Case 1: If only PDSCH-Config is supported, the TCI-state index for unicast and multicast has to be different. So, only one TCI state can be allocated for unicast per UE. If more UEs and G-RNTIs are involved, potentially no remaining TCI states can be used for unicast.   |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | G-RNTI1 | G-RNTI2 | G-RNTI3 | C-RNTI | | TCI-state index common for UE1, UE2, UE3 | 0 | 1 | 2 | 3 |   Case 2: If PDSCH-Config and PDSCH-Config-Multicast are both supported, the TCI-state index for unicast and multicast can be independent. Two TCI states are required for the two monitored G-RNTIs per UE and the remaining two TCI states can be used for unicast.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | For UE1 | G-RNTI1 | G-RNTI2 | G-RNTI3 | C-RNTI | | TCI-state in PDSCH-Config-Multicast | 0 | 1 | - | - | | TCI-state in PDSCH-Config | - | - | - | 0, 1 |  |  |  |  |  |  | | --- | --- | --- | --- | --- | | For UE2 | G-RNTI1 | G-RNTI2 | G-RNTI3 | C-RNTI | | TCI-state in PDSCH-Config-Multicast | - | 0 | 1 | - | | TCI-state in PDSCH-Config | - | - | - | 0, 1 |  |  |  |  |  |  | | --- | --- | --- | --- | --- | | For UE3 | G-RNTI1 | G-RNTI2 | G-RNTI3 | C-RNTI | | TCI-state in PDSCH-Config-Multicast | 0 | - | 1 | - | | TCI-state in PDSCH-Config | - | - | - | 0, 1 |   From the above comparison, we think PDSCH-Config-Multicast if configured can support more flexible sharing between multicast and unicast within the limited number of activated TCI states. As Ericsson said, the MAC-CE in unicast PDSCH can use the reserved bit to differentiate whether it is in PDSCH-Config-Multicast or PDSCH-Config.  Again, we don’t see any issue of using GC-PDSCH for MAC-CE activation and actually it is more efficient for a group of UE. But as a compromise, we can support only unicast PDSCH MAC-CE to activate the TCI-states in PDSCH-Config-Multicast. |
| Samsung | Fine with the initial version. Agree with Vivo and Huawei. |
| Moderator | Based on comments, majority view is still the initial version. I think QC’s suggestion is an optimization.  @QC/Ericsson, please confirm if you are OK to accept the initial version. |
| Qualcomm | Well, we are not sure the initial version can work or not in some cases. For example, if there are more G-RNTIs monitored by different UE belonging to multiple UE groups and gNB have to align the TCI-state for all there G-RNTIs (e.g., 4 or more G-RNTIs using different TCI-state for different UE groups in the above example), there may be no TCI-state available for unicast PDCCH/PDSCH.  Could supporting companies share any views on how to dynamically allocate the TCI-states for multiple G-RNTIs and C-RNTIs by using PDSCH-Config only? |
| LG Electronics | We are OK with the proposal.  By the way, as discussed in our contribution, we think that if the UE can be configured with a list of up to M TCI-State configurations within the higher layer parameter PDSCH-Config as in Alt 1 of FL’s proposal, a specific TCI state codepoint of DCI 4\_2 may indicate a deactivated TCI state for one UE but still an activated TCI state for the other UE. If such case happens, i.e. if a specific TCI state codepoint of DCI 4\_2 indicates a deactivated TCI state for a UE, it is not clear how UE receives multicast PDSCH by using the deactivated TCI state. In our view, it is natural that the UE ignores the corresponding multicast PDSCH.  For example, both UE1 and UE2 in the same group e.g. for G-RNTI#1 can be configured with the TCI states 1, 2, 3 and 4. Then, the network can activate TCI state 1 and 2 for UE1 by sending the TCI States Activation/Deactivation for UE-specific PDSCH MAC CE over unicast PDSCH. Meanwhile, the network can activate TCI state 2 for UE2 by sending the TCI States Activation/Deactivation for UE-specific PDSCH MAC CE over unicast PDSCH. In this case, if UE receives the DCI 4\_2 of which CRC is scrambled by G-RNTI#1 and the DCI 4\_2 indicates a specific codepoint mapped to both TCI state 1 for UE1 and TCI state 2 for UE2, UE1 and UE2 receive a same multicast PDSCH scheduled by the DCI 4\_2 by using TCI state 1 and TCI state 2, respectively. However, if UE receives the DCI 4\_2 of which CRC is scrambled by G-RNTI#1 and the DCI 4\_2 indicates a specific codepoint mapped to both TCI state 2 for UE1 and TCI state 3 for UE2, UE1 receives multicast PDSCH scheduled by the DCI 4\_2 by using TCI state 2, while it is not clear how UE2 receives multicast PDSCH by using TCI state 3 which is deactivated for UE2. |

## Issue#3-3) GC-PDSCH Rate matching

### Summary

1 company [ZTE] proposes the PRBs of SSB are not used for broadcast PDSCH and both of indicated resources in TS 38.214 clauses 5.1.4.1, 5.1.4.2 and the PRBs of SSB are not used for multicast PDSCH. Moderator suggests **initial proposal 3-3a**.

### 1st Round Proposals (Closed)

**Initial proposal 3-3a:**

Regarding rate matching of GC-PDSCH reception,

* the UE shall assume that the PRBs containing SS/PBCH block transmission resources are not available for PDSCH when receiving the PDSCH scheduled with MCCH-RNTI or G-RNTI for MTCH.
* the UE shall assume that both of indicated resources in clauses 5.1.4.1, 5.1.4.2 and the PRBs containing SS/PBCH block transmission resources are not available for the PDSCH scheduled with G-RNTI for multicast.
* Adopt the following TP for Clause 5.1.4 of TS38.214\_h00.

----------------- Start of TP ----------------

5.1.4 PDSCH resource mapping

**<**Unchanged text is omitted>

When receiving the PDSCH scheduled with SI-RNTI and the system information indicator in DCI is set to 0, the UE shall assume that no SS/PBCH block is transmitted in REs used by the UE for a reception of the PDSCH.

When receiving the PDSCH scheduled with SI-RNTI and the system information indicator in DCI is set to 1, RA-RNTI, MSGB-RNTI, P-RNTI, ~~or~~ TC-RNTI, MCCH-RNTI or G-RNTI for MTCH, the UE assumes SS/PBCH block transmission according to *ssb-PositionsInBurst*, and if the PDSCH resource allocation overlaps with PRBs containing SS/PBCH block transmission resources the UE shall assume that the PRBs containing SS/PBCH block transmission resources are not available for PDSCH in the OFDM symbols where SS/PBCH block is transmitted.

A UE expects a configuration provided by *ssb-PositionsInBurst* in *ServingCellConfigCommon* to be same as a configuration provided by *ssb-PositionsInBurst* in *SIB1*.

When receiving PDSCH scheduled by PDCCH with CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI, G-RNTI for multicast or PDSCHs with SPS, the REs corresponding to the configured or dynamically indicated resources in Clauses 5.1.4.1, 5.1.4.2 are not available for PDSCH. Furthermore, the UE assumes SS/PBCH block transmission according to *ssb-PositionsInBurst* if the PDSCH resource allocation overlaps with PRBs containing SS/PBCH block transmission resources, the UE shall assume that the PRBs containing SS/PBCH block transmission resources are not available for PDSCH in the OFDM symbols where SS/PBCH block is transmitted.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Spreadtrum | Support |
| vivo | ok |
| NTT DOCOMO | OK |
| Huawei, HiSilicon | ok |
| Xiaomi | OK |
| OPPO | OK |
| Apple | OK with this TP |
| ZTE | We support this TP. |
| Nokia, NSB | We are fine with this proposal |
| Samsung | OK |
| Qualcomm | Not sure we need this proposal.  If a UE is not required to support FDMed SSB and MCCH/MTCH, it seems no need to specify the RM for GC-PDSCH. |
| Ericsson | Support. The last sentence starting with “Furthermore…” seem to need a grammar fix using either a period or a “and”:  Furthermore, the UE assumes SS/PBCH block transmission according to *ssb-PositionsInBurst* if the PDSCH resource allocation overlaps with PRBs containing SS/PBCH block transmission resources, and the UE shall assume that the PRBs containing SS/PBCH block transmission resources are not available for PDSCH in the OFDM symbols where SS/PBCH block is transmitted. |
| CATT | OK |
| TD Tech, Chengdu TD Tech | ok |
| Moderator | It seems [QC] has concern for the broadcast part. I updated the proposal to focus on the multicast part and give companies more time to discuss on the broadcast part. |

### 2nd Round Proposals (Closed)

**Updated proposal 3-3a:**

Regarding rate matching of GC-PDSCH reception,

* ~~the UE shall assume that the PRBs containing SS/PBCH block transmission resources are not available for PDSCH when receiving the PDSCH scheduled with MCCH-RNTI or G-RNTI for MTCH.~~
* the UE shall assume that both of indicated resources in clauses 5.1.4.1, 5.1.4.2 and the PRBs containing SS/PBCH block transmission resources are not available for the PDSCH scheduled with G-RNTI for multicast.
* Adopt the following TP for Clause 5.1.4 of TS38.214\_h00.

----------------- Start of TP ----------------

5.1.4 PDSCH resource mapping

**<**Unchanged text is omitted>

When receiving the PDSCH scheduled with SI-RNTI and the system information indicator in DCI is set to 0, the UE shall assume that no SS/PBCH block is transmitted in REs used by the UE for a reception of the PDSCH.

When receiving the PDSCH scheduled with SI-RNTI and the system information indicator in DCI is set to 1, RA-RNTI, MSGB-RNTI, P-RNTI or TC-RNTI, the UE assumes SS/PBCH block transmission according to *ssb-PositionsInBurst*, and if the PDSCH resource allocation overlaps with PRBs containing SS/PBCH block transmission resources the UE shall assume that the PRBs containing SS/PBCH block transmission resources are not available for PDSCH in the OFDM symbols where SS/PBCH block is transmitted.

A UE expects a configuration provided by *ssb-PositionsInBurst* in *ServingCellConfigCommon* to be same as a configuration provided by *ssb-PositionsInBurst* in *SIB1*.

When receiving PDSCH scheduled by PDCCH with CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI, G-RNTI for multicast or PDSCHs with SPS, the REs corresponding to the configured or dynamically indicated resources in Clauses 5.1.4.1, 5.1.4.2 are not available for PDSCH. Furthermore, the UE assumes SS/PBCH block transmission according to *ssb-PositionsInBurst* if the PDSCH resource allocation overlaps with PRBs containing SS/PBCH block transmission resources, and the UE shall assume that the PRBs containing SS/PBCH block transmission resources are not available for PDSCH in the OFDM symbols where SS/PBCH block is transmitted.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| CATT | We wonder why it is assume that the PDSCH scheduled with MCCH-RNTI or G-RNTI for MTCH will not overlap with PRBs containing SS/PBCH block transmission resources? It was only agreed in RAN1#107b-e that a UE is not required to support reception of FDMed MCCH/MTCH PDSCH and SIB1or Paging PDSCH in PCell. Per our understanding, the first bullet of initial proposal 3-3a should be supported. |
| ZTE | We also think the first bullet should be supported, but we are ok to leave the discussion to AI8.12.3.  For the TP, we are ok with it. |
| Qualcomm | ok |
| Huawei, HiSilicon | Share the view from CATT. Wonder how it is related to FDM-ed SSB and broadcast? |
| Samsung | Agree with CATT – the first bullet should be supported. |
| Qualcomm | For broadcast, if only TDMed SSB and MCCH/MTCH are supported (under discussion in 8.12.3), we don’t see the rate matching is needed. |
| Ericsson | Support |
| Moderator | Based on comments so far, I think at least all companies are OK with the multicast part. Regarding the broadcast part, we can discuss it separately based on the progress in AI8.12.3. I moved the proposal in section 7. If any company has concern on this, please raise it directly in the email thread. |

## Issue#3-4) GC-PDSCH processing capability

### Summary

1 company [Qualcomm] proposes to capture the PDSCH capability 2 are not applied for multicast in TS 38.214, moderator suggests **Initial TP 3-4-1**.

1 company [Intel] raises the following proposals. Considering the related proposals are limited, more views on this are invited. Moderator will make some proposals based on more inputs.

* Proposal 1: When a UE does not support reception of FDM’ed unicast and MBS PDSCH, when scheduled with a MBS PDSCH scheduled by DCI 4\_0/4\_1/4\_2, in a cell configured with UE PDSCH processing capability 2, a UE may not expected to be scheduled by DCI 1\_1/1\_2 with a unicast PDSCH which is within X symbols of the last symbol of the MBS PDSCH where X is given by UE PDSCH processing capability 1. Otherwise, if scheduled, the UE should drop the MBS PDSCH
* Proposal 2: When a UE indicates support of reception of FDM’ed unicast and MBS PDSCH and is scheduled with a MBS PDSCH by DCI 4\_0/4\_1/4\_2, in a cell configured with UE PDSCH processing capability 2, a UE may not expected to be scheduled by DCI 1\_1/1\_2 with more than 1 unicast PDSCH which is within X symbols of the last symbol of the MBS PDSCH where X is given by UE PDSCH processing capability 1

### 1st Round Proposals (Closed)

**Initial TP 3-4-1:**

Adopt the following TP for Clause 5.3 in TS 38.214:

----------------- Start of TP ----------------

5.3 UE PDSCH processing procedure time

**<**Unchanged text is omitted>

- For UE processing capability 2 with scheduling limitation when *µPDSCH* = 1, if the scheduled RB allocation exceeds 136 RBs, the UE defaults to capability 1 processing time. The UE may skip decoding a number of PDSCHs with last symbol within 10 symbols before the start of a PDSCH that is scheduled to follow Capability 2, if any of those PDSCHs are scheduled with more than 136 RBs with 30kHz SCS and following Capability 1 processing time.

- For a UE that supports capability 2 on a given cell, the processing time according to UE processing capability 2 is applied if the high layer parameter *processingType2Enabled* in *PDSCH-ServingCellConfig* is configured for the cell and set to ‘enable’.

- The UE processing capability 2 is not applied to PDSCH scheduled by PDCCH with DCI format 4\_0/4\_1/4\_2.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Spreadtrum | Support Initial TP 3-4-1 |
| vivo | In NR R15, the processing capability for PDSCH scheduled by DCI 1\_0 was discussed in CR phase. There was no consensus on the supporting of mixed capability. As a consequence, mixed capability should be avoided by gNB scheduling. Here, for unicast and multicast, same issue exists if unicast supports CAP#2. To avoid duplicate discussion, we have the following suggestion:  For a cell with multicast reception, it is not expected that the high layer parameter *processingType2Enabled* in *PDSCH-ServingCellConfig* is set to ‘enable’. |
| NTT DOCOMO | OK |
| Xiaomi | OK |
| Lenovo, Motorola Mobility | Support |
| Apple | OK with this TP |
| ZTE | We can accept this proposal.  Another option is to define separate UE capability for processing capability 2 for PDSCH scheduled by PDCCH with DCI format 4\_0/4\_1/4\_2. |
| Samsung | OK in principle.  A positive statement would be preferable – e.g. “PDSCH receptions scheduled by DCI formats 4\_0/4\_1/4\_2 are according to UE processing capability 1” – but the suggested TP is acceptable. |
| Qualcomm | Support Initial TP 3-4-1 |
| Ericsson | Support |
| CATT | OK |
| TD Tech, Chengdu TD Tech | ok |
| Moderator | No update. Most companies are OK except vivo.  @vivo, we have agreed in RAN1#107b-e that PDSCH processing capability 2 is not applied to PDSCH scheduled by PDCCH with DCI format 4\_0/4\_1/4\_2, which is used to address the case that, when some Ues in the MBS group support cap2 but some other Ues do not support cap2, and gNB only wants to enable processing time capability 2 for unicast but not for multicast by setting the high layer parameter *processingType2Enabled* in *PDSCH-ServingCellConfig* to ‘enable’. With your suggestion, it basically does not allow a cell to be configured with processing time capability 2 for unicast as long as the cell is configured with multicast reception, it seems this restriction is not necessary. |

### 2nd Round Proposals (Closed)

**Initial TP 3-4-1:**

Adopt the following TP for Clause 5.3 in TS 38.214:

----------------- Start of TP ----------------

5.3 UE PDSCH processing procedure time

**<**Unchanged text is omitted>

- For UE processing capability 2 with scheduling limitation when *µPDSCH* = 1, if the scheduled RB allocation exceeds 136 RBs, the UE defaults to capability 1 processing time. The UE may skip decoding a number of PDSCHs with last symbol within 10 symbols before the start of a PDSCH that is scheduled to follow Capability 2, if any of those PDSCHs are scheduled with more than 136 RBs with 30kHz SCS and following Capability 1 processing time.

- For a UE that supports capability 2 on a given cell, the processing time according to UE processing capability 2 is applied if the high layer parameter *processingType2Enabled* in *PDSCH-ServingCellConfig* is configured for the cell and set to ‘enable’.

- The UE processing capability 2 is not applied to PDSCH scheduled by PDCCH with DCI format 4\_0/4\_1/4\_2.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

Provide your comments only when you have concern on it.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| vivo | I want to explain more about our suggestion in 1st round.  There was an email discussion in RAN1#106 e: [106-e-NR-7.1CRs-04] Issue#6: PDSCH processing time per Capability 2 and DCI format 1\_0. Where the main issue is:   1. Cap2 is applicable only for a PDSCH without additional DMRS, (2) a PDSCH scheduled by a DCI format 1\_0 and of durations longer than certain thresholds is assumed to be with dmrs-AdditionalPosition = ‘pos2’, that means Cap2 cannot be used for the PDSCH scheduled by DCI 1\_0 with long duration, and (3) for mixed capabilities/dynamic switching between capabilities based on DCI, it has been discussed extensively in previous meetings (in URLLC R16 HARQ, the main work of this AI is to discuss whether/how to support it, but no consensus finally). It will have impact on UE’s pipeline processing and companies have concerns to support it.   For this email discussion, RAN1 could not reach consensus either for Rel-15 or for Rel-16. The consequence of Rel-15 is that DCI 1\_1 should be used to ensure Cap2 timeline for the scheduled PDSCH. For both Rel-15 and Rel-16, processing timeline for PDSCH scheduled by DCI format1\_0 and of durations longer than certain thresholds is unclear, anyway UE may not provide a valid HARQ-ACK corresponding to the scheduled PDSCH. A safe way for gNB is not to schedule a PDSCH by DCI format1\_0 and of durations longer than certain threshold.  Then here, for multicast, I know the motivation to not support CAP2 for multicast is that some Ues in the same group may not support CAP2. The issue is, CAP2 is not supported for multicast. If CAP2 is used for unicast on the same CC, the issues for mixed capabilities/dynamic switching between capabilities based on DCI recurs. It will be a very hard work to discuss how to support mixed capabilities/dynamic switching between capabilities based on DCI. That is why I suggest we not to touch this discussion. I really encourage companies to consider this issue carefully. |
| Huawei, HiSilicon | To be safer, maybe we can FFS on this given the point vivo brought up. |
| Samsung | Support to keep the issue Vivo mentions as FFS. |
| Moderator | Based on comments, moderator suggests to deprioritize the discussion in this meeting. |

## Issue#3-5) Others

### Summary

1 company [CMCC] proposes the TP for PDSCHs simultaneous reception for section 5.1 in TS 38.214 and 1 company [Ericsson] proposes modification on DL reception type in TS 38.202, considering these issues are also related to other issues, e.g., carrier aggregation of multicast, moderator suggests to deprioritize the discussion in this meeting.

## Issue#3-6) New UE capabilities on max data rate (newly added)

### Summary

During the UE feature discussion in this meeting, some companies propose to introduce new FGs for the following capabilities. After some discussion in GTW, it was recommended that this issue is first discussed in AI 8.12.1 in the 2nd week.

* Max data rate of FDMed unicast PDSCH and group-common PDSCH for multicast respectively in a slot per CC.
* Max data rate of TDMed unicast PDSCH(s) and group-common PDSCH(s) for multicast respectively in a slot per CC.

### 1st Round Proposals (Open)

**Initial question 3-6a:**

Companies are encouraged to provide views on whether to introduce new FGs for the following capabilities.

* Max data rate of FDMed unicast PDSCH and group-common PDSCH for multicast respectively in a slot per CC.
* Max data rate of TDMed unicast PDSCH(s) and group-common PDSCH(s) for multicast respectively in a slot per CC.

Companies are encouraged to provide comments in the table below (I copied the responses in the UE feature discussion as below).

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Spreadtrum | Not understand the motivation. Clarification is needed. |
| Huawei, HiSilicon | We can accept them as separate FGs but we need to make it clear how network should understand such UE capability if such FGs are not reported by UE. |
| Apple | The motivation is not clear. The max data rate is for MBS PDSCH, unicast PDSCH or both? |
| MediaTek | More clarification is needed. |
| ZTE | More clarification is needed. |
| Qualcomm2 | In 38.306, the supported DL max data rate in a slot is summed over all the carriers in the frequency range for any signaled band combination and feature set consistent with the configured servings cells as  where parameters for the j-th CC reported in the IE *FeatureSetDownlinkPerCC* are originally for unicast only. Now a UE may have separate multicast and unicast processing capabilities, such as , *, .*  At least when a UE capable of FDMed/TDMed unicast and multicast in a slot in j-th CC, the max data rate counting for MBS PDSCH and unicast PDSCH will be different from unicast only. We think a separate FG is needed for such cases. |
| vivo | We have one question for clarification based on the elaboration from Qualcomm.  If a max data rate of FDMed or TDMed unicast PDSCH and group-common PDSCH for multicast is supported from UE, for example, data rate 1. Is it possible to assume data rate 1 is supported for unicast only case? |
| Moderator | [GTW1] More discussion is necessary to have common understanding |
| FL2 | This issue was not discussed in the GTW session on Feb 23. Companies are invited to check the clarification from QC and provide further comments, if any. |
| Qualcomm | To answer vivo’s question:  For a slot with unicast only on j-th CC, max data rate is , which is similar as legacy based on unicast parameters.  For a slot with unicast and multicast on j-th CC, max data rate is based on , which can be larger than for unicast only.  It is possible to keep the same total data rate of all CCs and borrow the margin from another CC to support the CC with multicast on top of unicast. |
| vivo2 | Thanks Qualcomm;s reply. We are fine to add them as separated FGs |
| ZTE | We are thinking that if the total number of PDSCHs that can be scheduled in each slot is kept unchanged and the max TBS is kept unchanged, it seems we don’t need to change the calculation of data rate. Is this the common understanding among companies? |
| Huawei, HiSilicon | We agree with QC’s intention, the ambiguity to network is how to understand the data rate UE can support per the existing report if not defining FG/component for data rate/max total TB size. |
| Spreadtrum | Thanks Qualcomm foe detailed explanation. We got it.  Regarding ZTE’s question, in our understanding, although total number of PDSCHs in a slot not changed, but the maximum layer, modulation order may be different for unicast and multicast, so the data rate is also different.  In our mind, maybe we should firstly discuss whether maximum layer, the maximum modulation order and others can be different for unicast and multicast for one UE, subject to UE capability. Then discuss this issue. |
| NTT DOCOMO | We share the similar view with ZTE. We are not sure these new FGs are needed. |
| Moderator | [GTW2] Still some companies don’t see the necessity of this FGs. **Further discuss in the GTW** |
| FL3 | As discussed in the GTW, this issue is further discuss in AI 8.12.1 |
| Moderator | Companies please continue the discussion in this table.  The following is my understanding on this issue, I’m not sure whether I understand it correctly:   * In the formular of data rate calculation,  is the maximum RB allocation in bandwidth  with numerology , as defined in 5.3 TS 38.101-1 [2] and 5.3 TS 38.101-2 [3], where  is the UE supported maximum bandwidth in the given band or band combination. In my understanding, even when a UE is capable of FDMed/TDMed unicast and multicast in a slot in j-th CC, as long as the UE supported maximum bandwidth in the given band or band combination is not increased due to additionally support of multicast reception, the max data rate counting for MBS PDSCH and unicast PDSCH will not be larger than unicast only, since it seems  for multicast are less likely to be larger than that of unicast. From this perspective, it seems separate FGs are not necessary. |
| Samsung | Agree with ZTE. There is no change from Rel-16. |
| ZTE2 | The data rate is calculated per slot per . Currently, the maximum number multicast/unicast PDSCHs that UE can receive is the same as Rel-15/16 and the maximum TBS is kept the same. In addition, the maximum number of layers, modulation order, bandwidth, etc are kept the same. Based on this, it seems the daterate for multicast will be the same as unicast. We don’t see the issue of datarate. |
| Spreadtrum | If it is the common understanding that the maximum number of layers, modulation order, etc are not changed even if supporting MBS, we agree that there is no change for max date rate. |
| Qualcomm | We agree with FL that the max bandwidth can be shared by unicast/multicast and  for multicast can be generally no larger than unicast. But we don’t agree with ZTE that the maximum number multicast/unicast PDSCHs means same maximum TBS.  As defined in the equation of the max data rate, UE will report the scaling factor per in j-th CC in IE *FeatureSetDownlinkPerCC*, which is used to adjust the data rate among the supported CCs. The UE can borrow the processing capability of other less loaded CC and support the max data rate in a slot with FDMed/TDMed unicast and multicast in j-th CC, larger than that of unicast only. The total max data rate of all supported CCs can be kept same.  So, although can be same as Rel16, at least we should allow for a slot with unicast and multicast can be reported separate from , and calculate the data rate in j-th CC as  For unicast only in a slot in j-th CC,  For unicast and multicast in a slot in j-th CC, |
| Xiaomi | We are fine with the intention. One clarification on Qualcomm’s comments: does this mean we need to introduce new scaling factor beyond the current ones, i.e. 1, 0.8, 0.75, and 0.4?  We think firstly we should discuss whether the current value sets are sufficient or not. If majority view thinks we need to introduce more scaling factors in order to smooth the load across CCs, we are OK to introduce more scaling factor. However, it seems there is no necessity to mention whether the factor is associated with unicast only or unicast+multicast. |
| CATT | There is no need introducing a separate max date rate for a slot with unicast and multicast. In Rel-16, the UE can receive multiple TDMed PDSCHs in a slot based on UE capability, and RAN1 doesn’t introduce an additional data rate for this case. For same reason, we don’t see the necessity of introducing the a separate max date rate for a slot with FDMed/TDMed multicast and unicast. |

# Issue #4: Retx and HARQ process management

## Background and submitted proposals

### Issue#4-1) LBRM and TBS determination

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| **Samsung** | **Proposal 7: A UE indicates in the capability report that it can support combining PTM initial transmission and PTP retransmission in case of different circular buffer sizes.** |
| **Qualcomm** | **Proposal 10: Endorse TP#8 for TS38.213 to address the Note in RAN1 agreement on PTM/PTP soft combining.**   * + **Note: The UE is not required to soft combine the PTM initial transmission and the PTP retransmission in case of different circular buffer**  TP#8 for TS38.213:18 Multicast Broadcast Services < Unchanged parts are omitted >  A PDSCH reception providing an initial transmission of a transport block is scheduled only by a multicast DCI format. For the first HARQ-ACK reporting mode, a PDSCH reception providing a retransmission of the transport block can be scheduled either by a multicast DCI format using a same G-RNTI as the G-RNTI of the initial transmission of the transport block, or by a unicast DCI format using a C-RNTI [6, TS 38.214]. The UE is not required to soft combine the initial transmission using the G-RNTI and the retransmission using C-RNTI in case of different circular buffer length as defined in [5, TS 38.212].  An activation for SPS PDSCH receptions using a G-CS-RNTI for a corresponding SPS PDSCH configuration is provided only by a multicast DCI format as described in clause 10.2 by replacing CS-RNTI with the G-CS-RNTI. A release for SPS PDSCH receptions using a G-CS-RNTI for a corresponding SPS PDSCH configuration is provided by a multicast DCI format as described in clause 10.2 by replacing CS-RNTI with the G-CS-RNTI, or by a DCI format with CRC scrambled by CS-RNTI. For the first HARQ-ACK reporting mode and for a transport block that a UE received in a SPS PDSCH, a PDSCH reception providing a retransmission of the transport block can be scheduled either by a unicast DCI format using a CS-RNTI or by a multicast DCI format using a same G-CS-RNTI as the G-CS-RNTI of the initial transmission of the transport block [6, TS 38.214]. The UE is not required to soft combine the initial transmission using the G-CS-RNTI and the retransmission using CS-RNTI in case of different circular buffer length as defined in [5, TS 38.212].  \*\*\* Unchanged text is omitted \*\*\* |

### Issue#4-2) Retransmission scheme configuration

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| **Huawei** | **Proposal 8: UE can be configured with PTP transmission for PTM HARQ retransmission by RRC signaling. UE will assume only PTM is used for retransmission unless the UE is configured with PTP for retransmission (if the UE supports it by capability signaling).** |
| **vivo** | **Proposal 9: For multicast, UE can be configured to enable receiving PTP retransmission for multicast PTM initial transmission with same HPID by RRC signaling. If UE is not configured to enable receiving PTP retransmission for multicast PTM initial transmission with same HPID, UE assumes only PTM is used for retransmission for multicast.** |
| **OPPO** | 1. **When PTM scheme 1 is used as initial transmission, PTM scheme 1 and PTP are not supported to be used simultaneously for the same TB for different UEs in the same multicast group.** 2. **PTM scheme 1 and PTP are not supported to be used as retransmission scheme simultaneously for a given SPS group-common PDSCH.** |
| **NTT DOCOMO** | **Proposal 9: The retransmission scheme for multicast is not configured to UE by RRC signalling.** |
| **Xiaomi** | **Proposal 4: Do not support PTM scheme 1 based retransmission and PTP scheme based retransmission simultaneously for dynamic MBS transmission in the same MBS group.**  **Proposal 7: Do not support PTM scheme 1 based retransmission and PTP scheme based retransmission simultaneously for SPS MBS transmission in the same MBS group.** |
| **Lenovo** | **Proposal 13: A UE receiving multicast does not expect to receive both PTM scheme 1 based retransmission and PTP based retransmission at a same time for a same TB.**  **Proposal 14: For a given HARQ process number, a UE is not expected to receive a new TB with the same HARQ process number before the completion of the transmission of a previous TB.** |

### Issue#4-3) HARQ process management

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| **vivo** | Proposal 10: For HARQ process management, there is no need differentiate the HARQ process ID used for PTP (re)transmission for unicast and PTP retransmission for multicast. |
| **OPPO** | 1. **It is up to gNB to avoid NDI collision between multicast and unicast crossed scheduling with the same HPID.** 2. **There is no necessary to introduce any mechanism to differentiate the HPID used for PTP (re)transmission for unicast and PTP retransmission for multicast.** |
| **ZTE** | **Proposal 3: If companies could NOT achieve consensus on how to address the 1) NDI conflict issue and 2) the differentiation of PTP (Re)Tx for unicast and PTP ReTx for multicast, NR MBS should support semi-static HARQ process sharing between unicast and multicast.**   * **A value range of HARQ process for multicast is configured via RRC signalling or defined in the spec, e.g., {0-7}.** * **For a DCI format with CRC scrambled by G-RNTI, the value of HPN in the DCI format should be within the configured or defined value range.** * **For a DCI format with CRC scrambled by C-RNTI, if the value of HPN is located within the configured or defined value range, it indicates that the retransmission of a multicast TB is scheduled by the DCI format.** |
| **CATT** | **Proposal 3:** **For improving the efficiency of using HPIDs, the NDI conflict issue needs to be solved though potential specification enhancement.**  **Proposal 4: For NDI scheme of multicast, Option 1(When a G-RNTI DCI is received with a given HPID in the DCI, the data shall be considered new, i.e. be treated as if the NDI bit had been toggled, irrespective of actual NDI toggling, if the G-RNTI is different from the most recent earlier received RNTI (i.e. C-RNTI or another G-RNTI) of the same HPID. When the received G-RNTI is the same as the most recent use of the HPID, legacy NDI toggling is used to indicate new data or retransmission.) is preferred.**  **Proposal 5: Down-selection from following options to solve the issue that the UE incorrectly soft-combine the received TB with PTP retransmission for multicast and the received TB with PTP (re)transmission for unicast when the HPID and NDI of multicast transmission and unicast transmission is same and the group-common PDCCH was missed.**   * **Option 1: introduce a field in DCI 1\_1/1\_2 of PTP transmission to differentiate the HARQ process ID used for PTP (re)transmission for unicast and PTP retransmission for multicast.** * **Option 2: use the different TB size of unicast and multicast to differentiate the HARQ process ID used for PTP (re)transmission for unicast and PTP retransmission for multicast.** |
| **NEC** | **Proposal 1:**   * **Introduce a new DCI field to differentia PTP (Re)Tx for unicast or PTP ReTx for multicast.**   + **If it is different to converge in this meeting, it should be gNB implemented to avoid the same HARQ process being used for unicast PTP (Re)Tx and multicast PTP ReTx.** |
| **Qualcomm** | **Proposal 9:** **If dynamic HARQ process sharing between unicast and multicast is to be supported in Rel-17, add 1-bit in unicast DCI format 1\_1/1\_2 to differentiate PTP for unicast and PTP retransmission for multicast**   * **UE is not expected to receive the PTP retransmission with C-RNTI using the same HARQ process ID for the multicast TB associated with different G-RNTIs at same time.** * **UE is not expected to receive the PTP retransmission with CS-RNTI using the same HARQ process ID for the multicast TB associated with different G-CS-RNTIs at same time.** * **Endorse TP#6 for TS38.212 and TP#7 for TS38.213.**  TP#6 for TS38.212:7.3.1.2.2 Format 1\_1 < Unchanged parts are omitted >  - HARQ process number – 4 bits  - PTP retransmission for multicast – 0 or 1 bit.  - 1 bit if higher layer parameter *pdsch-MulticastPtpRetransmission* is configured;  - 0 bit otherwise.  - Downlink assignment index – number of bits as defined in the following  < Unchanged parts are omitted > 7.3.1.2.3 Format 1\_2 < Unchanged parts are omitted >  - HARQ process number – 0, 1, 2, 3 or 4 bits determined by higher layer parameter *harq-ProcessNumberSizeForDCI-Format1-2*  - PTP retransmission for multicast – 0 or 1 bit.  - 1 bit if higher layer parameter *pdsch-MulticastPtpRetransmissionForDCI-Format1-2* is configured;  - 0 bit otherwise.  - Downlink assignment index – 0, 1, 2 or 4 bits  < Unchanged parts are omitted > TP#7 for TS38.213:18 Multicast Broadcast Services < Unchanged parts are omitted >  A PDSCH reception providing an initial transmission of a transport block is scheduled only by a multicast DCI format. For the first HARQ-ACK reporting mode, a PDSCH reception providing a retransmission of the transport block can be scheduled either by a multicast DCI format using a same G-RNTI as the G-RNTI of the initial transmission of the transport block, or by a unicast DCI format using a C-RNTI [6, TS 38.214]. If a UE is provided with multiple G-RNTIs, the UE is not expected to receive a retransmission by a unicast DCI format using a C-RNTI with same HARQ process ID for the initial transmission of the transport block scheduled by a multicast DCI format using different G-RNTIs at same time.  An activation for SPS PDSCH receptions using a G-CS-RNTI for a corresponding SPS PDSCH configuration is provided only by a multicast DCI format as described in clause 10.2 by replacing CS-RNTI with the G-CS-RNTI. A release for SPS PDSCH receptions using a G-CS-RNTI for a corresponding SPS PDSCH configuration is provided by a multicast DCI format as described in clause 10.2 by replacing CS-RNTI with the G-CS-RNTI, or by a DCI format with CRC scrambled by CS-RNTI. For the first HARQ-ACK reporting mode and for a transport block that a UE received in a SPS PDSCH, a PDSCH reception providing a retransmission of the transport block can be scheduled either by a unicast DCI format using a CS-RNTI or by a multicast DCI format using a same G-CS-RNTI as the G-CS-RNTI of the initial transmission of the transport block [6, TS 38.214]. If a UE is provided multiple G-CS-RNTIs, the UE is not expected to receive a retransmission by a unicast DCI format using a CS-RNTI with same HARQ process ID for the initial transmission of the transport block scheduled by a multicast DCI format using different G-CS-RNTIs at same time. |
| **Lenovo** | **Proposal 14: For a given HARQ process number, a UE is not expected to receive a new TB with the same HARQ process number before the completion of the transmission of a previous TB.** |
| **LG** | Proposal 8: For multiple GC-DCIs scheduling multiple G-RNTIs, NDI values for different G-RNTIs are separately toggled and managed.  Proposal 9: For multiple GC-DCIs scheduling multiple G-RNTIs with different HPNs, PTP retransmission is associated to PTM initial transmission for one of the G-RNTIs based on the same HARQ process ID and NDI.  Proposal 10: UE specific DCI indicates PTP retransmission.  Proposal 11: For PTP ReTX and unicast with a same HPN, NDI value for PTP ReTX and NDI value for unicast are separately toggled and managed.  Proposal 12: Upon receiving PTP retransmission of a TB with a HPN, UE expects PTP retransmission of the TB after sending NACK to the TB.   * + It is up to UE whether to additionally receive retransmission of the same TB on group common PDSCH with the same HPN and non-toggled NDI. |

### Issue#4-4) Others (L)

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| **OPPO** | 1. **PTM scheme 2 is NOT supported as a (re)transmission scheme for NR MBS.** |
| **Xiaomi** | **Proposal 3: Do not support PTM transmission scheme 2.** |
| **ASUSTeK** | **Proposal 4: PTM transmission scheme 2 for initial transmissions and retransmissions is supported for multicast.** |

## Issue#4-1) LBRM and TBS determination for PTP Retx

### Summary

Whether to support the UE capability to indicate that it can support combining PTM initial transmission and PTP retransmission in case of different circular buffer sizes has been discussed in last RAN1#107b-e meeting. In this meeting, [Samsung] proposes that UE indicates gNB whether it supports combining PTM initial transmission and PTP retransmission or not in case of different circular buffer sizes. [QC] proposes to capture the note in the spec. Based on the discussion in last meeting, most companies prefer to not have such a UE capability. Regarding capturing the note in the spec, some companies commented in last meeting it is not necessary, and they think it can be up to UE implementation. Moderator suggests deprioritize this discussion.

## Issue#4-2) Retransmission scheme configuration

### Summary

2 companies [Huawei, vivo] think it is beneficial to not configure PTP transmission for PTM HARQ retransmission in terms of UE power saving, so they propose the RRC signalling can be used to indicate whether PTP retransmission is enabled or not. 1 company [NTT DOCOMO] proposes not introduce such RRC signalling. This proposal has been discussed in last RAN1 meeting and 7 companies did not think it is necessary to have such configuration in the 2nd round discussion. In addition, in the LS on MBS SPS from RAN2 [26], RAN2 also asked RAN1 if retransmission (i.e. via PTM or PTP) can be changed per TB or per TB per transmission, or configured in RRC signalling. Considering this issue has impact on RRC parameters and should be finalized before the end of 1st week in this meeting, moderator suggests the **initial proposal 4-2a** to further check companies’ views. If companies cannot converge on this issue, I think it basically means retransmission (i.e. via PTM or PTP) cannot be configured in RRC signalling.

### 1st Round Proposals (Closed)

**Initial proposal 4-2a:**

For multicast, UE can be configured to enable receiving PTP retransmission for PTM initial transmission with same HPID by RRC signaling. If UE is not configured to enable receiving PTP retransmission for PTM initial transmission with same HPID, UE assumes only PTM is used for retransmission for multicast.

* The configuration is per CFR

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Spreadtrum | We prefer not to support it.  In our memory, the motivation of supporting both PTM retransmission and PTP retransmission is to provide more flexibility for gNB’s implementation, and make one balance between resource overhead and reliability. For example, if only a small amount of UEs decode the initial TB unsuccessfully, PTP retransmission can be considered to have the higher reliability; otherwise, PTM retransmission can be considered to reduce the resource overhead. Since the channel condition may be relatively dynamically changed, thus in our view, RRC signalling to enable PTP retransmission is not preferred. |
| vivo | Support. |
| NTT DOCOMO | Not support. We don’t think there is enough benefit in setting the retransmission scheme to be limited to PTM. |
| Huawei, HiSilicon | To clarify our position, we are proposing PTP retransmission is configured and if it is not configured the default retransmission scheme is PTM, which may also be related to the issue discussed in UE feature. We are NOT saying the configuration is for using the same HPID. |
| Xiaomi | We don’t see the necessity. |
| OPPO | It is not necessary to configure PTP reTx enable/disabled for PTM initial Tx, since PTP (re)Tx for NR MBS is a natural scheme which needs to be supported by a UE rather than disable it by default |
| Lenovo, Motorola Mobility | Not support.  Such configuration for enabling PTP retransmission is not needed. We don’t see any benefit with it. |
| Apple | One clarification question, if UE is configured with reception via PTP re-transmission, UE still needs to receive the PTM transmission/re-transmission, the benefit of proposed configuration seems not clear. |
| ZTE | We support the above proposal. |
| Nokia, NSB | We do not support this proposal, and agree with other companies in terms of limited benefits from this enhancement. |
| Qualcomm | We think PTP retransmission can be supported for PTM initial transmission associated with a G-RNTI configured with ACK/NACK-based feedback. For a G-RNTI with NACK-only or no feedback, PTP retransmission may be not applicable.  It may be helpful for UE to know the HARQ process ID for PTP is only for unicast traffic if PTP retransmission is not configured. |
| Ericsson | Not support. We think PTP ReTx is important enough so that all UEs should support it. |
| CATT | We are ok with the proposal 4-2a. |
| MediaTek | Not support. Since the UE needs to monitor the legacy unicast services with C-RNTI in the unicast DRX cycle, we do not see the benefit of configuring PTP ReTx for PTM by RRC signalling. Besides, RAN2 has defined split-MRB structure with PTM and PTP leg, PTM only and PTP only case, and it can be switched by RRC signalling based on UE’s PDCP status report. So, from our perspective, the further optimization for lower layer PTP ReTx is not needed. |
| TD Tech, Chengdu TD Tech | ok |
| Moderator | Based on comments so far and the discussion in 1st GTW session, moderator suggests to stop the discussion and leave it to RAN2. |

## Issue#4-3) HARQ process management

### Summary

Whether to support dynamic HARQ process sharing between unicast and multicast has been discussed in several meetings, but companies’ views are not converged. The main issues of supporting dynamic HARQ process sharing include:

1. NDI conflict issue (i.e., before receiving the G-RNTI DCI, two different UEs may have each received a TB using the same HPID, which for UE1 resulted in NDI bit status ‘0’ whereas for UE2 in NDI bit status ‘1’. When the gNB uses the same HPID for a new TB, with a G-RNTI that both UEs belong to, it is then logically impossible to toggle the NDI in a way that would satisfy the toggling rule for both UEs.)
2. the differentiation of PTP (Re)Tx for unicast and PTP ReTx for multicast.

These two issues have been discussed for several RAN1 meetings with no progress.

Regarding NDI conflict issue, two high level options (i.e., option 1 to rely on gNB implementation to avoid such issue, and option 2 to resolve this issue with potential specification enhancement) were discussed in RAN1#106-e and RAN#106b-e with no conclusion. However, in RAN2#116bis-e, the following agreement was made, in my understanding, this agreement basically has resolved the NDI conflict issue discussed in RAN1. It seems RAN2 is moving towards the direction that multicast and unicast can share the same HPID dynamically.

* If the downlink assignment is for C-RNTI, and if the previous downlink assignment indicated to the HARQ entity of the same HARQ process was either a downlink assignment received for the MAC entity's G-CS-RNTI or a configured downlink assignment for MBS, or

if the downlink assignment is for G-RNTI, and if the previous downlink assignment indicated to the HARQ entity of the same HARQ process was either a downlink assignment received for the MAC entity's G-CS-RNTI or other G-RNTI or C-RNTI or a configured downlink assignment for MBS or unicast,

Consider the NDI to have been toggled regardless of the value of the NDI.

Regarding how to differentiate the HPID is used for PTP (Re)Tx for unicast or PTP ReTx for multicast, since it is based on the prerequisite that multicast and unicast can share the same HPID dynamically and the NDI toggling rule is enhanced, there was also no conclusion in previous meetings.

Based on contributions submitted in this meeting, 3 companies [Qualcomm, CATT, NEC, LG] propose to introduce a new DCI field to differentiate between PTP (Re)Tx for unicast and PTP ReTx for multicast, or use different TB size of unicast and multicast to differentiate between PTP (Re)Tx for unicast and PTP ReTx for multicast. 2 companies [vivo, OPPO] propose no need to differentiate the HARQ process ID used for PTP (Re)Tx for unicast and PTP ReTx for multicast. 1 company [ZTE] propose to semi-statically configure the HARQ process number for multicast if companies have no consensus on dynamic HARQ process sharing. Considering it seems RAN2 is moving towards the direction that multicast and unicast can share the same HPID dynamically, moderator suggests **initial proposal 4-3a**.

### 1st Round Proposals (Closed)

**Initial proposal 4-3a:**

To support dynamic HARQ process sharing between unicast and multicast in Rel-17, down-select from following options:

* Option 1: add 1-bit in unicast DCI format 1\_1/1\_2 to differentiate PTP (Re)Tx for unicast and PTP ReTx for multicast.
* Option 2: use different TB sizes for unicast and multicast to differentiate whether a HARQ process ID is used for PTP (Re)Tx for unicast or PTP ReTx for multicast.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Spreadtrum | Not support both options. As the conclusion we have agreed shows that it is up to gNB’s implementation. Further optimization is not essential. |
| vivo | No need to differentiate PTP (Re)Tx for unicast and PTP ReTx for multicast |
| LG Electronics | We prefer Option 1. How option 2 works is not clear. |
| NTT DOCOMO | We support both Option 1 and 2. |
| Huawei, HiSilicon | We can be ok with option 1. |
| Xiaomi | We don’t think option 1 and option 2 are necessary. The concern mainly come from the miss detection of the initial MBS DCI, which is a very rare case (1%). If the group common DCI is missed, the following UE-specific DCI have a higher possibility of miss detection. The reason is that gNB usually use a much more conservative strategy to transmit multicast DCI, which lead to more robustness for group common DCI transmission. From this perspective, any enhancement for the DCI miss detection case needs more justification.  If the motivation is justified, we don’t prefer either of option 1 and option 2 which introduce more standard impacts or restrictions. Instead, we think UE can still differentiate the PTP retransmission is for MBS as UE has already report ACK for the previous TB occupying the same HARQ process ID. Hence, the same principle as RAN2 agreed can be reused here: the NDI in a DCI scheduling PTP ReTx is treated independently compared to the one in the previous DCI scheduling a unicast PDSCH. |
| OPPO | Similar view with Spreadtrum/vivo/Xiaomi that there is no necessary to differentiate them as we agreed that it is up to gNB’s implementation. |
| Lenovo, Motorola Mobility | Not support.  We think NDI conflicting issue can be easily solved based on the search space where the UE-specific DCI is received. Since the multicast CSS is only used for multicast service, when a UE-specific DCI for PTP-based retransmission is received in the multicast CSS, UE doesn’t combine one PDSCH scheduled by a DCI received in multicast CSS with another PDSCH scheduled by another DCI received in a SS other than the multicast CSS. |
| ZTE | For the above proposal, at such a late stage, we would suggest to leave this issue to implementation. The option2 is just one possible way of implementation, which doesn’t require any specification change. |
| Nokia, NSB | We think that Option 1 impacts legacy unicast DCI. We are also not sure how option 2 helps, since unicast and multicast DCIs would be scheduled using separate search spaces. Thus, we do not support both options, and this that this is a corner case – where UE misses the initial PTM transmission, which perhaps need not require any specification changes. |
| Qualcomm | We prefer Option 1. Option 2 may work but it will limit the scheduling flexibility.  Without differentiating PTP for unicast and multicast retransmission, we don’t think dynamic sharing of HPID can be supported for Rel17 multicast. |
| Ericsson | Not support.  As we have earlier discussed many times, when receiving a G-RNTI with a certain HPID and NDI, there is a fundamental issue when different UEs have different “latest NDI”, which will make some UEs receive the same NDI despite new data.  As also presented many times, a solution can easily be achieved to solve this (by the UE detecting new data when either a change of RNTI occurs when receiving a G-RNTI or when the NDI is toggled of the same G-RNTI). If this solution is adopted, there is also a need to differentiate between unicast and PTP ReTx, so one of Options 1 and 2 could then be discussed.  However, the default situation in RAN1 is that there is no support for the mentioned “latest NDI” issue, which means that the network will need to ensure – by implementation - that such collisions do not occur. If this is achieved by the network, there is no need to differentiate unicast from PTP ReTx, e.g. when a PTM PDCCH is lost.  This is because the network will need to ensure by implementation (lacking standardized support) that the NDI is always be toggled between a preceding RNTI and the G-RNTI. The C-RNTI of a following PTP ReTx will then also be toggled relative to the mentioned preceding RNTI (i.e. the one before the G-RNTI), since RAN1 has agreed that a ReTx has the same NDI (and HPID) as the initial Tx.  If the G-RNTI PDCCH is missed, the UE can therefore always correctly detect new data of the ReTx via the NDI toggling, so there is no problem to solve.  If there is no G-RNTI at all and the preceding C-RNTI needs to be retransmitted, then it uses the same rule as in legacy for NDI toggling, i.e. for unicast ReTx a different NDI value than the PTP ReTx.  It is therefore useless to solve a problem that is assumed not to exist! RAN1 currently assumes the gNB to ensure – by implementation – that there is no “latest NDI” collision and with this there is consequently no PTP ReTx issue.  However, if RAN1 agrees to solve the “latest NDI” issue via the mentioned RNTI change detection, then we are fine with also discussing Option 1/Option 2. |
| CATT | We support option 1 and option 2. |
| MediaTek | Share the similar view with Spreadtrum/vivo. |
| TD Tech, Chengdu TD Tech | Option 1 |
| Moderator | Given that several companies still think it is not necessary to differentiate the PTP (Re)Tx for unicast and PTP ReTx for multicast to solve the miss detection issue of GC-PDCCH, or think it can be up to gNB implementation. Moderator does not see good way forward to further discuss it. Companies can further discuss in this table.  @Ericsson, please refer to the RAN2 agreement in my summary, in my understanding, the NDI conflict issue can be resolved by RAN2 agreement. However, RAN2 agreement does not cover the case that the downlink assignment is for C-RNTI and the previous downlink assignment indicated to the HARQ entity of the same HARQ process was G-RNTI. Thus, I think the miss detection issue of GC-PDCCH still exists, however, there seems no consensus to resolve this issue. |
|  |  |
| NEC | We support option 1 since it is the simplest way. |
| CATT | For option2, gNB will schedule the different TB sizes for two consecutive PTP (re)transmissions for unicast and PTP retransmission for multicast with same HPID. Then, the different TB size can be used to differentiate whether a HARQ process ID is used for PTP (Re)Tx for unicast or PTP ReTx for multicast. |
| Moderator | Suggests to stop the discussion. |
| Ericsson | @FL: Thanks for pointing out the RAN2 agreement, which changes everything!  It is now clear that the NDI conflict issue does not need to be entirely solved by gNB implementation, as some companies have suggested should be the case.  As we have pointed out, the solution that has now been adopted by RAN2, for solving the main NDI conflict issue, however creates a secondary NDI issue with respect to the PTP ReTx of a G-RNTI initial Tx. This PTP ReTx issue now needs a solution.  We suggest each company to re-assess the situation internally, taking the RAN2 agreement into account, until next meeting, when we can continue the discussion.  Regarding possible solutions, we wish to also add the earlier proposed variant where the NDI of the C-RNTI NDI is always toggled with respect to the latest earlier C-RNTI and never with respect to an earlier G-RNTI. This means that if the UE misses the initial G-RNTI PDCCH and receives a C-RNTI ReTx it can with certainty determine whether this is a ReTx of an earlier C-RNTI or G-RNTI, based on the NDI. If the NDI is non-toggled with respect to the latest earlier C-RNTI then this is a retransmission of that earlier C-RNTI transmission, if the NDI is toggled then this a retransmission of an earlier G-RNTI.  This would require changing the earlier agreement of keeping the same NDI for initial PTM and PTP ReTx, but this would be easy to do, and the identified issue would be solved with this, with very minor spec impact and no impact on legacy C-RNTI (no additional DCI bit required) or no impact to scheduling flexibility (TB size rule). |

## Issue#4-4) Other TPs

### Summary

PTP retransmission is supported for the PTM initial transmission. However, the following agreement about HARQ process ID and NDI relationship between PTM initial and PTP retransmission is not captured in the spec yet, [20] suggests to capture corresponding TP in TS38.213.

Agreement:

The same HARQ process ID and NDI are used for PTM scheme 1 (re)transmissions and PTP retransmissions of the same TB.

### 1st Round Proposals (Closed)

**Initial TP 4-4-1:**

Adopt the following TP for Clause 18 in TS 38.213:

----------------- Start of TP ----------------

18 Multicast Broadcast Services

**<**Unchanged text is omitted>

A PDSCH reception providing an initial transmission of a transport block is scheduled only by a multicast DCI format. For the first HARQ-ACK reporting mode, a PDSCH reception providing a retransmission of the transport block can be scheduled either by a multicast DCI format using a same G-RNTI as the G-RNTI of the initial transmission of the transport block, or by a unicast DCI format using a C-RNTI, with same HARQ process ID and NDI as that of multicast DCI format using the G-RNTI for the initial transmission of the transport block [6, TS 38.214].

An activation for SPS PDSCH receptions using a G-CS-RNTI for a corresponding SPS PDSCH configuration is provided only by a multicast DCI format as described in clause 10.2 by replacing CS-RNTI with the G-CS-RNTI. A release for SPS PDSCH receptions using a G-CS-RNTI for a corresponding SPS PDSCH configuration is provided by a multicast DCI format as described in clause 10.2 by replacing CS-RNTI with the G-CS-RNTI, or by a DCI format with CRC scrambled by CS-RNTI. For the first HARQ-ACK reporting mode and for a transport block that a UE received in a SPS PDSCH, a PDSCH reception providing a retransmission of the transport block can be scheduled either by a unicast DCI format using a CS-RNTI or by a multicast DCI format using a same G-CS-RNTI as the G-CS-RNTI of the initial transmission of the transport block, with same HARQ process ID and NDI as that of multicast DCI format using the G-CS-RNTI for the initial transmission of the transport block [6, TS 38.214].

**<**Unchanged text is omitted>

----------------- End of TP ----------------

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| NTT DOCOMO | Generally fine. We would like to replace “ID” with “number” to make the description consistent with other sections. |
| OPPO | OK with this TP.  NTT DOCOMO’s changing of “HARQ process number” is agreeable to make the name consisitent. |
| Spreadtrum | Fine with DOCOMO’s revision |
| CATT | Per our understanding, the above agreement is only applied to dynamic scheduling. For the SPS PDSCH retransmission, the HARQ process ID is same as the initial transmission of the SPS PDSCH and NDI equal to 1. We would like to change as following:  For the first HARQ-ACK reporting mode and for a transport block that a UE received in a SPS PDSCH, a PDSCH reception providing a retransmission of the transport block can be scheduled either by a unicast DCI format using a CS-RNTI or by a multicast DCI format using a same G-CS-RNTI as the G-CS-RNTI of the initial transmission of the transport block, with same HARQ process ID ~~and NDI~~ as ~~that of multicast DCI format using the G-CS-RNTI for~~ the initial transmission of the transport block scheduled by multicast DCI format using G-CS-RNTI and NDI=1 [6, TS 38.214]. |
| Nokia, NSB | We are fine with NTT DOCOMO’s proposed change of “ID” to “number” |
| Ericsson | We have the same view CATT regarding SPS retransmission, it has to use a fixed NDI=1. Otherwise, the retransmission is actually a re-activation. |
| Qualcomm2 | For SPS GC-PDSCH retransmission, agree with CATT and Ericsson that NDI=1 and HPID is same as initial transmission. We are fine with CATT’s version. |
| Samsung | We do not support the TP – there is no need for it.  “TB retransmission” has been used in RAN1 specs since Rel-15 without spelling out the details. That is defined in TS 38.321 and there is no need for duplicate specifications. |
| Moderator | After reviewing the comments, I tend to agree with Samsung on this issue. Maybe no TP is needed on this issue in RAN1 spec, it seems the following RAN2 spec in TS38.321 can cover this. So I suggest to stop the discussion.  *5.3.2.2 HARQ process*  *When a transmission takes place for the HARQ process, one or two (in case of downlink spatial multiplexing) TBs and the associated HARQ information are received from the HARQ entity.*  *For each received TB and associated HARQ information, the HARQ process shall:*  *1> if the NDI, when provided, has been toggled compared to the value of the previous received transmission corresponding to this TB; or*  *1> if the HARQ process is equal to the broadcast process, and this is the first received transmission for the TB according to the system information schedule indicated by RRC; or*  *1> if this is the very first received transmission for this TB (i.e. there is no previous NDI for this TB):*  *2> consider this transmission to be a new transmission.*  *1> else:*  *2> consider this transmission to be a retransmission.* |
| vivo | Agree with Samsung and FL, how to determine a TB is new TB or for retransmission is captured in RAN2’s spec. |

# Issue #5: SPS for MBS

## Background and submitted proposals

### Issue#5-1) RAN2 LS about MBS SPS

Tdocs submitted under AI 8.12.1

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| **NTT DOCOMO** | **Proposal 10: The retransmission scheme for multicast can be changed per TB per transmission.**  **Proposal 11: A single CS-RNTI is used for PTP retransmissions of all G-CS-RNTIs**  **Proposal 12: Not support making an SPS-Config-Multicast active with multiple G-CS-RNTIs at the same time.** |
| **Td Tech** | **Proposal 1: RAN1 confirms the multiple-to-one mapping between G-CS-RNTI and MBS SPS-config. The maximum number of G-CS-RNTIs configured for UE can be set as a UE’s capability. For example, the maximum number of G-CS-RNTIs can be 2, 4 or 8, where only one G-CS-RNTI is counted if the multiple-to-one mapping between G-CS-RNTI and MBS SPS-config is applied for a set of G-CS-RNTIs. RAN1 further clarifies the multiple-to-one mapping between G-CS-RNTI and MBS SPS-config works in the following way.**  **Multiple G-CS-RNTIs can be mapped to a same MBS SPS-config in TDM mode. Different G-CS-RNTIs use a same MBS SPS-config in different time intervals which are not overlapped with each other. At some time starting point, a same MBS SPS-config can only be activated by a G-CS-RNTI and used by the G-CS-RNTI until it’s deactivated by the G-CS-RNTI. After the deactivation, it can be re-activated by the G-CS-RNTI or activated by a second G-CS-RNTI. When it’s activated by a second G-CS-RNTI, it’s used by the second G-CS-RNTI until it's deactivated by the second G-CS-RNTI.**  **Proposal 2: The PTM mode can be configured by RRC signalling per MBS session. The PTP mode can be configured by RRC signalling per UE per MBS session. If the PTM/PTP mode is configured, the mode for the retransmission of a TB can be changed per TB or per TB per retransmission. For the retransmission of a TB with PTP, CS-RNTI of UE is used to scramble the PDCCH/PDSCH carrying the scheduling information/TB. If the PTP mode is configured for multiple G-CS-RNTIs monitored by UE, a same CS-RNTI is used for the PTP retransmission of all these G-CS-RNTIs.** |
| **Intel** | **Proposal 7: Association of multiple G-CS-RNTIs to one SPS-Config-Multicast is not supported in Rel-17.**  **Proposal 8: Retransmission can be changed per TB per transmission and there is no restriction on the CS-RNTI that can be used for PTP retransmission of PTM initial transmission** |

Tdocs submitted under AI 5:

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| **vivo** | Answer1: The maximal number of G-CS-RNTI configured for UE depends on UE capability. It is not supported that multiple G-CS-RNTIs are mapped to same MBS SPS-config simultaneously. If an MBS SPS-config is activated by a DCI with G-CS-RNTI 1, and then the UE detects another DCI with G-CS-RNTI 2 to activate the same MBS SPS-config, the associated G-CS-RNTI for the MBS SPS-config is changed to G-CS-RNTI2.  **Answer2: The retransmission (i.e. via PTM or PTP) can be changed per TB per transmission if both retransmission schemes are supported and enabled by network (the details of capability and configuration are being discussed in RAN1). UE does not expect to receive PTM retransmission after PTP retransmission for the same TB. A single CS-RNTI is used for PTP retransmissions of all G-CS-RNTIs.** |
| **ZTE** | [RAN1] RAN1 confirms that RAN2’s understanding is correct and the maximum number of G-CS-RNTI configured per UE is up to RAN2. Multiple G-CS-RNTIs can NOT be mapped to same MBS SPS-config simultaneously.  [RAN1] From RAN1 perspective, retransmission (i.e. via PTM or PTP) can be changed per TB per transmission. A single CS-RNTI is used for PTP retransmissions of all G-CS-RNTIs. |
| **OPPO** | **Observation 1: RAN2’s understanding on the association between G-CS-RNTI and SPS-Config-Multicast, as well as RAN1’s agreements, are correct.**  **Proposal 1: The maximum number of G-CS-RNTI configured for UE is the RNTI-Value which is the same as that of G-RNTI.**  **Proposal 2: Multiple G-CS-RNTIs cannot be associated with one SPS-Config-Multicast for MBS.**  **Proposal 3: For MBS SPS, the retransmission scheme (i.e. via PTM scheme 1 or PTP) can be changed per TB for the same group of UEs.**  **Proposal 4: From per UE’s perspective for PTP retransmission of MBS SPS, a single CS-RNTI is used associated with all the G-CS-RNTIs of the SPS configurations of multicast.** |
| **CATT** | **Proposal 1:** **Multiple to one from G-CS-RNTI to MBS SPS-configs can be supported in the following case:**   * **If a MBS SPS-config has been activated by a G-CS-RNTI and another C-CS-RNTI wants to activate this MBS SPS-Config, gNB shall a SPS deactivation signalling for SPS-config release before the SPS transmission activated by another G-CS-RNTI.**   **Proposal 2: A single CS-RNTI can be used for PTP retransmissions of all G-CS-RNTIs.** |
| **Spreadtrum** | **Observation 1: RAN2’s understanding is right, i.e., The DCI scrambled with G-CS-RNTI will indicate which MBS SPS-config will be activated for G-CS-RNTI via HARQ process ID field which equals to sps-ConfigIndex in an MBS SPS-config.**  **Proposal 1: For the mapping between G-CS-RNTI and MBS SPS-Config,**   * **Support one-to-one mapping;** * **Support one-to-many mapping;** * **Not support many-to-one mapping.**   **Proposal 2: For one UE, the maximal number** **of G-CS-RNTI can be considered to be 8.**  **Proposal 3: Retransmission (i.e. via PTM or PTP) can be changed per TB for PTM initial transmission.**  **Proposal 4: Support one single CS-RNTI for PTP retransmissions of all G-CS-RNTIs.** |
| **CMCC** | **Proposal 1. Reply to RAN2 about Q1 with the following answer:**   * **RAN1 confirms RAN2’s understanding about multiple MBS SPS-configs and multiple G-CS-RNTIs and the association between a G-CS-RNTI and a MBS SPS-config is indicated by DCI scrambled with G-CS-RNTI.** * **The maximal number of G-CS-RNTI configured for UE is left to RAN2 design without RAN1 spec impact.** * **Multiple G-CS-RNTIs can be mapped to same MBS SPS-config, but for one MBS SPS-config it can only be activated by one G-CS-RNTI at a time. Regarding how multiple G-CS-RNTIs mapped to same MBS SPS-config, there are two possible alternatives:**   + **Alt 1. For a given MBS SPS-config which has been activated by one G-CS-RNTI, it can only be activated again by another G-CS-RNTI after the MBS SPS-config has been deactivated using the previous G-CS-RNTI or CS-RNTI.**   + **Alt 2. For a given MBS SPS-config which has been activated by one G-CS-RNTI, it can be activated again by another G-CS-RNTI without the SPS deactivation signalling.**   **Proposal 2. Reply to RAN2 about Q2 with the following answer:**   * **Retransmission scheme (i.e. via PTM or PTP) can be changed per TB or per TB per transmission.** * **A single CS-RNTI is used for PTP retransmissions of all G-CS-RNTIs.** |
| **MTK** | **Proposal 1: The motivation of supporting multiple G-CS-RNTIs needs to be further clarified.**  **Proposal 2: The maximum** **of G-CS-RNTIs is 2 if multiple G-CS-RNTIs are needed for multicast services.**  **Proposal 3: Confirm RAN2’s understanding that “the association between G-CS-RNTIs and MBS SPS-configs will not be specified in RRC signalling. The DCI scrambled with G-CS-RNTI will indicate which MBS SPS-config will be activated for G-CS-RNTI via HARQ process ID field which equals to sps-ConfigIndex in an MBS SPS-config”.**  **Proposal 4: It can be up to network implementation on which transmission scheme is used for multicast SPS retransmission.**  **Proposal 5: Not support that the retransmission scheme can be changed per TB.**  **Proposal 6: A single CS-RNTI is used for PTP retransmissions of all multicast SPS G-CS-RNTIs if supported.** |
| **Huawei** | **Proposal 1: No support for multiple G-CS-RNTIs associated with one SPS-config.**  **Proposal 2: From RAN1 perspective, it is beneficial that the PTP retransmission scheme for multicast SPS is configured by RRC signaling. The decision can be up to RAN2.**  **Proposal 3: If UE is configured with PTP retransmission for multicast SPS, UE may expect PTM or PTP retransmission can happen and it is depending on gNB scheduling.**  **Proposal 4: As long as a single CS-RNTI can differentiate the retransmission for each G-CS-RNTI, a single CS-RNTI can be used for PTP retransmissions of all G-CS-RNTIs.**  **Proposal 5: Reply LS to RAN2 to confirm RAN2’s understanding and respond to the two questions based on proposals 1-4.**  Based on the discussions in RAN1, the answers to Q1 and Q2 from RAN2’s LS are:   * Answer to Q1: RAN2’s understanding in the incoming LS is correct. The maximal number of G-CS-RNTIs configured for UE is subject to UE capability which is being discussed in RAN1 UE feature. RAN1 does not support multiple G-CS-RNTIs mapped to the same MBS *SPS-config*. * Answer to Q2: From RAN1 perspective, it is beneficial that the PTP retransmission scheme for multicast SPS is configured by RRC signaling. The decision can be up to RAN2. If UE is configured with PTP retransmission for multicast SPS, UE may expect PTM or PTP retransmission can happen and it is depending on gNB scheduling. As long as a single CS-RNTI can differentiate the retransmission for each G-CS-RNTI, a single CS-RNTI can be used for PTP retransmissions of all G-CS-RNTIs. |

### Issue#5-2) Collision of multicast SPS PDSCH and unicast SPS PDSCH

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| --- | --- |
| **Company** | **Proposals** |
| **Huawei** | **Proposal 7: For UE supporting FDM-ed scheduling between unicast and multicast, if more than one PDSCH on a serving cell each without a corresponding PDCCH transmission are scheduled in the same slot, the UE resolves collisions among unicast SPS PDSCHs resulting in one unicast SPS PDSCH and collisions among multicast SPS PDSCHs resulting in one multicast SPS PDSCH as in Rel-16, respectively. If the resulting unicast SPS PDSCH and multicast SPS PDSCH overlap in frequency, the UE receives the one with lower configured sps-ConfigIndex.** |
| **vivo** | Proposal 4: When more than one PDSCH on a serving cell each without a corresponding PDCCH transmission are in a slot, UE’s procedure to determine the PDSCHs for reception should be revised for the case that UE is capable of receiving FDMed unicast PDSCH and multicast PDSCH.  Observation 1: To solve the overlapping issues among SPS PDSCHs, as well as the overlapping between dynamic scheduled PDSCH and SPS PDSCH. Understanding on UE capability of FDMed unicast PDSCH and multicast PDSCH should be aligned first. |
| **CATT** | **Proposal 2: For multicast, if UE is provided fdmed-Reception-Multicast, and if more than one PDSCH on a serving cell each without a corresponding PDCCH transmission are in a slot,**   * **Step 0:The UE resolves collision among unicast SPS PDSCH(s) as in Rel-16. The UE resolves collision among multicast SPS PDSCH(s) as in Rel-16.** * **Step 1: Set j=0, where j is the number of selected PDSCH(s) for decoding. Q is the union set of resulting unicast and multicast SPS PDSCH(s) in step 0.** * **Step 2:The UE receive one PDSCH with the lowest configured sps-ConfigIndex within , set j=j+1. Designate the received PDSCH as the survivor PDSCH.** * **Step 3:The survivor PDSCH in step 2 and any other PDSCH(s) overlapping in frequency and time domain with the survivor PDSCH in step 2 are excluded from Q.** * **Step 4:Repeat step 2 and 3 until Q is empty or j is equal to 2.** |
| **ASUSTeK** | **Proposal 5: If UE has capability for FDM reception of multicast and unicast PDSCH, and if more than one PDSCH on a serving cell each without a corresponding PDCCH transmission are in a slot, down-selecting following one alternative:**   * **Alt1: Extending Rel-16 procedure for determining one resultant multicast SPS PDSCH and one or more resultant (TDM) unicast SPS PDSCH in a slot, which resultant multicast SPS PDSCH and one or more resultant unicast SPS PDSCH could be received simultaneously.** * **Alt2: Extending Rel-16 procedure for determining only one resultant multicast SPS PDSCH and only one resultant unicast SPS PDSCH in a slot, which could be received simultaneously.** |
| **Apple** | **Proposal 1: Support Case 4, i.e., FDM between multiple TDMed unicast PDSCHs and multiple TDMed GC-PDSCHs in a slot, based on UE capability.**  **Proposal 2:** **If UE is provided *fdmed-Reception-Multicast*, UE assumes there is no collision between unicast PDSCH and multicast PDSCH in frequency domain.** |
| **CMCC** | **Proposal 3. Don’t support Case 6: FDM between multiple TDMed unicast PDSCHs and one GC-PDSCH in a slot.**  **Proposal 4. If UE is provided *fdmed-Reception-Multicast*, the UE can only support one of the following PDSCH reception for both DG-PDSCH and SPS.**   * **one multicast PDSCH in one slot;** * **one unicast PDSCH in one slot;** * **one multicast PDSCH FDMed with one unicast PDSCH in one slot.**   **Proposal 5. For multicast, if UE is provided *fdmed-Reception-Multicast*, and if more than one PDSCH on a serving cell each without a corresponding PDCCH transmission are in a slot, the UE resolves collisions among unicast SPS PDSCHs resulting in one unicast SPS PDSCH and collisions among multicast SPS PDSCHs resulting in one multicast SPS PDSCH as in Rel-16, respectively. If the resulting unicast SPS PDSCH and multicast SPS PDSCH overlap in frequency, the UE receives the one with lower configured *sps-ConfigIndex*.** |
| **Samsung** | **Proposal 1: If a UE does not support FDM unicast/multicast PDSCH receptions, the UE resolves collisions among unicast PDSCHs and multicast PDSCHs by reusing Rel-16 rules.**  **Proposal 2: If a UE supports only FDM PDSCH receptions per slot on a cell, the UE first separately resolves collisions among unicast PDSCHs and among multicast PDSCHs as in Rel-16. If the resulting unicast and multicast PDSCHs overlap in frequency, the UE receives one PDSCH using Rel-16 rules; else, the UE receives both PDSCHs.**  **Observation 1:****FDM and TDM multicast/unicast PDSCH receptions are beyond the WI scope and would require additional rules (on top of Rel-16) for resolving collisions.** |

### Issue#5-3) Others (L)

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| **vivo** | Proposal : For reliability of the group-common PDCCH activation of SPS group-common PDSCH, Alt 1 is supported.   * **Alt 1: retransmit the activation command via group-common PDCCH.** |
| **Xiaomi** | **Proposal 6: Do not support multiple G-CS-RNTIs associated with one SPS-config.**  **Proposal 8: For multicast of RRC\_CONNECTED UEs, the G-CS-RNTI(s) is/are configured per serving cell.** |
| **ASUSTeK** | **Proposal 3: SPS multicast PDSCH receptions are not interrupted in a CFR when switching between two BWPs if the CFR can be shared between the two BWPs.** |

## Issue#5-1) RAN2 LS on MBS SPS

### Summary

The LS form RAN2 about MBS issues (R1-2200888/R2-2202016) is quoted as the following:

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| --- |
| RAN2 has discussed MBS SPS related issues and made the following agreements:   * One-to-many mapping between G-CS-RNTI and MBS sessions is supported and it is assumed that this does not introduce additional specification work. * Capture CS-RNTI usage in table for MBS in section 7.1 in MBS MAC running CR, i.e. for PTP for PTM retransmission via CS-RNTI and MBS SPS deactivationvia CS-RNTI when MBS SPS is configured. * If MBS SPS is configured and CS-RNTI is not configured, the retransmission of SPS via PTP is not supported and MBS SPS deactivation via CS-RNTI is not supported. * The sps-ConfigIndex should unique in UE no matter the SPS is for unicast or multicast.   Besides, RAN2 has the following understanding:  **RAN2’s understanding:** There can be multiple MBS SPS-configs and multiple G-CS-RNTIs. However, the association between G-CS-RNTIs and MBS SPS-configs will not be specified in RRC signalling. The DCI scrambled with G-CS-RNTI will indicate which MBS SPS-config will be activated for G-CS-RNTI via HARQ process ID field which equals to *sps-ConfigIndex* in an MBS SPS-config.  Based on this, RAN2 understands that one to one mapping or one to multiple mapping from G-CS-RNTI to MBS SPS-config are supported as legacy. However, if multiple G-CS-RNTIs were mapped to same MBS SPS-config, it is not clear how that would work. Thus, RAN2 would like to ask the following question:  **Q1:RAN2 respectfully asks RAN1 to confirm RAN2’s understanding and the maximal number of G-CS-RNTI configured for UE? Can** **multiple G-CS-RNTIs be mapped to same MBS SPS-config and if so how that would work?**  In addition, RAN2 discussed the handling of retransmission and wonders if retransmission (i.e. via PTM or PTP) can be changed per TB or per TB per transmission, or configured in RRC signalling and whether a single CS-RNTI is used for PTP retransmissions of all G-CS-RNTIs?  **Q2: Clarify the handling of PTM retransmissions.** |

**Summary of Q1:**

* Regarding RAN2’s understanding, all companies confirm that RAN2’s understanding is correct.
* Regarding the maximal number of G-CS-RNTI configured for UE,
  + 1 company [Spreadtrum] proposes the maximum number of G-CS-RNTI can be considered to be 8.
  + 1 company [MTK] proposes the maximum number of G-CS-RNTIs is 2.
  + 2 companies [TD Tech, vivo, Huawei] think it depends on UE capability. [Huawei] thinks it is being discussed in RAN1 UE feature.
  + 2 companies [ZTE, CMCC] propose it is up to RAN2 decision.
  + 1 company [OPPO] proposes the maximum number of G-CS-RNTI configured for UE is the RNTI-Value which is the same as that of G-RNTI.
  + Moderator suggests **initial proposal 5-1a**.
* Regarding whether multiple G-CS-RNTI can be mapped to the same MBS SPS-config,
  + 5 companies [NTT DOCOMO, TD tech, vivo, CATT, CMCC] think multiple G-CS-RNTI can be mapped to the same MBS SPS-config, but multiple G-CS-RNTIs can NOT be mapped to same MBS SPS-config at the same time.
  + 5 companies [Intel, ZTE, OPPO, Spreadtrum, Huawei] propose to not support multiple G-CS-RNTIs mapped to the same MBS SPS-Config.
  + In RAN1#106bis-e, moderator clarified in the sub-bullet of updated proposal 5-1a after the 3rd round comments that, for a SPS-config for multicast which was previously activated by GC-PDCCH scrambled by one G-CS-RNTI, after it is deactivated, the same SPS-config can be activated again by GC-PDCCH scrambled by another G-CS-RNTI. In this sense, multiple G-CS-RNTI can be mapped to the same MBS SPS-config but not at the same time.
  + Based on companies’ contributions, multiple G-CS-RNTI can be mapped to the same MBS SPS-config in the following ways:
    - For an MBS SPS-config which was previously activated by PDCCH with G-CS-RNTI1, after it is deactivated, the same MBS SPS-config can be activated again by PDCCH with G-CS-RNTI2.
    - If an MBS SPS-config is activated by a SPS activation PDCCH with G-CS-RNTI1, and then the UE detects another SPS activation PDCCH with G-CS-RNTI2 to activate the same MBS SPS-config, the associated G-CS-RNTI for the MBS SPS-config is changed to G-CS-RNTI2, and the MBS SPS-config is no longer associated with G-CS-RNTI1.
  + Moderator suggests **initial proposal 5-1b**.

**Summary of Q2:**

* Regarding whether retransmission (i.e. via PTM or PTP) can be changed per TB or per TB per transmission, or configured in RRC signalling, companies’ views are as the following:
  + **Per TB:** OPPO, Spreadtrum
  + **Per TB per transmission:** NTT DOCOMO, Intel, vivo, ZTE, CMCC
  + **Configured in RRC signalling:** TD Tech, Huawei, vivo
  + Most companies propose the retransmission can be changed per TB per transmission. 2 companies support it can be changed per TB. In my understanding, it seems reasonable the retransmission can be changed per TB per transmission, e.g., for an multicast TB, the first retransmission can be via PTM if many UEs feedback NACK for the initial transmission, and then if only few UEs (e.g., 1) still feedback NACK for the first retransmission, gNB can retransmit the TB via PTP. Whether retransmission (i.e. via PTM or PTP) can be configured in RRC signalling depends on the discussion in issue#4-2.
* Regarding whether a single CS-RNTI is used for PTP retransmissions of all G-CS-RNTIs, all companies’ answer is yes.
* Moderator suggests **initial proposal 5-1c**.

As chairman’s guidance, the Rel-17 related outgoing LSs in RAN1#108-e have to be finalized by end of Week1, companies are appreciated to make consensus on this LS as soon as possible.

### 1st Round Proposals (Closed)

**Initial proposal 5-1a:**

In the reply LS on MBS SPS to RAN2, capture the following:

* RAN1 confirms that RAN2’s understanding is correct.
* The maximum number of G-CS-RNTI configured for UE is subject to UE capability, and it is being discussed in RAN1 UE feature.

**Initial proposal 5-1b:**

Multiple G-CS-RNTI can be mapped to the same MBS SPS-config but not at the same time. It can work in the following ways:

* For an MBS SPS-config which was previously activated by PDCCH with G-CS-RNTI1, after it is deactivated, the same MBS SPS-config can be activated again by PDCCH with G-CS-RNTI2.
* If an MBS SPS-config is activated by a SPS activation PDCCH with G-CS-RNTI1, and then the UE detects another SPS activation PDCCH with G-CS-RNTI2 to activate the same MBS SPS-config, the associated G-CS-RNTI of the MBS SPS-config is changed to G-CS-RNTI2, and the MBS SPS-config is no longer associated with G-CS-RNTI1.

**Initial proposal 5-1c:**

In the reply LS on MBS SPS to RAN2, capture the following for Q2:

* Retransmission scheme (i.e. via PTM or PTP) can be changed per TB per transmission.
* A single CS-RNTI is used for PTP retransmissions of all G-CS-RNTIs.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Spreadtrum | Initial proposal 5-1a: Support  Initial proposal 5-1b: not support. The motivation and the benefit is not clear, but with more spec work. Many-to-one mapping between G-CS-RNTI and MBS SPS config seems to make things more complex. So we prefer not to support it.  Initial proposal 5-1c:   * + Not support the first bullet. The benefit of change per TB per transmission is not clear, and it would complex UE’s implementation. For example, in case of different circular buffer for PTM and PTP for one TB, UE needs to classify different transmission occasions, in order to have up to 2 soft combing process. In addition, the performance may be not good for the shorten number of transmission to be soft combined.   + Support the second bullet. |
| vivo | Initial proposal 5-1a: support  Initial proposal 5-1b: support  Initial proposal 5-1c: generally fine. If PTP retransmission scheme is configured by RRC as Initial proposal 4-2a proposed. The first sub-bullet should be “if both PTM and PTP are enabled, retransmission scheme (i.e. via PTM or PTP) can be changed per TB per transmission”. In addition, for all I know, in RAN2’s discussion, RAN2 is more care about whether PTM retransmission can be used after PTP retransmission for the same TB if the retransmission scheme can be changed per TB per transmission. It is related with their discussions on how to determine a TB is a new TB or for retransmission via NDI and HPID. We think once PTP is used for retransmission, that means the number of UEs with NACK is small, it does not make sense for gNB to change the retransmission scheme to PTM. We suggest to add the following sub-bullet.  UE does not expect to receive PTM retransmission after PTP retransmission for the same TB |
| LG Electronics | **Initial proposal 5-1a:** OK  **Initial proposal 5-1b:** The first bullet point is fine. However, the second bullet point is optimization and not needed. gNB should deactivate the SPS with G-CS-RNTI1 before reactivating the SPS with G-CS-RNTI2.  **Initial proposal 5-1c:** Regarding the first bullet, we assume that gNB can simultaneously perform retransmissions based on both PTM and PTP. However, from UE perspective, once PTP retransmission was scheduled but NACK was sent, UE expects PTP retransmission for the same TB, not PTM retransmission. |
| NTT DOCOMO | proposal 5-1a: Support  proposal 5-1b: Support  proposal 5-1c: Support |
| Huawei, HiSilicon | 5-1a: ok  5-1b: not support. The motivation is not clear or at least not strongly motivated, but rather the specification may be a lot.  5-1c: retransmission should be configured. The factor affect the decision-making is mainly coming from RAN2 about the DRX operation for unicast and multicast. We should let RAN2 make the decision. |
| Xiaomi | **Initial proposal 5-1a:** Support.  **Initial proposal 5-1b:** we are not sure the motivation for multiple-to-one mapping between G-CS-RNTI and SPS configuration. In RAN2, it was already agreed that one-to-many mapping between G-CS-RNTI and MBS sessions. Can proponents elaborate a bit on this proposal?  **Initial proposal 5-1c:** Support. |
| OPPO | Proposal 5-1a: OK.  Proposal 5-1b: Not support. The main bullet says that multiple G-CS-RNTIs can be mapped to one MBS SPS-config, while the following two sub-bullets are not exactly the understanding of multiple-to-one mapping. We are not sure companies have the same and aligned understanding on the two sub-bullets, and at least we do not think it as multiple-to-one mapping. Furthermore, as Huawei/HiSi commented, we are not quite sure about the specification impact if we agree the two sub-bullets.  Proposal 5-1c:  Before discussing the two bullets, whether a prerequisite agreement should be made that “PTM scheme 1 retransmission and PTP retransmission cannot be used simultaneously for different UEs in the same MBS group”, while the FFS in previous meeting is not solved.   * First bullet (Per TB or per TB per Tx): Not support. For example, a TB is transmitted and retransmitted by initial Tx + reTx 1 + reTx 2, the only valid/useful use case is PTM + PTM + PTP. If only few UEs in the group report NACK after initial Tx, the first reTx can be PTP and the following reTx is(are) also be PTP, i.e. PTM + PTP + PTP. reTx scheme changing per TB rather than per transmission is simpler to network and a group of UEs. * OK with the second bullet.   *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* |
| Lenovo, Motorola Mobility | 5-1a: Support  5-1b: Not support. The motivation is unclear to us. We think the multiple configure G-CS-RNTI can be differentiated by different config index.  5-1c: Not support. Retransmission can’t be arbitrarily changed per TB per transmission. It doesn’t make sense that current retransmission is PTP and next retransmission is PTM. |
| ZTE | For Initial proposal 5-1a: from our perspective, the maximum number of G-CS-RNTI configured for UE can be left to RAN2.  For Initial proposal 5-1b: we are fine with the main bullet and the first bullet. For the second bullet, we are not sure whether RAN1 has the expertise to discuss it, we propose to leave it to RAN2.  Initial proposal 5-1c: OK |
| Nokia, NSB | We are fine with these proposals |
| Qualcomm | For 5-1b, we don’t support the second subbullet, which would define a new procedure for SPS release. |
| Ericsson | 5.1a: Support  5-1b: Support the first bullet point. Not support second bullet point now – this needs further discussion as to what use case is applicable.  5-1c: Support |
| CATT | **Initial proposal 5-1a:** We fine with this proposal.  **Initial proposal 5-1b:** We support the first bullet. The motivation to support second bullet may need more discussion.  If the MBS SPS-configure activated by PDCCH with G-CS-RNTI1 can be changed to activated by PDCCH with G-CS-RNTI2 without deactivation indication, the misunderstanding between gNB and UE may be happen. Assuming a general case that an SPS-config for MBS group1 including UE1 and UE2 is activated by a PDCCH with G-CS-RNTI1, and then the same SPS-config for MBS group2 including UE2 and UE3 is activated by another PDCCH with G-CS-RNTI2. Since UE2 is included in both MBS group1 and MBS group2, the scheme in the second bullet can be workable. However, the UE1 has a problem that it doesn’t know the SPS-config activated by PDCCH with G-CS-RNTI1 has been deactivated and continues to receive the SPS transmission even though the gNB no longer transmits the MBS SPS-Config associated with G-CS-RNTI1.  **Initial proposal 5-1c:** We fine with this proposal. |
| TD Tech, Chengdu TD Tech | **ok** |
| Moderator | Proposal 5-1a and 5-1c have been agreed with modification as below in 1st GTW.  **Agreement**  In the reply LS on MBS SPS to RAN2, capture the following for Q1:   * RAN1 confirms that RAN2’s understanding is correct. * RAN1 thinks that the maximum number of G-CS-RNTI configured for UE should be subject to UE capability.   **Agreement**  In the reply LS on MBS SPS to RAN2, capture the following for Q2:   * From RAN1 perspective, retransmission scheme (i.e. via PTM or PTP) can be changed per TB per transmission.   + UE is not expected to receive PTM retransmission after PTP retransmission for the same multicast TB   + There is no consensus in RAN1 to support PTM retransmission and PTP retransmission simultaneously for different UEs in the same MBS group * A single CS-RNTI is used for PTP retransmissions of all G-CS-RNTIs.   Proposal 5-1b was updated based on GTW discussion, which I think is the best we can do now. |

### 2nd Round Proposals (Closed)

**Updated proposal 5-1b:**

RAN1 thinks that multiple G-CS-RNTIs cannot be mapped to same MBS SPS-config at the same time for a UE.

* Note: for example, for an MBS SPS-config which was previously activated by PDCCH with G-CS-RNTI1, after it is deactivated, the same MBS SPS-config can be activated again by PDCCH with G-CS-RNTI2.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Lenovo | Based on current proposal, in the main bullet, does it imply multiple G-CS-RNTIs can be configured to a same MBS SPS-config while only one G-CS-RNTI is activated?  Our understanding is only one G-CS-RNTI can be mapped to one MBS SPS-config. So we suggest removing “at the same time” in the main bullet. |
| OPPO | There are two association cases between G-CS-RNTI and MBS SPS-confg:   * Case 1: Multiple G-CS-RNTIs can be configured to associated with the same MBS SPS-config, which is the configuration process. Regarding the SPS scheduling procedure, at the same time only one G-CS-RNTI can be mapped or associated with the one SPS-config. This is what the current proposal and the note’s meaning.   + One more clarification on the example in the note is needed: “Note: for example, for an MBS SPS-config which was previously activated by PDCCH with G-CS-RNTI1, after it is deactivated, the same MBS SPS-config can be activated again by PDCCH with G-CS-RNTI2”. After G-CS-RNTI2 with this SPS-config is deactivated, whether G-CS-RNTI1 associated with this SPS-config can be activated again? * Case 2: In the configuration process, only one G-CS-RNTI is configured to associated with one MBS SPS-config, and this one G-CS-RNTI can be mapped with multiple MBS sessions (as agreed by RAN2). The G-CS-RNTI is always associated with this MBS SPS-config, and multiple different MBS sessions can be supported.   We prefer to support case 2 on the mapping relationship. |
| Moderator | In the LS, it clearly says “the association between G-CS-RNTIs and MBS SPS-configs will not be specified in RRC signalling.”. RAN1 also agreed that the G-CS-RNTI(s) is/are configured per serving cell. So my understanding is that the G-CS-RNTIs are not configured for a MBS SPS-config, since there is no association between G-CS-RNTIs and MBS SPS-Configs by RRC signalling, and the association is only defined by the activation PDCCH.  I’m confused by what Lenovo said “does it imply multiple G-CS-RNTIs can be configured to a same MBS SPS-config while only one G-CS-RNTI is activated?”, and I’m also confused by what OPPO said, e.g., “Case 1: Multiple G-CS-RNTIs can be configured to associated with the same MBS SPS-config, which is the configuration process.”, “Case 2: In the configuration process, only one G-CS-RNTI is configured to associated with one MBS SPS-config”. |
| LG Electronics | We are fine with the proposal.  We think that one or more G-CS-RNTIs can be configured to be associated with the same MBS SPS config index, depending on RRC configuration. However, for the SPS config index the DCI can activate SPS with only one G-CS-RNTI among RRC-configured G-CS-RNTIs. |
| CATT | We are OK with the current proposal. |
| ZTE | We are OK with the current proposal.  For the two cases in OPPO’s comments above, our understanding is Case 1. We don’t think case1 has much impact on the RRC signalling design. |
| vivo | We prefer the proposal in 1st round.  Currently, for unicast SPS PDSCH, if gNB wants to change some parameters for a SPS-config by DCI, gNB can deactivate the SPS-config first and then reactivate the same SPS-config. gNB can also reactivate the same SPS-config directly without deactivation before. For multicast SPS, we think the same reactivation mechanism can be reused. We didn’t find any technical reason to not support the second bullet. For the case raised by CATT. We think gNB can use the way in the first sub-bullet to reactivate the SPS-config. But in the other cases, for example, an SPS-config for MBS group1 including UE1 and UE2 is activated by a PDCCH with G-CS-RNTI1, and MBS group2 with G-CS-RNTI2 also include UE1 and UE2. If gNB wants to use the same SPS-config for G-CS-RNTI2. The way in the second sub-bullet can be used. It can leave the freedom for gNB to decide how to reactivate an SPS-config like unicast SPS. |
| Nokia, NSB | We are fine with this proposal and think that ‘at the same time’ is required if the intention is to clarify that one-to-one mapping is used between G-CS-RNTI and SPS-Config (index). Please do note that as we have stated before, we do not think that one-to-one mapping is a significant issue and can be handled using gNB implementation. |
| NTT DOCOMO | We are fine with the proposal. As long as multiple G-CS-RNTIs are not mapped to the same SPS-config at the same time, it can be up to gNB implementation whether to use the same SPS-config with multiple G-CS-RNTIs. |
| Lenovo 2 | Firstly, since RAN2 is also discussing the maximum number of G-CS-RNTIs per UE and whether the maximum number is 8 or 16 is not decided, maybe we can wait for the outcome of RAN2’s discussion. In case of max 16 supported, anyway, multiple G-CS-RNTIs can be mapped to one SPS config.  Secondly, @Moderator, we are not sure whether “map” means “configure”. Based on the example in the bullet, maybe “activate” is better, i.e., RAN1 thinks that multiple G-CS-RNTIs cannot be activated to same MBS SPS-config at the same time for a UE. |
| OPPO 2 | Thanks FL for the further clarification and confirmation.   * Based on the clarification by FL, and according to the relative agreement in RAN1 and RAN2, it should be a common understanding that there would be NO explicit configuration in higher layer RRC signaling on the mapping relationship between G-CS-RNTI and MBS SPS-config. The only way to find the association / connection relationship between a G-CS-RNTI and an MBS SPS-config is when a PDCCH, with CRC scrambled with a G-CS-RNTI, is used to activate a SPS. Therefore, it might not be proper to say “configuration on the mapping relationship between G-CS-RNTI and MBS SPS-config” since there would be no such configuration. * Scenario 1: If the maximum number of G-CS-RNTI per serving cell is larger than the number of MBS SPS-config, e.g. max. number of G-CS-RNTI is 16 and total number of MBS SPS-config is 8, many-to-one association has to be supported. If not supported, there can be 8 or more than 8 G-CS-RNTIs that will never be used. * Scenario 2: If the maximum number of G-CS-RNTI per serving cell is equal to or less than the number of MBS SPS-config, e.g. 8 G-CS-RNTI and 8 MBS SPS-config, 1-to-1 or 1-to-many association between them can work. Besides, 1-to-many is supported, e.g G-CS-RNTI 1 can be associated with SPS-configIndex 1 / 2 / 3; G-CS-RNTI 2 can be associated with SPS-configIndex 2 / 3 / 4. For this example, one SPS-config (e.g. SPS-configIndex 2) can be associated with two G-CS-RNTIs (1 and 2) from perspective of SPS-config. Even (G-CS-RNTI 1 & SPS-configIndex 2) and (G-CS-RNTI 2 & SPS-configIndex 2) cannot activated at the same time. * Scenario 3: If the maximum number of G-CS-RNTI per serving cell is 1, and the number of MBS SPS-config is 8, then 1-to-many association is anyway to be supported.   The key point is: Whether scenario 2 can be supported, and what is the benefit to support it? Because from our perspective, one G-CS-RNTI can be mapped with multiple MBS sessions, and one G-CS-RNTI associated with multiple MBS SPS-config can be activated and workable at the same time to schedule different MBS sessions. In short, for an MBS SPS-config, one G-CS-RNTI is enough to work, what is the motivation/benefit to support multiple G-CS-RNTIs for a SPS-config? Is there anything that have to use different G-CS-RNTI to differentiate? |
| Xiaomi | We tend to agree with Lenovo and OPPO that one G-CS-RNTI per SPS configuration is sufficient. Although the maximum number of SPS configuration is limited to 8, many-to-one mapping between G-CSI-RNTI and SPS configuration doesn’t help to relax the limitation. There is no point to bundle service and G-CS-RNTI together. One very simple example is that gNB use single C-RNTI to schedule eMBB and URLLC traffic, let alone there are plenty of services under the umbrella of MBS and URLLC respectively. So there is no issue for supporting diverse services with single G-CS-RNTI related SPS configuration. In short, service is transparent from RAN1 perspective.  The scenarios raised by vivo make sense to us, although we believe it is not a typical case where gNB dynamically changing the UE group via different G-CS-RNTI.  For sake of progress, we can be flexible on this issue. We can live with the current proposal. |
| MediaTek | We can live with the current proposal. Lenovo2’s version is also OK for us.  Regarding the case mentioned by OPPO, our understanding is case 2. |
| Spreadtrum | We have one question for clarification, just to ensure whether we are in the same page.   * + According to RAN1 agreement and confirmed RAN2 understanding, the association between G-CS-RNTI and MBS SPS config is determined by activation PDCCH. So in our understanding, once the SPS is released, the association between the G-CS-RNTI and the MBS SPS config also would be released.   For scenarios listed by OPPO, we think scenario 1where the number of G-CS-RNTI is larger than the number of MBS config is not practical, and we have not seen any reasonable reason for UE to support this configuration as the additional UE complexity is introduced but no additional benefit.  For scenario 2 listed by OPPO, we also have not seen additional benefit but additional UE complexity introduced, compared with one-to-many mapping.  In short, in our understanding, indeed the proposal could work, but compared to one-to-many mapping, we have not seen any benefit but additional UE complexity is introduced. Maybe we missed something. Appreciated if proponents could provide further clarification. |
| Moderator | My understanding is that one G-RNTI/G-CS-RNTI may correspond to one MBS session. Even if the maximum number of G-CS-RNTI is not larger than 8, but the maximum number of SPS configurations supported by UE is also subject to UE capability (the basic feature may be that UE only supports one SPS group-common PDSCH configuration for multicast). For example, if UE only supports one SPS group-common PDSCH configuration for multicast, but more than one G-CS-RNTI (i.e. more than one MBS session) is configured for the UE, UE can still use the SPS configuration for different G-CS-RNTIs, but not at the same time. I do not see any complexity or even any spec effort to allow what the note described. |
| Spreadtrum2 | Thanks Moderator for the detailed explanation.  Firstly, we would like to clarify the complexity issue. Regarding the complexity issue, this is because that the number of RNTIs would bring complexity for UE’s implementation, e.g., for PDCCH decoding, more attempt on CRC check is needed. It even would bring impact on UE’s HW as some company stated  For the example listed by moderator, if UE only support one SPS group-common PDSCH configuration, since one-to-one mapping between G-CS-RNTI and MBS session may be adopted by gNB, so UE should support many-to-one mapping between G-CS-RNTI and MBS SPS config. But for this example, we don’t understand why gNB adopt so one-to-one mapping between G-CS-RNTI and MBS session when only one MBS SPS is configured. Multiple MBS sessions mapped into one MBS SPS config also can be achieved by one G-CS-RNTI mapping to multiple MBS sessions. Given what we have said, we understand that somehow it is up to gNB’s implementation. Since we have agreed that the maximum number of G-CS-RNTI configured for UE should be subject to UE capability, so we can live with the proposal. |
| OPPO 3 | Thank you very much moderator for the further clarification in details.   * The maximum number of G-CS-RNTI is not discussed or determined in UE feature session. It is not even triggered now. Some candidate numbers are proposed by companies (e.g. 1,2,3,4). But the motivation/benefit might not be clear to us if the max. number of G-CS-RNTI is larger than the number of MBS SPS-config. If all of the MBS SPS are activated (e.g. 4 MBS SPS) at the same time, at most 4 G-CS-RNTIs are enough by considering 1-to-1 association, and having extra G-CS-RNTIs seems always redundant. * It would be better that we can conclusion our discussion to make decision and provide reply LS to RAN2 by the end of this week, so RAN2 will have time to discuss the following procedures in next week based on RAN1’s reply. * If the maximum number of G-CS-RNTI in UE feature session can be determined by this week, we may capture it in the reply LS; if not determined, the maximum number can be informed to RAN2 later when it is agreed, because the number only does not really impact on the further discussion and design in RAN2. * The association between G-CS-RNTI and MBS SPS-config should be included in the reply LS anyway. Based on the discussion by now, we can observe that the indication of the association is only by the procedure of SPS activation through PDCCH, which means it is up to gNB’s implementation. I would like to suggest that the proposal can be changed as:   **Updated proposal 5-1b:**  RAN1 thinks that multiple G-CS-RNTIs cannot be mapped to same MBS SPS-config at the same time for a UE.   * It is up to gNB on how to associate G-CS-RNTI and MBS SPS-config. * ~~Note: for example, for an MBS SPS-config which was previously activated by PDCCH with G-CS-RNTI1, after it is deactivated, the same MBS SPS-config can be activated again by PDCCH with G-CS-RNTI2.~~ |
| Samsung | OK with the proposal. The ‘note’ is just a ‘note’ and only gives an example that is reasonable in our view. However, also OK without it and without any sub-bullet to the main sentence. |
| Qualcomm | We support the proposal.  Regarding vivo’s comment, for the same SPS-config, using G-CS-RNTI2 to replace G-CS-RNTI1 without releasing is a new procedure. In legacy unicast SPS, network may configure a new SPS-config to change SPS parameters, but it is limited to the same CS-RNTI. |
| Ericsson | Support |
| Moderator | Let’s check if companies are OK to have it without any sub-bullet as following. If some companies have concern on it, please directly raise it in the email thread.  **Updated proposal 5-1b:**  RAN1 thinks that multiple G-CS-RNTIs cannot be mapped to same MBS SPS-config at the same time for a UE. |
| Nokia, NSB | We are fine with this updated proposal 5-1b. |
| Qualcomm2 | We can live with the updated proposal 5-1b. |
| Samsung | OK with updated proposal 5-1b. |
| Moderator | **The following has been agreed in GTW session.**  **Agreement**  RAN1 thinks that multiple G-CS-RNTIs cannot be mapped to same MBS SPS-config at the same time for a UE. |

## Issue#5-2) Collision of multicast PDSCH and unicast PDSCH

### Summary

This issue was discussed in RAN1#107b-e with no conclusion. We have agreed to support the following cases according to the previous meetings’ agreements:

* FDM between one unicast PDSCH and one GC-PDSCH in a slot
* TDM between one unicast PDSCH and one GC-PDSCH in a slot
  + Case 1: TDM between M (M>1) TDMed unicast PDSCHs and one GC-PDSCH in a slot
  + Case 2: TDM among N (N>1) GC-PDSCHs in a slot
  + Case 3: TDM between K (K>1) TDMed unicast PDSCHs and L (L>1) TDMed GC-PDSCHs

But we never agree the following:

* Case 4: FDM between multiple TDMed unicast PDSCHs and multiple TDMed GC-PDSCHs in a slot
* Case 5: FDM among multiple GC-PDSCHs in a slot
* Case 6: FDM between multiple TDMed unicast PDSCHs and one GC-PDSCH in a slot

In RAN1#107bis-e, moderator suggested the following proposal:

* For multicast, if UE is provided *fdmed-Reception-Multicast*, and if more than one PDSCH on a serving cell each without a corresponding PDCCH transmission are in a slot, the UE resolves collisions among unicast SPS PDSCHs resulting in one unicast SPS PDSCH and collisions among multicast SPS PDSCHs resulting in one multicast SPS PDSCH as in Rel-16, respectively. If the resulting unicast SPS PDSCH and multicast SPS PDSCH overlap in frequency, the UE receives the one with lower configured *sps-ConfigIndex*.

Based on the contributions submitted in this meeting, companies’ views are divergent.

* 2 company [Huawei, vivo] clarified that the parameter *fdmed-Reception-Multicast* is defined when discussing the HARQ-ACK codebook generation and it is configured to UE for instructing UE how to generate Type-1 codebook. For other codebook types, there is no difference on TDMed or FDMed PDSCHs on codebook construction and no configuration of FDMed reception is needed.
* 1 company [vivo] propose the following related issues need to be clarified:
  + 1) If UE is capable of receiving FDMed unicast and multicast PDSCH, whether it is needed for gNB to configure UE to receive FDMed unicast and multicast PDSCH or not.
  + 2) Whether UE can support FDMed PDSCHs and TDMed PDSCHs simultaneously. [Vivo] thinks, at least in different slots, if UE indicates both capabilities of FDMed PDSCHs and TDMed PDSCHs, UE should be able to receive FDMed PDSCHs and TDMed PDSCHs in different slots.
* 1 company [Samsung] proposes:
  + If a UE supports only FDM PDSCH receptions per slot on a cell, the UE first separately resolves collisions among unicast PDSCHs and among multicast PDSCHs as in Rel-16. If the resulting unicast and multicast PDSCHs overlap in frequency, the UE receives one PDSCH using Rel-16 rules; else, the UE receives both PDSCHs.
  + FDM and TDM multicast/unicast PDSCH receptions are beyond the WI scope and would require additional rules (on top of Rel-16) for resolving collisions.
* 1 company [Apple] proposes if UE is provided fdmed-Reception-Multicast, UE assumes there is no collision between unicast PDSCH and multicast PDSCH in frequency domain.
* [CATT] and [ASUSTeK] also propose their solutions

Based on companies’ views, it seems we can separately discuss the following two cases.

* **Case 1:** UE only supports FDM between multicast PDSCH and unicast PDSCH in a slot, but does not support TDM between multicast PDSCH and unicast/multicast PDSCH in a slot.
* **Case 2:** UE supports both FDM between multicast PDSCH and unicast PDSCH and TDM between multicast/unicast PDSCHs in a slot.

For case 1, moderator suggests the initial proposal 5-2a without the RRC parameter *fdmed-Reception-Multicast* and clarify that this procedure is only applied when more than one multicast SPS PDSCH and one unicast SPS PDSCH are in a slot. It should be noted if there is no multicast SPS PDSCH in a slot, the legacy Rel-16 SPS PDSCH collision rule is applied depends on UE’s capability of maximum supporting TDMed unicast PDSCHs. **Moderator suggests initial proposal 5-2a**.

For case 2, since companies have different views on this, moderator suggests **initial question 5-2b** on this issue.

### 1st Round Proposals (Closed)

**Initial proposal 5-2a:**

If a UE only supports FDM reception between unicast PDSCH and multicast PDSCH in a slot but does not support TDM between multicast PDSCH and unicast/multicast PDSCH in a slot, and if more than one PDSCH on a serving cell each without a corresponding PDCCH transmission are in a slot and at least one of them is multicast PDSCH, the UE resolves collisions among unicast SPS PDSCHs resulting in one unicast SPS PDSCH and collisions among multicast SPS PDSCHs resulting in one multicast SPS PDSCH as in Rel-16, respectively. If the resulting unicast SPS PDSCH and multicast SPS PDSCH overlap in frequency, the UE receives the one with lower configured *sps-ConfigIndex*; else, the UE receives both PDSCHs.

**Initial question 5-2b:**

If a UE supports both FDM reception between unicast PDSCH and multicast PDSCH in a slot and TDM between multicast PDSCH and unicast/multicast PDSCH in a slot, if more than one PDSCH on a serving cell each without a corresponding PDCCH transmission are in a slot and at least one of them is multicast PDSCH, what’s your views on the following alternatives?

* Alt 1: Introduce a RRC parameter to configure whether the current procedure in TS38.214 h00 is used or the following procedure is used.
  + the UE resolves collisions among unicast SPS PDSCHs resulting in one unicast SPS PDSCH and collisions among multicast SPS PDSCHs resulting in one multicast SPS PDSCH as in Rel-16, respectively. If the resulting unicast SPS PDSCH and multicast SPS PDSCH overlap in frequency, the UE receives the one with lower configured *sps-ConfigIndex*; else, the UE receives both PDSCHs.
* Alt 2: The following procedure is used.
  + Step 0: The UE resolves collision among unicast SPS PDSCH(s) as in Rel-16. The UE resolves collision among multicast SPS PDSCH(s) as in Rel-16.
  + Step 1: Set j=0, where j is the number of selected PDSCH(s) for decoding. Q is the union set of resulting unicast and multicast SPS PDSCH(s) in step 0.
  + Step 2: The UE receives one PDSCH with the lowest configured *sps-ConfigIndex* within , set j=j+1. Designate the received PDSCH as the survivor PDSCH.
  + Step 3: The survivor PDSCH in step 2 and any other PDSCH(s) overlapping in frequency and time domain with the survivor PDSCH in step 2 are excluded from Q.
  + Step 4: Repeat step 2 and 3 until Q is empty or j is equal to 2.
* Alt 3: No further enhancements for this case (i.e. the current procedure in TS38.214 h00 is used).

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Spreadtrum | **Initial proposal 5-2a**: In our understanding, for the use case where the resulting unicast SPS PDSCH and multicast SPS PDSCH non-overlap in both frequency and time, the UE still should receive the one with lower configured sps-ConfigIndex, not both. Thus, we prefer to revise the proposal below:  If a UE only supports FDM reception between unicast PDSCH and multicast PDSCH in a slot but does not support TDM between multicast PDSCH and unicast/multicast PDSCH in a slot, and if more than one PDSCH on a serving cell each without a corresponding PDCCH transmission are in a slot and at least one of them is multicast PDSCH, the UE resolves collisions among unicast SPS PDSCHs resulting in one unicast SPS PDSCH and collisions among multicast SPS PDSCHs resulting in one multicast SPS PDSCH as in Rel-16, respectively. If the resulting unicast SPS PDSCH and multicast SPS PDSCH overlap in time and non-overlap in frequency, the UE receives both PDSCHs ~~the UE receives the one with lower configured~~ *~~sps-ConfigIndex~~*; else, the UE receives the one with lower configured *sps-ConfigIndex* ~~the UE receives both PDSCHs~~.  **Initial question 5 -2b**: The discussion is not needed, Since we don’t support the use case where both FDM reception between unicast PDSCH and multicast PDSCH in a slot and TDM between multicast PDSCH and unicast/multicast PDSCH in a slot can be supported. It doesn’t make sense to discuss the spec work for use case we don’t support especially in maintenance stage. |
| vivo | 1. To make sure that company have the same understanding that for case 2, if there is no multicast SPS PDSCH in a slot, the legacy Rel-16 SPS PDSCH collision rule is applied depends on UE’s capability of maximum supporting TDMed unicast PDSCHs, we prefer to add this in Initial question 5-2b. In addition, if there is no unicast SPS PDSCH in a slot, we think the legacy Rel-16 SPS PDSCH collision rule can also be applied. 2. We prefer to adopt unified solution for case 1 and case 2(the slot with at least one multicast SPS PDSCH). 3. If at most one unicast SPS PDSCH and one multicast SPS PDSCH can be selected when UE support FDM reception, there is no need for the UE to resolve collision among unicast SPS PDSCH(s) as in Rel-16 nor need to resolve collision among multicast SPS PDSCH(s) as in Rel-16. UE can just select one unicast/multicast SPS PDSCHs with lowest *sps-ConfigIndex* directly. 4. For Initial proposal 5-2a or alt 1 in Initial question 5-2b, it is not an optimal solution. As shown in the following figure, only SPS 1 is received. For alt 2 in Initial question 5-2b, in the following example, SPS 1 and SPS 3 (both are unicast PDSCHs) are received. It may not be our original intension. 5. We have the following proposal.   If the UE is not capable of receiving FDMed unicast and multicast PDSCH per slot per carrier or there is only unicast PDSCHs or only multicast SPS PDSCHs in the slot, the legacy Rel-16 SPS PDSCH collision rule is applied depends on UE’s capability of maximum supporting TDMed unicast PDSCHs.  If the UE is capable of receiving FDMed unicast and multicast PDSCH per slot per carrier and there are any unicast SPS PDSCH and multicast PDSCH in the slot  ‒ Step 0: *Q* is the set of activated PDSCHs without corresponding PDCCH transmissions within the slot.  ‒ Step 1: A UE receives one PDSCH with the lowest configured *sps-ConfigIndex* within *Q*. Designate the received PDSCH as survivor PDSCH.  ‒ Step 2: If the survivor PDSCH in step 1 is unicast PDSCH, a UE receives one multicast PDSCH with the lowest configured *sps-ConfigIndex* within *Q* (if any), where the multicast PDSCH and the survivor PDSCH in step 1 are in different frequency. If the survivor PDSCH in step 1 is multicast PDSCH, a UE receives one unicast PDSCH with the lowest configured *sps-ConfigIndex* within *Q* (if any), where the unicast PDSCH and the survivor PDSCH in step 1 are in different frequency. |
| Huawei, HiSilicon | I suppose the FDM and TDM capability being discussed in UE feature are the features for dynamic scheduling. Now here the proposals are talking about SPS. I am worried the current FG for FDM/TDM may not be applicable for SPS and whether we need to introduce the FG for FDM/TDM multicast SPS or whether there features should be supported in this release. |
| Xiaomi | **Initial proposal 5-2a:** Support  **Initial question 5-2b:** We think it is too complicated for the scenario of TDM+FDM PDSCHs. Proper configuration should be sufficient to avoid such kind of collision. |
| Lenovo, Motorola Mobility | **5-2a: OK**  **5-2b: Agree with Spreadtrum that** the discussion is not needed since we don’t support the use case where both FDM reception between unicast PDSCH and multicast PDSCH in a slot and TDM between multicast PDSCH and unicast/multicast PDSCH in a slot. |
| Apple | Proposal 5-2a, with this proposal, UE could drop the MBS SPS PDSCH reception according to the rule “If the resulting unicast SPS PDSCH and multicast SPS PDSCH overlap in frequency, the UE receives the one with lower configured *sps-ConfigIndex*”. From gNB side, only unicast SPS will be transmitted for this case. It’s unfair for other UEs only receiving the MBS SPS PDSCH, the MBS SPS is dropped without reason. Group of MBS UEs will be impacted. Thus, it’s reasonable for UE assuming there is no overlapping in frequency domain if UE is provided *fdmed-Reception-Multicast*.  Proposal 5-2b, Alt2 is preferred if UE is provided *fdmed-Reception-Multicast.* |
| ZTE | As also proposed by some other companies, it would be good if companies can first align the understanding on the desired UE behaviour for FDMed PDSCH reception. For example, is UE allowed to receive multiple FDMed unicast PDSCH and multicast PDSCH, e.g., FDMed unicast PDSCH#1 and multicast PDSCH#2 in the first 7 symbols and FDMed unicast PDSCH#3 and multicast PDSCH#4 in the last 7 symbols.  Also, based on the UE feature discussion, it is highly likely that TDMed reception will be the prerequisite of FDMed reception. Thus, it is not possible to have the type of UE that only supports FDMed reception but not support TDMed reception. |
| Qualcomm | For proposal 5-1a,  If a UE only supports FDM reception between unicast PDSCH and multicast PDSCH in a slot, we are not sure whether to allow the scheduling of overlapped multiple multicast SPSs in a slot. Since the SPS collision may happen periodically, which means the UE has to always drop some of multicast SPS(s).  For proposal 5-1b, we slightly prefer not to support the FDM reception between multiple unicast PDSCH and multiple multicast PDSCH in a slot. |
| Ericsson | 5-2a: Support  5-2b: we support Alt1. For Alt2, it seems there is a problem with step 3 for UEs with capabilities of more than 2 PDSCH. |
| CATT | **Initial proposal 5-1a:** We fine with this proposal.  **Initial proposal 5-1b:** We support the first bullet. The motivation to support second bullet may need more discussion.  If the MBS SPS-configure activated by PDCCH with G-CS-RNTI1 can be changed to activated by PDCCH with G-CS-RNTI2 without deactivation indication, the misunderstanding between gNB and UE may be happen. Assuming a general case that an SPS-config for MBS group1 including UE1 and UE2 is activated by a PDCCH with G-CS-RNTI1, and then the same SPS-config for MBS group2 including UE2 and UE3 is activated by another PDCCH with G-CS-RNTI2. Since UE2 is included in both MBS group1 and MBS group2, the scheme in the second bullet can be workable. However, the UE1 has a problem that it doesn’t know the SPS-config activated by PDCCH with G-CS-RNTI1 has been deactivated and continues to receive the SPS transmission even though the gNB no longer transmits the MBS SPS-Config associated with G-CS-RNTI1.  **Initial proposal 5-1c:** We fine with this proposal. |
| MediaTek | **question 5-2b:** it does not need to discuss this issue since the case that FDM reception between unicast PDSCH and multicast PDSCH in a slot and TDM between multicast PDSCH and unicast/multicast PDSCH in a slot is **NOT supported**. |
| TD Tech, Chengdu TD Tech | **5-2a: ok**  **5-2b: alt 3** |
| Moderator | **Proposal 5-2a**: Companies’ views are divergent. Some companies think it is not possible to have the type of UE that only supports FDMed reception but does not support TDMed reception, some companies think it’s reasonable for UE assuming there is no overlapping in frequency domain if UE is provided *fdmed-Reception-Multicast*, some companies think FDM and TDM capability being discussed in UE feature are the features for dynamic scheduling not for SPS, some companies prefer unified solution for case 1 and case 2, etc…. Consider the situation, moderator suggests to deprioritize the discussion. Companies if desired can still discuss it in this table.  **Proposal 5-2b**: Companies’ views are divergent, considering we never had agreement to support case 4/5/6, and we also did not agree to support both FDM reception between unicast PDSCH and multicast PDSCH in a slot and TDM between multicast PDSCH and unicast/multicast PDSCH in a slot, Moderator suggests to deprioritize the discussion. Companies if desired can still discuss it in this table. |
| vivo | Here is our response to some comments above   1. for FDM/TDM may not be applicable for SPS   [vivo] In Rel-15/Rel-16, TDM is applicable for both DG and SPS. There is no difference between DG and SPS when considering the PDSCH capability. FDM/TDM is applicable for SPS.   1. it is too complicated for the scenario of TDM+FDM PDSCHs. Proper configuration should be sufficient to avoid such kind of collision/ don’t support the use case where both FDM reception between unicast PDSCH and multicast PDSCH in a slot and TDM between multicast PDSCH and unicast/multicast PDSCH in a slot.   [vivo] for Proposal 5-2b, it is not proposing to support TDM+FDM in the same slot, as the FL explained, it is for TDM and FDM in different same slot. that is, in a slot, either TDM or FDM is used. It is for the case that UE is capable of both TDM and FDM reception. In that case, we think at least TDM and FDM in different slots should be supported.   1. not sure whether to allow the scheduling of overlapped multiple multicast SPSs in a slot. Since the SPS collision may happen periodically, which means the UE has to always drop some of multicast SPS(s).   [vivo]Similar as Rel-16, the collision should be for SPS-config with different periodicities, and the SPS-config with higher index would not always be dropped. It is not reasonable for gNB to have such scheduling if an SPS-config would always be dropped. |
| CATT | * Share same view as vivo that the FDM/ TDM should be applicable for multicast SPS. The TDMed reception capability in Rel15/16 is for unicast PDSCHs and it doesn’t distinguish whether the unicast PDSCH is SPS scheduling or DG. The FDM/TDMed reception capability for multicast should comply same the principle with unicast. And the FDMed reception method of multicast SPS PDSCH should be further studied. * We are not sure what’s the difference between Initial proposal 5-2a and Initial proposal 5-2b. In our view, both Alt 1 and Alt 2 in Initial proposal 5-2b is using to support FDM reception between unicast PDSCH and multicast PDSCH in a slot. It has nothing to do with whether a UE supports both FDM reception capability and TDM reception capability in a slot. * Alt 2 is preferred. Alt 2 is based on the legacy TDMed SPS reception method of Rel16 to enable the UE to receive FDMed SPS PDSCH between unicast PDSCH and multicast PDSCH. Compared with Alt1, Alt 2 complies the order of SPS-ConfigIndex of unicast/multicast SPS PDSCH to determine the priority of SPS PDSCH reception in a slot, which is more reasonable. |
| Samsung | As mentioned in our Tdoc, the FDM+TDM scenario will be too complex for defining specific rules. If it is to be supported, some RRC support is likely to be required which will need to be further discussed and will be late even if agreed. We are OK to exclude it (FDM is not even in the WI scope although there is support for it).  We would like to also repeat that presence of DG unicast/multicast PDSCHs needs to also be considered now; otherwise, the situation may be more complex later when they have to. |
| Moderator | Based on comments so far, moderator suggests to deprioritize the discussion on proposal 5-2b. Regarding proposal 5-2a, I noticed it seems [Apple, ZTE, QC] may have some concern on it, but I’m not sure. Let’s just check if some companies really have concern on proposal 5-1a. If some companies still think it is not necessary, let’s deprioritize the discussion. |

### 2nd Round Proposals (Open)

**Initial proposal 5-2a:**

If a UE only supports FDM reception between unicast PDSCH and multicast PDSCH in a slot but does not support TDM between multicast PDSCH and unicast/multicast PDSCH in a slot, and if more than one PDSCH on a serving cell each without a corresponding PDCCH transmission are in a slot and at least one of them is multicast PDSCH, the UE resolves collisions among unicast SPS PDSCHs resulting in one unicast SPS PDSCH and collisions among multicast SPS PDSCHs resulting in one multicast SPS PDSCH as in Rel-16, respectively. If the resulting unicast SPS PDSCH and multicast SPS PDSCH overlap in frequency, the UE receives the one with lower configured *sps-ConfigIndex*; else, the UE receives both PDSCHs.

Provide your comments only when you have concern on it.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | We think a UE only supports FDM reception between unicast PDSCH and multicast PDSCH is weird. It is more like to have two types of UE 1) only support TDM reception 2) support both TDM and FDM reception. If we want to have a unified solution for these kinds of UEs and have minimized spec change, we suggest the following to close this issue.  ***Initial proposal 5-2a:***  *If a UE ~~only~~ supports FDM reception between unicast PDSCH and multicast PDSCH in a slot but does not support TDM between multicast PDSCH and unicast/multicast PDSCH in a slot, and if more than one PDSCH on a serving cell each without a corresponding PDCCH transmission are in a slot and at least one of them is multicast PDSCH, the UE resolves collisions among unicast SPS PDSCHs resulting in one unicast SPS PDSCH and collisions among multicast SPS PDSCHs resulting in one multicast SPS PDSCH as in Rel-16, respectively. If the resulting unicast SPS PDSCH and multicast SPS PDSCH overlap in both time and frequency, the UE receives the one with lower configured sps-ConfigIndex; else, the UE receives both PDSCHs.*  Although the above proposal is not ideal, for example, the legacy Rel-16 procedure may result in more than one unicast SPS PDSCH or more than one multicast SPS PDSCH, but this can be controlled by network somehow. |
| vivo | As comment by other companies, the assumption of “If a UE only supports FDM reception between unicast PDSCH and multicast PDSCH in a slot but does not support TDM between multicast PDSCH and unicast/multicast PDSCH in a slot” is untenable. In addition, as we comment in the 1st round, the proposal solution brings unnecessary complexity but get bad performance.  We have the following suggestion:  [If a UE only supports FDM reception between unicast PDSCH and multicast PDSCH in a slot but does not support TDM between multicast PDSCH and unicast/multicast PDSCH in a slot, and] If more than one PDSCH on a serving cell each without a corresponding PDCCH transmission are in a slot and at least one of them is multicast PDSCH, the UE receives one SPS PDSCH with the lowest configured sps-ConfigIndex within the slot.   * If the resulting PDSCH above is unicast PDSCH, the UE receives one multicast PDSCH with the lowest configured sps-ConfigIndex within in the slot, where the multicast PDSCH and the resulting PDSCH above are in different frequency.   If the resulting PDSCH above is multicast PDSCH, the UE receives one unicast PDSCH with the lowest configured sps-ConfigIndex within the slot, where the unicast PDSCH and the resulting PDSCH above in step 1 are in different frequency. |
| Spreadtrum | Fine with ZTE’s revision. |
| Nokia, NSB | We are fine with ZTE’s revision |
| Ericsson | OK with ZTE’s version. |
| Samsung | OK with ZTE’s version. |
| Moderator | It seems ZTE’s suggestion maybe agreeable. Let’s have a try. I made some modification, since in my understanding ZTE’s intention is to cover both kinds of UEs, i.e., 1) only support TDM reception 2) support both TDM and FDM reception. Companies please check if you are OK with the updated version.  **Updated proposal 5-2a:**  If a UE ~~only~~ supports FDM reception between unicast PDSCH and multicast PDSCH in a slot ~~but does not support TDM between multicast PDSCH and unicast/multicast PDSCH in a slot~~, and if more than one PDSCH on a serving cell each without a corresponding PDCCH transmission are in a slot and at least one of them is multicast PDSCH, the UE resolves collisions among unicast SPS PDSCHs resulting in one unicast SPS PDSCH and collisions among multicast SPS PDSCHs resulting in one multicast SPS PDSCH as in Rel-16, respectively. If the resulting unicast SPS PDSCH and multicast SPS PDSCH overlap in both time and frequency, the UE receives the one with lower configured *sps-ConfigIndex*; else, the UE receives both PDSCHs*.* |
| Apple | For updated proposal 5-2a, it will cause SPS PDSCH dropping issue. gNB can’t transmit both unicast SPS PDSCH and multicast SPS PDSCH overlapped both in time and frequency, at least one of them will be dropped. If multicast SPS PDSCH is dropped, group of UEs will be impacted. In original proposal, both unicast SPS PDSCH and multicast SPS PDSCH will be transmitted in a slot, the UE could select one of them to receive if overlapped in frequency. Other UEs will not impact.  So, Initial proposal 5-2a sounds more reasonable to move forward. |
| CATT | For the sake of compromise, we can live with the updated proposal. |
| ZTE | The initial FL proposal can support Case 1 and Case 2 below, but can NOT support Case 3 since SPS#1 and SPS#2 are overlapping in frequency. However, this is weird since UE is capable of receiving Case 1 (FDM) and Case 2 (FDM+TDM) already. Case 3 is just a legacy TDM case.    However, the updated proposal from us and suggested by the moderator can allow UE to support Case 3.  We suggest to go with the updated proposal. |
| vivo | If case 3 in the figures given by ZTE is also supported, SPS#1 and SPS# 2 both are unciast SPS should also be supported. As shown in the following figure, even there are mulitcast SPS in the slot, unicast SPS 1 and SPS 3 should be selected based on the rule that lowest index with the highest priority. So, we have one question for the proposal: If a UE only supports FDM reception between unicast PDSCH and multicast PDSCH in a slot, and if more than one PDSCH on a serving cell each without a corresponding PDCCH transmission are in a slot and at least one of them is multicast PDSCH. Our intension is to select at most one unicast SPS and at most one multicast SPS PDSCH, where the unicast SPS and multicast SPS are FDMed or TDMed. Or Our intension is to select at most two SPS which can satisfy UE’s capability? If it is the former, SPS 1 and SPS 4 should be received in the following figure. If it is the latter, SPS 1 and SPS 3 should be received.  In addition, as we comment above, for the [updated] proposal 5-2a, it will cause unnecessary SPS PDSCH dropping issue. For example, in the following case, only unicast SPS 1 is received. But UE has the capability to receive unicast SPS 1 and multicast 4 if our principle is to select at most one unicast SPS PDSCH and at most one multicast SPS PDSCH with the lowest index.    One more question for clarification. If a UE only supports FDM reception between unicast PDSCH and multicast PDSCH in a slot, and if more than one PDSCH on a serving cell each without a corresponding PDCCH transmission are in a slot and none of them is multicast PDSCH, does the UE determine PDSCHs for reception as in Rel-16? If so, why Rel-16 can’t be reused when there are more than one PDSCH on a serving cell each without a corresponding PDCCH transmission in a slot and none of them is unicast PDSCH? |
| Spreadtrum | For the updated proposal, we have one question for clarification. If UE only support FDMed reception not supported intra-slot TDMed reception, why UE should receive both TDMed PDSCHs, e.g., case 2 and case 3. We think the prerequisite condition for the updated proposal is that UE supports both FDMed multiplexing in a slot and TDMed multiplexing in a slot. |
| MediaTek | Not support the proposal.  The current proposal seems to mean that multiple unicast PDSCHs and multiple group common PDSCH can be in the same slot for the FDMed case. However, based on the previous discussion and UE feature description, it only has one unicast PDSCH and one group common PDSCH for the FDMed case. Besides, we suggest to deprioritize the discussion since the UE feature discussion for the FDMed case only focus on the dynamic scheduling. From our perspective, the motivation is not clear to schedule the FDMed unicast PDSCH and group common PDSCH for the semi-static scheduling case, and it can be avioided by gNB implementaition. |
| Lenovo | We share same view with Spreadtrum. |

# 1st set Stable proposals and TPs

**Initial proposal 2-1a:**

Send an LS to inform RAN2 that the following parameters are NOT needed for PDCCH-Config-Multicast:

* + downlinkPreemption
  + tpc-PUCCH
  + tpc-PUSCH
  + tpc-SRS
  + uplinkCancellation-r16
  + monitoringCapabilityConfig-r16 (the default is *R15monitoringcapablity*)
  + searchSpaceSwitchConfig-r16

**Initial proposal 3-1a:**

Send an LS to inform RAN2 that the following parameters are NOT needed for PDSCH-Config-Multicast:

* *minimumSchedulingOffsetK0-r16*
* *antennaPortsFieldPresenceDCI-1-2-r16, aperiodicZP-CSI-RS-ResourceSetsToAddModListDCI-1-2-r16, aperiodicZP-CSI-RS-ResourceSetsToReleaseListDCI-1-2-r16, dmrs-DownlinkForPDSCH-MappingTypeA-DCI-1-2-r16, dmrs-DownlinkForPDSCH-MappingTypeB-DCI-1-2-r16, dmrs-SequenceInitializationDCI-1-2-r16, harq-ProcessNumberSizeDCI-1-2-r16, mcs-TableDCI-1-2-r16, numberOfBitsForRV-DCI-1-2-r16, pdsch-TimeDomainAllocationListDCI-1-2-r16, prb-BundlingTypeDCI-1-2-r16, priorityIndicatorDCI-1-2-r16, rateMatchPatternGroup1DCI-1-2-r16, rateMatchPatternGroup2DCI-1-2-r16, resourceAllocationType1GranularityDCI-1-2-r16, vrb-ToPRB-InterleaverDCI-1-2-r16, referenceOfSLIVDCI-1-2-r16, resourceAllocationDCI-1-2-r16,*
* *dataScramblingIdentityPDSCH2-r16*
* *repetitionSchemeConfig-r16, repetitionSchemeConfig-v1630*

**Updated proposal 1-1a:**

If UE supports carrier aggregation for unicast, multicast reception on an activated SCell with self-scheduling is supported subject to UE capability in Rel-17.

* UE is not expected to be configured simultaneously with more than one component carrier for multicast reception.
* Cross-carrier scheduling for multicast reception is not supported in Rel-17.
* The capability of supporting MBS multicast on SCell is a separate capability from the CA capability for unicast.
  + The granularity of UE reporting the capability of supporting MBS multicast reception is per FSPC

**Updated proposal 2-2a (for conclusion):**

When HARQ feedback is disabled, the following fields (if present) of DCI format 4\_1/4\_2 can be assumed to be reserved and UE ignores them:

* PUCCH resource Indicator
* PDSCH-to-HARQ\_feedback timing indicator

**Initial proposal 2-4a:**

For RRC\_CONNECTED UEs, a multicast PDCCH to schedule a multicast PDSCH is counted as a unicast DCI to schedule a unicast PDSCH.

* Adopt the following TP for Clause 10.1 in TS 38.213:

----------------- Start of TP ----------------

10.1 UE procedure for determining physical downlink control channel assignment

**<**Unchanged text is omitted>

For a scheduled cell and at any time, a UE expects to have received at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, G-RNTI for multicast, G-CS-RNTI or MCS-C-RNTI scheduling 16 PDSCH receptions for which the UE has not received any corresponding PDSCH symbol and at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, or MCS-C-RNTI scheduling 16 PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

**Initial TP 2-6-1:**

Adopt the following TP for Clause 7.3.1.5.2 in TS 38.212:

----------------- Start of TP ----------------

7.3.1.5.2 Format 4\_1

**<**Unchanged text is omitted>

- Reserved bits – 3 bits

~~- Padding bits, if required~~

~~Zeros shall be appended to DCI format 4\_1 until the payload size equals that of DCI format 1\_0 monitored in common search space in the same serving cell.~~

**<**Unchanged text is omitted>

----------------- End of TP ----------------

**Initial TP 2-6-2:**

Adopt the following TP for Clause 7.3.1.5.3 in TS 38.212:

----------------- Start of TP ----------------

7.3.1.5.3 Format 4\_2

**<**Unchanged text is omitted>

- Downlink assignment index – number of bits as defined in the following

- 4 bits if more than one serving cell are configured in the DL for multicast and the higher layer parameter *pdsch-HARQ-ACK-Codebook-Multicast=dynamic*, where the 2 MSB bits are the counter DAI and the 2 LSB bits are the total DAI;

- 2 bits if only one serving cell is configured in the DL for multicast and the higher layer parameter *pdsch-HARQ-ACK-Codebook-Multicast=dynamic*, where the 2 bits are the counter DAI;

- 0 bits otherwise.

If the UE is configured with a PUCCH-SCell, the number of serving cells is determined within a PUCCH group.

If the UE is configured with a PUCCH-SCell, *pdsch-HARQ-ACK-Codebook* is replaced by *pdsch-HARQ-ACK-Codebook-secondaryPUCCHgroup-r16* if present for the secondary PUCCH group.

If higher layer parameter *priorityIndicatorDCI-~~1-1~~4-2* is configured in *PDSCH-Config-Multicast*, if the bit width of the Downlink assignment index in DCI format ~~1\_1~~4\_2 for one HARQ-ACK codebook is not equal to that of the Downlink assignment index in DCI format ~~1\_1~~4\_2 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller Downlink assignment index until the bit width of the Downlink assignment index in DCI format ~~1\_1~~4\_2 for the two HARQ-ACK codebooks are the same.

- PUCCH resource indicator – 3 bits as defined in Clause 9.2.3 of [5, TS 38.213]

- PDSCH-to-HARQ\_feedback timing indicator – 0, 1, 2, or 3 bits as defined in Clause 9.2.3 of [5, TS 38.213]. The bitwidth for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *dl-DataToUL-ACK* in *PUCCH-Config-Multicast1* if configured or *PUCCH-Config-Multicast2* if configured; otherwise, *I* is the number of entries in the higher layer parameter *dl-DataToUL-ACK* in *PUCCH-Config.*

If higher layer parameter *priorityIndicatorDCI-~~1-1~~4-2* is configured in *PDSCH-Config-Multicast*, if the bit width of the PDSCH-to-HARQ\_feedback timing indicator in DCI format ~~1\_1~~4\_2 for one HARQ-ACK codebook is not equal to that of the PDSCH-to-HARQ\_feedback timing indicator in DCI format ~~1\_1~~4\_2 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller PDSCH-to-HARQ\_feedback timing indicator until the bit width of the PDSCH-to-HARQ\_feedback timing indicator in DCI format ~~1\_1~~4\_2 for the two HARQ-ACK codebooks are the same.

- Antenna port(s) – 4, 5, or 6 bits as defined by Tables 7.3.1.2.2-1/2/3/4, where the number of CDM groups without data of values 1, 2, and 3 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively. The antenna ports shall be determined according to the ordering of DMRS port(s) given by Tables 7.3.1.2.2-1/2/3/4.

If a UE is configured with both *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB*, the bitwidth of this field equals , where is the "Antenna ports" bitwidth derived according to *dmrs-DownlinkForPDSCH-MappingTypeA* and is the "Antenna ports" bitwidthderived according to *dmrs-DownlinkForPDSCH-MappingTypeB*. A number of zeros are padded in the MSB of this field, if the mapping type of the PDSCH corresponds to the smaller value of and .

- Transmission configuration indication – 0 bit if higher layer parameter *tci-PresentInDCI* in *PDCCH-Config-Multicast* is not enabled; otherwise 3 bits as defined in Clause 5.1.5 of [6, TS38.214].

- DMRS sequence initialization – 1 bit.

- Priority indicator – 0 bit if higher layer parameter *priorityIndicatorDCI-~~1-1~~4-2* is not configured in *PDSCH-Config-Multicast*; otherwise 1 bit as defined in Clause 9 in [5, TS 38.213].

- Enabling/disabling HARQ-ACK feedback indication –1 bit if higher layer parameter *harq-FeedbackEnabler-Multicast* indicates *dci-enabler*; 0 bit, otherwise.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

**Initial TP 2-6-3:**

Adopt the following TP for Clause 10.2 in TS 38.213:

----------------- Start of TP ----------------

**<**Unchanged text is omitted>

10.2 PDCCH validation for DL SPS and UL grant Type 2

A UE validates, for scheduling activation or scheduling release, a DL SPS assignment PDCCH or a configured UL grant Type 2 PDCCH if

- the CRC of a corresponding DCI format is scrambled with a CS-RNTI provided by *cs-RNTI*, or a

G-CS-RNTI provided by g-cs-RNTI, and

**<**Unchanged text is omitted>

Table 10.2-1: Special fields for single DL SPS or single UL grant Type 2 scheduling activation PDCCH validation when a UE is provided a single SPS PDSCH or UL grant Type 2 configuration in the active DL/UL BWP of the scheduled cell

|  |  |  |  |
| --- | --- | --- | --- |
|  | DCI format 0\_0/0\_1/0\_2 | DCI format 1\_0/1\_2/4\_1 | DCI format 1\_1/4\_2 |
| HARQ process number | set to all ‘0’s | set to all ‘0’s | set to all ‘0’s |
| Redundancy version | set to all ‘0’s | set to all ‘0’s | For the enabled transport block: set to all ‘0’s |

Table 10.2-2: Special fields for single DL SPS or single UL grant Type 2 scheduling release PDCCH validation when a UE is provided a single SPS PDSCH or UL grant Type 2 configuration in the active DL/UL BWP of the scheduled cell

|  |  |  |
| --- | --- | --- |
|  | DCI format 0\_0/0\_1/0\_2 | DCI format 1\_0/1\_1/1\_2/4\_1/4\_2 |
| HARQ process number | set to all ‘0’s | set to all ‘0’s |
| Redundancy version | set to all ‘0’s | set to all ‘0’s |
| Modulation and coding scheme | set to all ‘1’s | set to all ‘1’s |
| Frequency domain resource assignment | set to all ‘0’s for FDRA Type 2 with  set to all ‘1’s, otherwise | set to all ‘0’s for FDRA Type 0 or for *dynamicSwitch*  set to all ‘1’s for FDRA Type 1 |

Table 10.2-3: Special fields for a single DL SPS or single UL grant Type 2 scheduling activation PDCCH validation when a UE is provided multiple DL SPS or UL grant Type 2 configurations in the active DL/UL BWP of the scheduled cell

|  |  |  |  |
| --- | --- | --- | --- |
|  | DCI format 0\_0/0\_1/0\_2 | DCI format 1\_0/1\_2/4\_1 | DCI format 1\_1/4\_2 |
| Redundancy version | set to all ‘0’s | set to all ‘0’s | For the enabled transport block: set to all ‘0’s |

Table 10.2-4: Special fields for a single or multiple DL SPS and UL grant Type 2 scheduling release PDCCH validation when a UE is provided multiple DL SPS or UL grant Type 2 configurations in the active DL/UL BWP of the scheduled cell

|  |  |  |
| --- | --- | --- |
|  | DCI format 0\_0/0\_1/0\_2 | DCI format 1\_0/1\_1/1\_2/4\_1/4\_2 |
| Redundancy version | set to all ‘0’s | set to all ‘0’s |
| Modulation and coding scheme | set to all ‘1’s | set to all ‘1’s |
| Frequency domain resource assignment | set to all ‘0’s for FDRA Type 2 with  set to all ‘1’s, otherwise | set to all ‘0’s for FDRA Type 0 or for *dynamicSwitch*  set to all ‘1’s for FDRA Type 1 |

----------------- End of TP ----------------

**Updated proposal 3-3a:**

Regarding rate matching of GC-PDSCH reception,

* ~~the UE shall assume that the PRBs containing SS/PBCH block transmission resources are not available for PDSCH when receiving the PDSCH scheduled with MCCH-RNTI or G-RNTI for MTCH.~~
* the UE shall assume that both of indicated resources in clauses 5.1.4.1, 5.1.4.2 and the PRBs containing SS/PBCH block transmission resources are not available for the PDSCH scheduled with G-RNTI for multicast.
* Adopt the following TP for Clause 5.1.4 of TS38.214\_h00.

----------------- Start of TP ----------------

5.1.4 PDSCH resource mapping

**<**Unchanged text is omitted>

When receiving the PDSCH scheduled with SI-RNTI and the system information indicator in DCI is set to 0, the UE shall assume that no SS/PBCH block is transmitted in REs used by the UE for a reception of the PDSCH.

When receiving the PDSCH scheduled with SI-RNTI and the system information indicator in DCI is set to 1, RA-RNTI, MSGB-RNTI, P-RNTI or TC-RNTI, the UE assumes SS/PBCH block transmission according to *ssb-PositionsInBurst*, and if the PDSCH resource allocation overlaps with PRBs containing SS/PBCH block transmission resources the UE shall assume that the PRBs containing SS/PBCH block transmission resources are not available for PDSCH in the OFDM symbols where SS/PBCH block is transmitted.

A UE expects a configuration provided by *ssb-PositionsInBurst* in *ServingCellConfigCommon* to be same as a configuration provided by *ssb-PositionsInBurst* in *SIB1*.

When receiving PDSCH scheduled by PDCCH with CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI, G-RNTI for multicast or PDSCHs with SPS, the REs corresponding to the configured or dynamically indicated resources in Clauses 5.1.4.1, 5.1.4.2 are not available for PDSCH. Furthermore, the UE assumes SS/PBCH block transmission according to *ssb-PositionsInBurst* if the PDSCH resource allocation overlaps with PRBs containing SS/PBCH block transmission resources, and the UE shall assume that the PRBs containing SS/PBCH block transmission resources are not available for PDSCH in the OFDM symbols where SS/PBCH block is transmitted.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

# 2nd set Stable proposals and TPs

**Updated proposal 2-7a:**

Regarding the number of DCIs that a UE can process in a slot or span, MBS broadcast DCI monitored by the UE is treated as unicast DCI scheduling DL following the current feature group 3-1/3-5a/3-5b for RRC\_CONNECTED UEs.

**Initial TP 2-8-1:**

Adopt the following TP for Clause 7.3.1.5.3 in TS 38.212:

----------------- Start of TP ----------------

7.3.1.5.3 Format 4\_2

**<**Unchanged text is omitted>

- Rate matching indicator – 0, 1, or 2 bits according to higher layer parameters *rateMatchPatternGroup1* and *rateMatchPatternGroup2* in *PDSCH-Config-Multicast*, where the MSB is used to indicate *rateMatchPatternGroup1* and the LSB is used to indicate *rateMatchPatternGroup2* when there are two groups.

- ZP CSI-RS trigger – 0, 1, or 2 bits as defined in Clause 5.1.4.2 of [6, TS 38.214]. The bitwidth for this field is determined as bits, where is the number of aperiodic ZP CSI-RS resource sets configured in *PDSCH-Config-Multicast* ~~by higher layer~~.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

# Proposals for GTW session

**Initial proposal 3-1b:**

Send an LS to inform RAN2 that the following parameters are NOT needed for PDSCH-Config-Multicast:

* *zp-CSI-RS-ResourceToAddModList, zp-CSI-RS-ResourceToReleaseList*
* *sp-ZP-CSI-RS-ResourceSetsToAddModList, sp-ZP-CSI-RS-ResourceSetsToReleaseList*
* *p-ZP-CSI-RS-ResourceSet*

**Initial proposal 3-2a:**

For TCI states activation/deactivation for multicast GC-PDSCH, Alt-1 is supported.

* Alt-1: The unicast PDSCH carrying a ‘TCI States Activation/Deactivation for UE-specific PDSCH MAC CE’ is received by the UE to map up to 8 TCI states configured in *PDSCH-Config* to the TCI codepoints in both unicast DCI format and DCI format 4\_2. The following text in Clause 5.1.5 of TS38.214 is deleted.
  + “The UE can be configured with a list of up to *M’* *TCI-State*configurations within the higher layer parameter *PDSCH-Config-Multicast* to decode PDSCH associated with a G-RNTI or a G-CS-RNTI according to a detected PDCCH with DCI intended for the UE and the given serving cell, where M’ depends on the UE capability.”

**Updated TP 2-4b:**

Adopt the following TP for Clause 10.1 in TS 38.213:

----------------- Start of TP ----------------

10.1 UE procedure for determining physical downlink control channel assignment

**<**Unchanged text is omitted>

For a scheduled cell and at any time, if a UE is provided a C-RNTI, ~~a~~the UE expects to have received at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, G-RNTI, G-CS-RNTI or MCS-C-RNTI scheduling 16 PDSCH receptions for which the UE has not received any corresponding PDSCH symbol and at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, or MCS-C-RNTI scheduling 16 PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

**Initial TP 2-6-4:**

Adopt the following TP for Clause 10.1 in TS 38.213:

----------------- Start of TP ----------------

10.1 UE procedure for determining physical downlink control channel assignment

**<**Unchanged text is omitted>

A set of PDCCH candidates for a UE to monitor is defined in terms of PDCCH search space sets. A search space set can be a CSS set or a USS set. A UE monitors PDCCH candidates in one or more of the following search spaces sets

- a Type0-PDCCH CSS set on the primary cell of the MCG configured by

- *pdcch-ConfigSIB1* in *MIB* or by *searchSpaceSIB1* in *PDCCH-ConfigCommon* or by *searchSpaceZero* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a SI-RNTI, or

- *searchSpaceZero* in *PDCCH-ConfigCommon*, when *pdcch-Config-MCCH* and *pdcch-Config-MTCH* are provided, for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI

- a Type0A-PDCCH CSS set configured by *searchSpaceOtherSystemInformation* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a SI-RNTI on the primary cell of the MCG

- a Type0B-PDCCH CSS set configured by *searchSpaceBroadcast* in *pdcch-Config-MCCH* and *pdcch-Config-MTCH* for a DCI format with CRC scrambled by a MCCH-RNTI or a G-RNTI on the primary cell of the MCG

- a Type1-PDCCH CSS set configured by *ra-SearchSpace* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a RA-RNTI, a MsgB-RNTI, or a TC-RNTI on the primary cell

- a Type1A-PDCCH CSS set configured by *sdt-SearchSpace* in *PDCCH-ConfigCommon* for a DCI format with CRC scrambled by a C-RNTI or a CS-RNTI on the primary cell as described in clause 19.1

- a Type2-PDCCH CSS set configured by *pagingSearchSpace* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a P-RNTI on the primary cell of the MCG

- a Type2A-PDCCH CSS set configured by *peiSearchSpace* in *DownlinkConfigCommonSIB* for a DCI format 2\_7 with CRC scrambled by a RNTI on the primary cell of the MCG

- a Type3-PDCCH CSS set configured by

- *SearchSpace* in *PDCCH-Config* with *searchSpaceType* = *common* for DCI formats with CRC scrambled by INT-RNTI, SFI-RNTI, TPC-PUSCH-RNTI, TPC-PUCCH-RNTI, TPC-SRS-RNTI, or CI-RNTI and, only for the primary cell, C-RNTI, MCS-C-RNTI, CS-RNTI(s), or PS-RNTI, or

- *SearchSpace-Multicast* in *PDCCH-Config-Multicast* for DCI formats with CRC scrambled by G-RNTI, or G-CS-RNTI, or

- *searchSpaceBroadcast* in *pdcch-Config-MCCH* and *pdcch-Config-MTCH* on a secondary cell for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI, and

**<**Unchanged text is omitted>

If the active DL BWP and an MBS frequency resource provided by *cfr-Config-MCCH-MTCH* for a UE have same SCS and same CP length and the active DL BWP includes all RBs of the MBS frequency resource, and if the UE is provided *searchSpaceBroadcast* ~~for Type0B-PDCCH CSS set~~, the UE monitors PDCCH for *searchSpaceBroadcast* ~~for Type0B-PDCCH CSS set~~ on the active DL BWP.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

# References

1. RP-193248 New WID proposal: NR Multicast and Broadcast Services
2. RP-201038 Revised WID: Core part: NR multicast and broadcast services
3. R1-2200948 Resource configuration and group scheduling for RRC\_CONNECTED UEs Huawei, HiSilicon
4. R1-2201006 Remaining Issues on Group Scheduling Mechanisms for RRC\_CONNECTED Ues supporting MBS Nokia, Nokia Shanghai Bell
5. R1-2201114 Remaining issues on mechanisms to support group scheduling for RRC\_CONNECTED Ues vivo
6. R1-2201170 Maintenance of Mechanisms to Support Group Scheduling for RRC\_CONNECTED UEs ZTE
7. R1-2201257 Discussion on remaining issues of group scheduling mechanism for RRC\_CONNECTED UEs OPPO
8. R1-2201338 Remaining issue on group scheduling mechanism for RRC\_CONNECTED UEs in MBS CATT
9. R1-2201496 Remaining issues on group scheduling mechanisms for RRC\_CONNECTED UEs NTT DOCOMO, INC.
10. R1-2201592 Discussion on RAN2 LS on MBS SPS TD Tech, Chengdu TD Tech
11. R1-2201607 Discussion on mechanisms to support group scheduling for RRC\_CONNECTED UEs ASUSTeK
12. R1-2201717 Group Scheduling for RRC\_CONNECTED Ues Intel Corporation
13. R1-2201786 Remaining issues on MBS group scheduling mechanism for RRC\_connected UEs Apple
14. R1-2201815 Discussion on the remaining issues on MBS group scheduling for RRC\_CONNETED UEs Spreadtrum Communications
15. R1-2201876 Remaining issues on group scheduling mechanisms for RRC\_CONNECTED UEs CMCC
16. R1-2201908 Remaining Issues on Group Scheduling Mechanisms for RRC\_CONNECTED UEs NEC
17. R1-2201931 Remaining issues on group scheduling for RRC\_CONNECTED UEs Xiaomi
18. R1-2202034 Maintenance on group scheduling for RRC\_CONNECTED UEs Samsung
19. R1-2202079 Remaining issues on NR MBS group scheduling for RRC\_CONNECTED UEs MediaTek Inc.
20. R1-2202160 Maintenance on group scheduling for Multicast RRC\_CONNECTED UEs Qualcomm Incorporated
21. R1-2202227 Remaining issues on group scheduling mechanism for RRC\_CONNECTED UEs Lenovo, Motorola Mobility
22. R1-2202232 Correction on group scheduling for RRC\_CONNECTED UEs ETRI
23. R1-2202331 Corrections of MBS for RRC\_CONNECTED UEs Google Inc.
24. R1-2202349 Support of group scheduling for RRC\_CONNECTED UEs LG Electronics
25. R1-2202396 Mechanisms to support MBS group scheduling for RRC\_CONNECTED Ues Ericsson
26. R1-2200888 LS on MBS SPS RAN2, OPPO
27. R1-2201055 Draft reply LS on MBS SPS vivo
28. R1-2201152 [Draft] Reply LS on MBS SPS ZTE
29. R1-2201261 Discussion on the LS from RAN2 of MBS SPS OPPO
30. R1-2201262 Draft LS reply on MBS SPS OPPO
31. R1-2201323 Discussion on Reply LS on MBS issue of SPS CATT
32. R1-2201814 Discussion on LS on MBS SPS Spreadtrum Communications
33. R1-2201829 Discussion on RAN2 LS on MBS SPS CMCC
34. R1-2201830 Draft reply LS on MBS SPS CMCC
35. R1-2202078 Discussion on RAN2 LS on MBS SPS MediaTek Inc.
36. R1-2202435 Discussion on the incoming LS about MBS SPS Huawei, HiSilicon
37. R1-2202436 DRAFT LS reply about MBS SPS Huawei, HiSilicon

# Appendix 1: Agreements in #102 e-meetings

**RAN1#102-e**

Agreements:

For RRC\_CONNECTED UEs, HARQ-ACK feedback is supported for multicast and no additional evaluation is needed to justify this.

* + FFS: The detailed HARQ-ACK feedback solutions, e.g., ACK/NACK based, NACK-only based.
  + FFS: HARQ-ACK feedback can be optionally disabled and/or enabled.

Agreements:

For RRC\_CONNECTED UEs, at least 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.

o   FFS: whether to support UE-specific PDCCH to schedule a PDSCH for MBS.

Agreements:

* For RRC\_CONNECTED UEs, define/configure common frequency resource for group-common PDSCH.
  + FFS: whether to reuse the BWP framework or not
  + FFS: the relation between the common frequency resource and UE dedicated BWP, e.g., the common frequency resource is a MBS specific BWP, or the common frequency resource is confined within UE’s dedicated BWP, etc.
  + FFS: whether more than one common frequency resource can be configured per UE

Agreements:

* For RRC\_CONNECTED UEs, at least support FDM between unicast PDSCH and group-common PDSCH in a slot based on UE capability.
  + FFS: TDM or SDM in a slot.

Agreements:

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

Agreements:

* For RRC\_CONNECTED UEs, existing CSI feedback can be used for multicast transmission.
  + FFS: whether enhancement is needed

# Appendix 2: Agreements in #103 e-meetings

**RAN1#103-e**

**Mechanisms to support group scheduling for RRC\_CONNECTED UEs**

**Agreements:** For convenience of discussion, consider the following clarification as RAN1 common understanding.

* **PTP transmission**: For RRC\_CONNECTED UEs, use UE-specific PDCCH with CRC scrambled by UE-specific RNTI (e.g., C-RNTI) to schedule UE-specific PDSCH which is scrambled with the same UE-specific RNTI.
* **PTM transmission scheme 1**: For RRC\_CONNECTED UEs in the same MBS group, use group-common PDCCH with CRC scrambled by group-common RNTI to schedule group-common PDSCH which is scrambled with the same group-common RNTI. This scheme can also be called group-common PDCCH based group scheduling scheme.
* **PTM transmission scheme 2**: For RRC\_CONNECTED UEs in the same MBS group, use UE-specific PDCCH with CRC scrambled by UE-specific RNTI (e.g., C-RNTI) to schedule group-common PDSCH which is scrambled with group-common RNTI. This scheme can also be called UE-specific PDCCH based group scheduling scheme.
* Note: The ‘UE-specific PDCCH / PDSCH’ here means the PDCCH / PDSCH can only be identified by the target UE but cannot be identified by the other UEs in the same MBS group with the target UE.
* Note: The ‘group-common PDCCH / PDSCH’ here means the PDCCH / PDSCH are transmitted in the same time/frequency resources and can be identified by all the UEs in the same MBS group.
* FFS whether or not to have additional definition of transmission scheme(s)

Agreements**:** For RRC\_CONNECTED UEs, if initial transmission for multicast is based on PTM transmission scheme 1, at least support retransmission(s) can use PTM transmission scheme 1.

* FFS: whether to support PTP transmission for retransmission(s).
* FFS: whether to support PTM transmission scheme 2 for retransmission(s).
* FFS: How to indicate the association between PTM scheme 1 and PTP transmitting the same TB.
* FFS: If multiple retransmission schemes are supported, then can different retransmission schemes be supported simultaneously for different UEs in the same group?

**Working assumption:**

For multicast of RRC-CONNECTED UEs, a common frequency resource for group-common PDCCH / PDSCH is confined within the frequency resource of a dedicated unicast BWP to support simultaneous reception of unicast and multicast in the same slot

* Down select from the two options for the common frequency resource for group-common PDCCH/ PDSCH
  + Option 2A: The common frequency resource is defined as an MBS specific BWP, which is associated with the dedicated unicast BWP and using the same numerology (SCS and CP)
    - FFS BWP switching is needed between the multicast reception in the MBS specific BWP and unicast reception in its associated dedicated BWP
  + Option 2B: The common frequency resource is defined as an ‘MBS frequency region’ with a number of contiguous PRBs, which is configured within the dedicated unicast BWP.
    - FFS: How to indicate the starting PRB and the length of PRBs of the MBS frequency region
* FFS whether UE can be configured with no unicast reception in the common frequency resource
* FFS on details of the group-common PDCCH / PDSCH configuration
* FFS whether to support more than one common frequency resources per UE / per dedicated unicast BWP subjected to UE capabilities

Agreements: Support TDM between one unicast PDSCH and one group-common PDSCH in a slot based on UE capability for RRC\_CONNECTED UEs.

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

Agreements: For PTM transmission scheme 1, the CORESET for group-common PDCCH is configured within the common frequency resource for group-common PDSCH.

* FFS: number of CORESET(s) for group-common PDCCH within the common frequency resource for group-common PDSCH

Agreements: For search space set of group-common PDCCH of PTM scheme 1 for multicast in RRC\_CONNECTED state, the CCE indexes are common for different UEs in the same MBS group.

Agreements: Down select from the two options for BDs/CCEs limit for Rel-17 MBS

* Option 1: the maximum number of monitored PDCCH candidates and non-overlapped CCEs per slot per serving cell defined in Rel-15 is kept unchanged for Rel-17 MBS.
* Option 2: For UEs supporting CA capability, the budget of BDs/CCEs of an unused CC can be used for group-common PDCCH to count the number of BDs/CCEs, which is similar to the method used for multi-DCI based multi-TRP in Rel-16.

Agreements:For RRC\_CONNECTED UEs, support inter-slot TDM between unicast PDSCH and group-common PDSCH in different slots (mandatory for the UE supporting MBS).

Agreements:Further study the following cases for simultaneous reception of unicast PDSCH and group-common PDSCH in a slot based on UE capability for RRC\_CONNECTED UEs.

* Case 1: support TDM between multiple TDMed unicast PDSCHs and one group-common PDSCH in a slot
* Case 2: support TDM among multiple group-common PDSCHs in a slot
* Case 3: support TDM between multiple TDMed unicast PDSCHs and multiple TDMed group-common PDSCHs in a slot
* Case 4: support FDM between multiple TDMed unicast PDSCHs and multiple TDMed group-common PDSCHs in a slot
* Case 5: support FDM among multiple group-common PDSCHs in a slot
* FFS: maximum number of PDSCHs in a slot simultaneous received per UE

Agreements:For search space set of group-common PDCCH of PTM scheme 1 for multicast in RRC\_CONNECTED state, further study the following options.

* Option 1: Define a new search space type specific for multicast
* Option 2: Reuse the existing CSS type(s) in Rel-15/16
  + FFS: whether modifications are needed for multicast
* Option 3: Reuse the existing USS in Rel-15/16 with necessary modifications for MBS
  + FFS: detailed modifications

Agreements:No specification enhancement in Rel-17 to support SDM between unicast PDSCH and group-common PDSCH in a slot for RRC\_CONNECTED UEs.

Agreements**:** For PTM transmission scheme 1, if Option 2A or Option 2B for common frequency resource for group-common PDCCH/PDSCH is agreed, the FDRA field of group-common PDCCH is interpreted based on the common frequency resource.

Agreements: For search space set of group-common PDCCH of PTM scheme 1 for multicast in RRC\_CONNECTED state, further study the following options for the monitoring priority of search space set

* Option 1: The monitoring priority of search space set for multicast is the same as existing Rel-15/16 CSS
* Option 2: The monitoring priority of search space set for multicast is the same as existing Rel-15/16 USS
* Other options are not precluded
* The monitoring priority is used at least for PDCCH overbooking case
  + FFS for other cases (e.g., to prune PDCCH in terms of whether it’s unicast or multicast, etc.)

**Mechanisms to improve reliability for RRC\_CONNECTED UEs**

Agreements:

For RRC\_CONNECTED UEs receiving multicast, at least for PTM scheme 1, support at least one of the following:

* ACK/NACK based HARQ-ACK feedback for multicast,
  + From per UE perspective, UE feedback ACK or NACK.
  + From UEs within the group perspective,
    - FFS: PUCCH resource configuration for ACK/NACK feedback e.g., shared or separate PUCCH resources.
  + FFS details including conditions for it to be used
* NACK-only based HARQ-ACK feedback for multicast,
  + From per UE perspective, UE only feedback NACK.
  + From UEs within the group perspective~~, further down-select between:~~
    - FFS: PUCCH resource configuration for NACK only feedback.
  + FFS details including conditions for it to be used
* To decide in RAN1#104-e whether or not to support only one or both of the above schemes
  + If both are supported, FFS configuration/selection of ACK/NACK-based and NACK-only based HARQ-ACK feedback

Agreements:

For RRC\_CONNECTED UEs receiving multicast, for ACK/NACK based HARQ-ACK feedback if supported for group-common PDCCH scheduling, PUCCH resource configuration for HARQ-ACK feedback from per UE perspective is, down-select one of the following options:

* Option 1: shared with PUCCH resource configuration for HARQ-ACK feedback for unicast
* Option 2: separate from PUCCH resource configuration for HARQ-ACK feedback for unicast
* Option 3: Option 1 or option 2 based on configuration

Agreements:

For RRC\_CONNECTED UEs receiving multicast, for NACK-only based HARQ-ACK feedback if supported for group-common PDCCH scheduling, PUCCH resource configuration for HARQ-ACK feedback from per UE perspective is separate from PUCCH resource configuration for HARQ-ACK feedback for unicast.

* FFS PUCCH format

Agreements:

Enabling/disabling HARQ-ACK feedback for MBS is supported, further down-select between:

* Option 1: DCI
* Option 2: RRC configures enabling/disabling
* Option 3: RRC configures the enabling/ disabling function and DCI indicates enabling /disabling
* FFS: Option 4: MAC-CE indicates enabling/disabling
* FFS: Option 5: RRC configures the enabling/ disabling function and MAC-CE indicates enabling /disabling

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

Agreements:

From the perspective of RRC\_CONNECTED UEs receiving multicast, at least for PTM scheme 1 initial transmission, retransmission supports, for the purpose of down-selection, options are:

* Option 1: group-common PDCCH scheduled group-common PDSCH
* Option 2: UE-specific PDCCH scheduled PDSCH
  + Alt 1: PDSCH is UE-specific PDSCH
  + Alt 2: PDSCH is group-common PDSCH
* Option 3: both option 1 and option 2
* FFS other options
* FFS CBG based retransmission

Agreements:

FFS whether CSI feedback enhancement is needed for MBS, including but not limited:

* New CQI measurement
* New CSI report formats
* Targeted BLER
* CSI-RS configuration
* A-CSI-RS transmission triggering
* SRS configuration

Agreements:

For ACK/NACK based HARQ-ACK feedback if supported, both Type-1 and Type-2 HARQ-ACK codebook are supported for RRC\_CONNECTED UEs receiving multicast,

* FFS details of HARQ-ACK codebook design.
* FFS whether enhanced Type-2 and/or Type-3 HARQ-ACK codebook is supported or not.

**Basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs**

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

# Appendix 3: Agreements in #104 e-meetings

**RAN1#104-e**

**Mechanisms to support group scheduling for RRC\_CONNECTED UEs**

Agreement:

For multicast of RRC-CONNECTED UEs, a common frequency resource for group-common PDCCH / PDSCH is confined within the frequency resource of a dedicated unicast BWP to support simultaneous reception of unicast and multicast in the same slot

* Down select from the two options for the common frequency resource for group-common PDCCH/ PDSCH
  + Option 2A: The common frequency resource is defined as an MBS specific BWP, which is associated with the dedicated unicast BWP and using the same numerology (SCS and CP)
    - FFS BWP switching is needed between the multicast reception in the MBS specific BWP and unicast reception in its associated dedicated BWP
  + Option 2B: The common frequency resource is defined as an ‘MBS frequency region’ with a number of contiguous PRBs, which is configured within the dedicated unicast BWP.
    - FFS: How to indicate the starting PRB and the length of PRBs of the MBS frequency region
* FFS whether UE can be configured with no unicast reception in the common frequency resource
* FFS on details of the group-common PDCCH / PDSCH configuration
* FFS whether to support more than one common frequency resources per UE / per dedicated unicast BWP subjected to UE capabilities
* FFS whether the use of a common frequency resource for multicast is optional or not
* FFS whether the common frequency resource is applicable for PTM scheme 2 (if supported) or not

Agreement:

* If Option 2B is supported for common frequency resource for multicast of RRC-CONNECTED UEs, the starting PRB and the length of PRBs of the MBS frequency region within a dedicated unicast BWP are configured via UE-specific RRC signaling.
  + The starting PRB is referenced to one of the two options:
    - Option 1: Point A
    - Option 2: the starting PRB of the dedicated unicast BWP
  + FFS the detailed signaling
* If Option 2A is supported for common frequency resource for multicast of RRC-CONNECTED UEs, the configurations of the starting PRB and the length of PRBs of the MBS frequency resource reuse the legacy BWP configuration.

Agreement:

For RRC\_CONNECTED UEs, if ACK/NACK based HARQ-ACK feedback is supported for PTM scheme 1, and if initial transmission for multicast is based on PTM transmission scheme 1, support retransmission(s) using PTP transmission.

* The HARQ process ID and NDI indicated in DCI is used to associate the PTM scheme 1 and PTP transmitting the same TB.

Agreement:

The maximum number of monitored PDCCH candidates and non-overlapped CCEs per slot per serving cell defined in Rel-15 is kept unchanged for Rel-17 MBS.

* FFS whether the budget of BDs/CCEs of an unused CC can be used for group-common PDCCH to count the number of BDs/CCEs for UEs supporting CA capability based on configuration, which is similar to the method used for multi-DCI based multi-TRP in Rel-16.

Working Assumption:

Keep the “3+1” DCI size budget defined in Rel-15 for Rel-17 MBS.

* FFS: Whether the G-RNTI is counted as “C-RNTI” or as “other RNTI” when considering the “3+1” DCI size budget rule for group-common PDCCH.

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:

From RAN1 perspective, the CFR (common frequency resource) for multicast of RRC-CONNECTED UEs, which is confined within the frequency resource of a dedicated unicast BWP and using the same numerology (SCS and CP), includes the following configurations:

* Starting PRB and the number of PRBs
* One PDSCH-config for MBS (i.e., separate from the PDSCH-Config of the dedicated unicast BWP)
* One PDCCH-config for MBS (i.e., separate from the PDCCH-Config of the dedicated unicast BWP)
* SPS-config(s) for MBS (i.e., separate from the SPS-Config of the dedicated unicast BWP)
* FFS: Other configurations and details including whether signaling of starting PRB and the length of PRBs is needed when CFR is equal to the unicast BWP
* FFS: Whether a unified CFR design is also used for broadcast reception for RRC\_IDLE/INACTIVE and RRC\_CONNECTED
* FFS: Whether Coreset(s) for CFR in addition to existing Coresets in UE dedicated BWP is needed
* Note: The terminology of CFR is only aiming for RAN1 discussion, and the detailed signaling design is up to RAN2
* Note: This agreement does not negate any previous agreements made on CFR

Agreement:

For search space set of group-common PDCCH of PTM scheme 1 for multicast in RRC\_CONNECTED state, at least support CSS

* FFS: reuse existing CSS type(s) in Rel-15/16 or define a new Type CSS
* FFS: Two options for monitoring priority:
  + Option 1: the monitoring priority is the same as existing Rel-15/16 CSS
  + Option 2: the monitoring priority is determined based on the search space set indexes of search space set(s) for multicast and USS sets.

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

**Mechanisms to improve reliability for RRC\_CONNECTED UEs**

Agreement:

For ACK/NACK based feedback if supported for RRC\_CONNECTED UEs receiving multicast, UE can be optionally configured a separate *PUCCH-Config* for multicast. Otherwise, *PUCCH-Config* for unicast applies.

Agreement:

The priority for HARQ-ACK feedback for RRC\_CONNECTED UE receiving multicast can be,

* Lower, higher than or equal to the HARQ-ACK feedback for unicast
  + FFS: How to reflect the priority in specification, e.g., whether it is configured or indicated to the UE
  + FFS: The total number of priorities across multicast and unicast
* FFS the priority between HARQ-ACK feedback for multicast and other UCI for unicast (SR, CSI) or PUSCH for unicast.

Agreement:

For ACK/NACK based feedback if supported for multicast, for Type-2 HARQ-ACK feedback construction for PTM scheme 1,

* DAI for unicast and DAI for multicast are separately counted.
* Concatenation of Type-2 HARQ-ACK codebook for unicast and multicast is supported.
  + FFS details on concatenating the codebooks.
* FFS whether to support concatenating more than one Type-2 HARQ-ACK codebook for multicast.

Agreement:

For RRC\_CONNECTED UEs receiving multicast, support the following:

* ACK/NACK based HARQ-ACK feedback for multicast,
  + It is up to network to configure orthogonal PUCCH resources among UEs within the same group.
* FFS: NACK-only based HARQ-ACK feedback for multicast,
  + It is up to network to configure the PUCCH resources and the PUCCH resources can be shared among UEs within the same group.
* FFS details.

Agreement:

For the cases of HARQ-ACK feedback (at least for ACK/NACK based feedback) is available for multicast and unicast for a given UE receiving multicast, for determining the PUCCH resource,

* Support multiplexing for the same priority and prioritizing for different priorities at least when the corresponding PUCCH resources overlap in time in a slot.
  + FFS whether it is subject to UE capability.
* FFS the case of non-overlapping PUCCHs resources for HARQ-ACK in the same slot.
* FFS whether sub-slot based PUCCH transmission for HARQ-ACK is supported.
* FFS the case of HARQ-ACK feedback for multicast and other UCI for unicast.

Agreement:

For ACK/NACK based feedback if supported for multicast, construction of Type-1 HARQ-ACK codebook based on the union of the PDSCH TDRA sets of the unicast service and the multicast service (if they are separately configured), at least of the same priority, is supported

* FFS details of Type-1 HARQ-ACK codebook construction for FDM-ed unicast and multicast.
* FFS details of Type-1 HARQ-ACK codebook construction for FDM-ed multicast and multicast if supported.
* FFS: whether/how to optimize the Type-1 codebook construction to reduce the HARQ-ACK feedback payload size.

Agreement:

For enabling/disabling HARQ-ACK feedback for RRC\_CONNECTED UE receiving multicast,

* Option 3: RRC signalling configures the enabling/ disabling function of DCI indicating the enabling /disabling HARQ-ACK feedback.
  + If RRC signalling configures the function, DCI indicates (explicitly or implicitly) whether HARQ-ACK feedback is enabled/disabled
    - FFS details on RRC signalling and DCI indicating.
  + If RRC signalling does not configure the function, DCI does not indicate enabling/disabling the HARQ-ACK feedback.
    - FFS whether enabling or disabling the feedback is the default mode.
* Option 2: RRC indicates enabling/disabling.
* FFS: whether down-selection between option 3 and option 2 is needed or support the both options.
* FFS: enabling/disabling by MAC-CE.

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.

**Basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs**

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.

# Appendix 4: Agreements in #104b e-meetings

**RAN1#104b-e**

**Mechanisms to support group scheduling for RRC\_CONNECTED UEs**

Agreement:

For group-common PDCCH of Rel-17 MBS, support at least two DCI formats.

* DCI format 1\_0 is used as the baseline for the first DCI format with CRC scrambled with G-RNTI.
* DCI format 1\_1 or 1\_2 is used as the baseline for the second DCI format with CRC scrambled with G-RNTI
  + FFS: Which of DCI format 1\_1 or 1\_2 is used as the baseline
* FFS: Details of the reuse (or not) of DCI format 1\_0, 1\_1 or 1\_2 fields

Agreement:

The same HARQ process ID and NDI are used for PTM scheme 1 (re)transmissions and PTP retransmissions of the same TB.

Agreement:

At least support the following cases for PDSCH reception for MBS in a slot based on UE capability for RRC\_CONNECTED UEs

* Case 1: support TDM between M (M>1) TDMed unicast PDSCHs and one group-common PDSCH in a slot per CC
  + FFS: the value(s) of M
* Case 2: support TDM among N (N>1) group-common PDSCHs in a slot per CC
  + FFS: the value(s) of N
* Case 3: support TDM between K (K>1) TDMed unicast PDSCHs and L (L>1) TDMed group-common PDSCHs in a slot per CC
  + FFS: the value(s) of K and L

Agreement:

If a CFR is configured for multicast in RRC-CONNECTED state and confined within a dedicated unicast BWP, further study the following options.

* Option 1: the CORESET configured in PDCCH-config for unicast in the dedicated unicast BWP can be used for multicast transmission if the CORESET is fully contained in the CFR in frequency domain, and the CORESET configured in PDCCH-config for MBS in the CFR can be used for unicast transmission.
* Option 2: the CORESET configured in PDCCH-config for unicast in the dedicated unicast BWP cannot be used for multicast transmission even if the CORESET is fully contained in the CFR in frequency domain, and the CORESET configured in PDCCH-config for MBS in the CFR cannot be used for unicast transmission.
* Option 3: the CORESET configured in PDCCH-config for unicast in the dedicated unicast BWP can be used for multicast transmission if the CORESET is fully contained in the CFR in frequency domain, but the CORESET configured in PDCCH-config for MBS in the CFR cannot be used for unicast transmission.
* Option 4: the CORESET configured in PDCCH-config for unicast in the dedicated unicast BWP cannot be used for multicast transmission even if the CORESET is fully contained in the CFR in frequency domain, but the CORESET configured in PDCCH-config for MBS in the CFR can be used for unicast transmission.

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

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.

Conclusion:

The maximum number of HARQ processes per cell, currently supported for unicast, is kept unchanged for UE to support multicast reception.

* How to allocate HARQ processes between unicast and multicast is up to gNB.

Agreement:

Send an LS to RAN2 regarding at least the following questions:

* Whether RAN1 should take into account the case of UE supporting multiple G-RNTIs?

Agreement:

Include the following in the LS to RAN2:

* Whether RAN1 should consider the case of UE supporting multiple G-CS-RNTIs?
* The agreements related to SPS will also be included in the LS for information

**R1-2104045 LS on G-RNTI and G-CS-RNTI for MBS RAN1, CMCC**

**Decision:** As per email decision posted on April 22nd, the LS is approved.

Agreement:

For CSS of group-common PDCCH of PTM scheme 1 for multicast in RRC\_CONNECTED state, down-select from the following alternatives (to be decided in RAN1#105):

* Alt 1: support Type-3 CSS
  + The monitoring priority of Type-3 CSS for group-common PDCCH is the same as existing Rel-15/16 CSS, regardless of which DCI format of group-common PDCCH is configured in Type-3 CSS
* Alt 2: support a new Type-x CSS
  + The monitoring priority of new Type-x CSS is determined based on the search space set indexes of the new Type-x CSS set and USS sets, regardless of which DCI format of group-common PDCCH is configured in the new Type-x CSS.
* Alt 3: support both Alt 1 and Alt 2

Agreement:

The down-selection of Option 2A and Option 2B for CFR for multicast of RRC-CONNECTED UEs will be made before the end of RAN1#105-e.

Conclusion:

It is based on gNB implementation to schedule unicast on the frequency resources covered by CFR configured for multicast.

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

**Mechanisms to improve reliability for RRC\_CONNECTED UEs**

Agreement:

Support NACK-only based HARQ-ACK feedback for RRC\_CONNECTED UEs receiving multicast.

Agreement:

Two priority indexes are introduced for multicast, with

* Index 0 meaning low priority and index 1 meaning high priority.
* Priority index can be included in DCI formats scheduling the group-common PDSCH.
  + FFS details for DCI formats.
* FFS: the priority comparison between multicast and unicast with the same priority index.

Agreement:

For a separate *PUCCH-ConfigurationList* for multicast that is optionally configured, at least for ACK/NACK based HARQ-ACK feedback,

* The separate *PUCCH-ConfigurationList* for multicastconfigurationcan be a list which includes up to 2 *PUCCH-Config* configurations corresponding low priority codebook and high priority codebook, respectively.
* FFS other configurations

Agreement:

For Type-2 HARQ-ACK codebook concatenation to be multiplexed in the same PUCCH resource,

* The first Type-2 HARQ-ACK sub-codebook for unicast precedes the second Type-2 HARQ-ACK sub-codebook for multicast.
* FFS: The number of Type-2 HARQ-ACK sub-codebooks for multicast.
* Note: The case of SPS PDSCH will be discussed separately.

Agreement:

For multiplexing the ACK/NACK-based HARQ-ACK feedback for multicast and unicast, determining the PUCCH resources for transmission is based on the PRI indicated in the “last DCI”, where the “last DCI” refers to, down-select the following alternatives:

* Alt.1: the last DCI for unicast;
* Alt.2: the last DCI across unicast and multicast;

# Appendix 5: Agreements in #105 e-meetings

**RAN1#105-e**

**Mechanisms to support group scheduling for RRC\_CONNECTED UEs**

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

Agreement:

For PTP retransmission of SPS group-common PDSCH, CS-RNTI is used for CRC scrambling of PDCCH with the NDI bit set to 1.

Agreement:

As a baseline, reuse existing fields in DCI format 1\_0 with CRC scrambled by C-RNTI for the fields of first DCI format with CRC scrambled with G-RNTI.

* FFS: how to determine the bitlength of FDRA field.
* FFS: Whether ‘Identifier for DCI formats’, ‘TPC command for scheduled PUCCH’ are needed.
* FFS: How to perform DCI size alignment
* FFS: Whether to include new DCI fields
* Note: All of the fields may not be reused and the size of the fields may not be the same

Working assumption:

Option 2B for CFR associated with UE active BWP other than initial BWP is supported at least for multicast of RRC-CONNECTED UEs.

* FFS: CFR associated with initial BWP
* FFS: CFR larger than initial BWP

Agreement:

For multicast of RRC\_CONNECTED UEs, further study

* How the LBRM (Limited buffer rate-matching) for GC-PDSCH TBS is determined.
* How the xOverhead for GC-PDSCH TBS determination is configured.
* Whether MAC-CE over GC-PDSCH is needed for activation/deactivation of semi-persistent ZP CSI-RS resource set if the semi-persistent ZP CSI-RS resource set is configured in PDSCH-Config in CFR.

Agreement:

Confirm the working assumption:

Keep the “3+1” DCI size budget defined in Rel-15 for Rel-17 MBS.

* FFS: Whether the G-RNTI is counted as “C-RNTI” or as “other RNTI” when considering the “3+1” DCI size budget rule for group-common PDCCH.

Agreement:

For Rel-17 MBS UE, the UE maximum number of TDMed PDSCH receptions capability in a slot per CC is kept as for Rel-15/Rel-16, i.e., {2/4/7} based on UE FG5-11/5-11a/5-11b.

* Note:   Group-common PDSCH(s) are counted as unicast PDSCH(s).

Agreement:

For reliability of the group-common PDCCH activation of SPS group-common PDSCH, support at least one of the following alternatives.

* Alt 1: retransmit the activation command via group-common PDCCH.
* Alt 2: retransmit the activation command via UE-specific PDCCH.
* Alt 3: retransmit the activation command via MAC-CE.
* FFS other details.
* Note: Down-selection can take into account the HARQ-ACK feedback scheme for SPS activation

Working assumption:

The maximum number of CORESETs per BWP is not increased for support of MBS, and the number of CORESETs configured within the CFR is left to gNB implementation.

Agreement:

As a baseline, reuse existing fields in DCI format 1\_1 for the fields of the second DCI format with CRC scrambled with G-RNTI.

* FFS: whether ‘Identifier for DCI formats’, ‘TPC command for scheduled PUCCH’, ‘Carrier indicator’ and ‘Bandwidth part indicator’ are needed.
* FFS: How to perform DCI size alignment
* FFS: Whether to include new DCI fields for the second DCI format
* Note: All of the fields may not be reused and the size of the fields may not be the same

Agreement:

For HARQ process management, further study whether/how to differentiate the HARQ process ID used for PTP (re)transmission for unicast and PTP retransmission for multicast.

**Mechanisms to improve reliability for RRC\_CONNECTED UEs**

Agreement:

The signalling for URLLC feature can be reused to configure separate codebooks for unicast and multicast, respectively, at least for the case of different priorities, at least for Type-2 HARQ codebook

* FFS: The case for the same priority.
* FFS: The case of Type-1 HARQ codebook
* FFS: Whether this applies to separate PUCCH transmissions only

Agreement:

Support PUCCH format 0 and format 1 for NACK-only based HARQ-ACK feedback for multicast.

Agreement:

Support NACK-only based HARQ-ACK feedback at least for multicast SPS PDSCH without PDCCH scheduling.

* FFS for SPS activation/deactivation.

Agreement:

The priority of multicast is the same as the priority of unicast for the same priority index of HARQ-ACK at least for ACK/NACK based feedback.

Agreement:

NR supports at least the following cases for UE supporting multicast:

* UE supports two non-overlapping slot-based PUCCHs for ACK/NACK based HARQ-ACK feedback for multicast with different priorities in a slot subject to UE capability.
* UE supports two non-overlapping slot-based PUCCHs for ACK/NACK based HARQ-ACK feedback for multicast and unicast with different priorities, respectively, in a slot subject to UE capability.

Agreement:

For Type-1 HARQ-ACK codebook construction for FDM-ed unicast and multicast with the same priority from the same TRP, support

* Opt 4: HARQ-ACK bits for all the PDSCH occasions over all the slots for all serving cells for unicast, precede, HARQ-ACK bits for all the PDSCH occasions over all the slots for all serving cells for multicast. (This is similar to the joint Type-1 codebook for mTRP).
* FFS: If UE reports the capability of supporting the FDM-ed unicast and multicast in the same slot, UE can be indicated semi-statically to generate Type-1 HARQ-ACK codebook as FDM-ed manner (i.e., Opt 4).
  + Otherwise, UE does not expect unicast and multicast are to be scheduled in FDM-ed.

**Conclusion:**

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

Agreement:

For ACK/NACK based HARQ-ACK feedback for multicast, the multiplexing/prioritizing rule between the HARQ-ACK for multicast and SR/CSI can reuse Rel-16 multiplexing/ prioritizing rule between the HARQ-ACK for unicast and SR/CSI.

Agreement:

For support of ACK/NACK based HARQ-ACK feedback for SPS multicast,

* the HARQ-ACK codebook index corresponding the HARQ-ACK codebook for SPS PDSCH is included in the configuration for SPS multicast.
  + UE determines a priority index from the HARQ-ACK codebook index
* UE can be optionally configured a separate SPS-PUCCH-AN-List for all SPS multicast configurations. Otherwise, a common SPS-PUCCH-AN-List applies to all SPS unicast and SPS multicast configurations.

Agreement:

For TDM-ed unicast and multicast, for Type-1 HARQ-ACK codebook construction for ACK/NACK-based unicast and multicast to be multiplexed in the same PUCCH resource, determining PDSCH reception candidate occasions is based on down-selecting one of the two alternatives as follows:

* Alt 1:
  + for slot timing values in the intersection of set for unicast (termed set *A*) and set for multicast (termed set *B*), based on union of the PDSCH TDRA sets,
  + for slot timing values in set A but not in set B, based on PDSCH TDRA set for unicast, and
  + for slot timing values in set B but not in set A, based on PDSCH TDRA set for multicast.
* Alt 2: for slot timing values in the union of set for unicast and set for multicast, based on the union of the PDSCH TDRA sets.
* Companies are encouraged to continue discussion of pros and cons for each alternative for further down-selection in the next meeting.

assumption:

For enabling/disabling ACK/NACK-based HARQ-ACK feedback for RRC\_CONNECTED UE receiving multicast via dynamic group-common PDSCH:

* RRC signalling configures the enabling/ disabling function of group-common DCI indicating the enabling /disabling ACK/NACK based HARQ-ACK feedback.
  + If RRC signalling configures the function of group-common DCI based indication, group-common DCI indicates (explicitly or implicitly) whether ACK/NACK based HARQ-ACK feedback is enabled/disabled
  + Otherwise, enabling/disabling ACK/NACK based HARQ-ACK feedback is configured by RRC signalling.
  + FFS details on RRC signalling and group-common DCI indicating.
* FFS whether/how this option is extended to apply to NACK-only based feedback and multiple G-RNTI cases.
* FFS the relation to the HARQ-ACK codebook types and HARQ-ACK codebook construction.
* FFS the relation to the enabling/disabling ACK/NACK based HARQ-ACK feedback for retransmission.
* FFS whether/how to allow UE not to react to the DCI signalling, but instead follow UE-specific RRC configuration for HARQ feedback.
* FFS whether/how to apply it to SPS group-common PDSCH.

**Basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs**

Agreement:

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

Agreement:

For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, 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*.

# Appendix 6: Agreements in #106 e-meetings

**RAN1#106-e**

**Mechanisms to support group scheduling for RRC\_CONNECTED UEs**

Agreement:

Confirm the working assumption with the following update:

Option 2B for CFR associated with UE active BWP other than initial DL BWP is supported at least for multicast of RRC-CONNECTED UEs.

* ~~FFS: CFR associated with initial BWP~~
* ~~FFS: CFR larger than initial BWP~~

Note: The deleted FFSs can be discussed in another AI.

Agreement:

For multicast of RRC-CONNECTED UEs, align the size of the first DCI format for GC-PDCCH with DCI format 1\_0 with CRC scrambled by C-RNTI monitored in CSS.

Agreement:

Confirm the following working assumption:

The maximum number of CORESETs per BWP is not increased for support of MBS, and the number of CORESETs configured within the CFR is left to gNB implementation.

Agreement:

For indication of the starting PRB and the length of PRBs of CFR for multicast of RRC-CONNECTED UEs,

* the starting PRB is referenced to Point A, i.e., the starting PRB is a PRB determined by *subcarrierSpacing* of the associated BWP and *offsetToCarrier* corresponding to this subcarrier spacing, similar as how *locationAndBandwidth* of a BWPis indicated as described in TS 38.331.
* FFS: Indication mechanism.

Agreement:

For LBRM and TBS determination for GC-PDSCH:

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

Agreement:

The first DCI format for GC-PDCCH uses the same fields as DCI format 1\_0 with CRC scrambled by C-RNTI with the following modifications:

* At least ‘Identifier for DCI formats’ is not needed.
  + FFS: Whether the field should be ignored and reserved, or should be removed.
* For FDRA determination, down-select from following options:
  + Option 1:
    -  is given by
      * the size of CORESET 0 if CORESET 0 is configured for the cell; and
      * the size of initial DL bandwidth part if CORESET 0 is not configured for the cell.
    - For resource indication value (*RIV*) of downlink resource allocation type 1, the resource blocks that can be indicated are
      * the resource blocks in the CORESET 0 if CORESET 0 is configured for the cell; and
      * the resource blocks in the initial DL bandwidth part if CORESET 0 is not configured for the cell.
  + Option 2:
    -  is given by
      * the size of CORESET 0 if CORESET 0 is configured for the cell; and
      * the size of initial DL bandwidth part if CORESET 0 is not configured for the cell.
    - For resource indication value (*RIV*) of downlink resource allocation type 1, the similar scheme as for the case that the DCI size for DCI format 1\_0 in USS is derived from the size of DCI format 1\_0 in CSS but applied to an active BWP is used.
      * FFS details, e.g., if the size of CFR (i.e. ) is larger than the size of CORESET0/initial DL bandwidth part, the resource indication value (*RIV*) is defined as in section 5.1.2.2.2 in TS38.214, where K is the maximum value from set {1, 2, 4, 8} which satisfies ;otherwise,
  + Option 3:  is given by the size of CFR in the active DL BWP

Agreement:

The second DCI format for GC-PDCCH uses the same fields as DCI format 1\_1 with the following modifications:

* At least ‘Identifier for DCI formats’ and ‘SRS request’ are not needed.
  + FFS whether the fields should be ignored and reserved, or should be removed.
* Note: At least the configurable fields in DCI format 1\_1 remain configurable for the second DCI format

Agreement:

For initializing scrambling sequence generator for GC-PDCCH with the second DCI format,

* equals the higher layer parameter *pdcch-DMRS-ScramblingID* if it is configured in the CORESET in a CFR used for the GC-PDCCH; otherwise.
* FFS: Values for . Choices include one or more of the following:
  + Alt1: G-RNTI used for the GC-PDCCH.
  + Alt2: 0
  + Alt3: Other fixed values

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

Agreement:

For FDRA determination of the first DCI format for GC-PDCCH, down-select from Option 2 and updated Option 3.

* + Option 2:
    -  is given by
      * the size of CORESET 0 if CORESET 0 is configured for the cell; and
      * the size of initial DL bandwidth part if CORESET 0 is not configured for the cell.
    - For resource indication value (*RIV*) of downlink resource allocation type 1, the similar scheme as for the case that the DCI size for DCI format 1\_0 in USS is derived from the size of DCI format 1\_0 in CSS but applied to an active BWP is used.
      * FFS details, e.g., if the size of CFR (i.e. ) is larger than the size of CORESET0/initial DL bandwidth part, the resource indication value (*RIV*) is defined as in section 5.1.2.2.2 in TS38.214, where K is the maximum value from set {1, 2, 4, 8} which satisfies ;otherwise,
  + Option 3:  is given by the size of CFR in the active DL BWP
    - If the size of the first DCI format for GC-PDCCH prior to truncation is larger than the size of DCI format 1\_0 monitored in CSS, the bit width of the FDRA field in the first DCI format for GC-PDCCH is reduced by truncating the first few most significant bits such that the size of the first DCI format for GC-PDCCH equals the size of DCI format 1\_0 monitored in CSS.
    - FFS: Whether the removed/reserved fields can be repurposed for FDRA
    - FFS: Solution for the case where the size of the first DCI format for GC-PDCCH prior to padding is smaller than the size of DCI format 1\_0 monitored in CSS.

Conclusion:

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

Agreement:

For initializing scrambling sequence generator for GC-PDSCH scheduled by the second DCI format for multicast received in Type-x CSS,

* 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; otherwise.
* 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,

* equals the higher layer parameter *pdcch-DMRS-ScramblingID* if it is configured in the CORESET in a CFR used for the GC-PDCCH; otherwise.

**Mechanisms to improve reliability for RRC\_CONNECTED UEs**

Agreement:

For UE supporting both unicast and multicast, the *pdsch-HARQ-ACK-Codebook/pdsch-HARQ-ACK-CodebookList* can be separately configured for multicast from that for unicast.

Agreement:

When UE is configured Type-1 codebooks for unicast and multicast with different priorities, respectively, the UE separately generates each of the Type-1 codebooks.

* FFS: How UE is configured one codebook for unicast and one codebook for multicast and the two codebooks are of different priorities.

Agreement:

For a UE configured with Type-1 HARQ-ACK codebook,

* If UE is not configured to receive FDM-ed unicast and multicast, Type-1 HARQ codebook is generated as the agreement for TDM-ed unicast and multicast.
* If UE is configured to receive FDM-ed unicast and multicast, Type-1 HARQ codebook is generated as the agreement for FDM-ed unicast and multicast.

Agreement:

For UEs supporting ACK/NACK-based HARQ-ACK feedback for multicast and unicast, the following values are unchanged compared to unicast in Rel-16:

* + The maximum number of PUCCH resources sets in each *PUCCH-Config*,
  + The maximum number of PUCCH resources in a PUCCH resource set in each *PUCCH-Config*,
  + The maximum number of UCI information bits for the first PUCCH resource set.
  + The total number of PUCCH resources from all *PUCCH-Config/PUCCH-ConfigurationList*.
  + Note:
    - This applies to both cases of whether or not UE is configured optionally with a separate *PUCCH-Config or PUCCH-ConfigurationList* for multicast.
    - The case of NACK-only based is discussed separately.

Agreement:

When UE is configured with the *pdsch-HARQ-ACK-Codebook/pdsch-HARQ-ACK-CodebookList* for ACK/NACK based feedback for multicast, it is applied to all G-RNTIs configured to UE.

Agreement:

For the separate *PUCCH-ConfigurationList* that is optionally configured to UE for NACK-only based HARQ-ACK feedback for multicast,

* + The separate *PUCCH-ConfigurationList* for multicast configuration can be a list which includes up to 2 *PUCCH-Config* configurations corresponding low priority feedback and high priority feedback, respectively.
  + FFS: how to handle the case when separate *PUCCH-ConfigurationList* is not configured to UE for NACK-only based HARQ-ACK feedback for multicast.

Agreement:

The priority index is,

* for the second DCI format for GC-PDCCH, optionally configured to be included in the DCI format. If not configured, the priority index is not included in the DCI format and is low priory by default.
* for the first DCI format for GC-PDCCH, down-select from:
  + - Alt1: Optionally configured to be included in the DCI format. If not configured, the priority index is not included in the DCI format and is low priory by default.
    - Alt2: Always low priority, i.e., the priority index is not included in the DCI format.

Agreement:

The priority of multicast for NACK-only based feedback is the same as the priority of unicast for the same priority index of HARQ-ACK.

Agreement:

When more than one NACK-only based feedback are available for transmission in the same PUCCH slot, down-select from the following alternatives:

* + Alt1: Support UE multiplexing the HARQ-ACK bits by transforming NACK-only into ACK/NACK HARQ bits.
  + Alt2: Support sub-slot based PUCCH for this case.
  + Alt3: Support UE transmitting more than one slot-based PUCCHs in the same PUCCH slot.
  + Alt4: Define combination of NACK-only which corresponds to a specific sequence or a PUCCH transmission.
  + Alt5: NACK-only bundling

Agreement:

When UE supports and is configured with more than one G-RNTI,

* + for Type-2 codebook construction, DAI is separately counted per G-RNTI.
  + Type-2 codebook is constructed by concatenating Type-2 sub-codebook of each RNTI following the ascending order of the G-RNTI value.

Agreement:

Update the WA made in RAN1#105-e meeting regarding enabling/disabling HARQ-ACK feedback as follows:

Working assumption:

For enabling/disabling ACK/NACK-based HARQ-ACK feedback for RRC\_CONNECTED UE receiving multicast via dynamic group-common PDSCH:

* RRC signaling configures the enabling/ disabling function of group-common DCI indicating the enabling /disabling ACK/NACK based HARQ-ACK feedback.
  + If RRC signaling configures the function of group-common DCI based indication, group-common DCI indicates (explicitly or implicitly) whether ACK/NACK based HARQ-ACK feedback is enabled/disabled
  + Otherwise, enabling/disabling ACK/NACK based HARQ-ACK feedback is configured by RRC signaling.
  + FFS details on RRC signaling and group-common DCI indicating.
* FFS whether/how this option is extended to apply to NACK-only based feedback and multiple G-RNTI cases.
* FFS the relation to the HARQ-ACK codebook types and HARQ-ACK codebook construction.
* FFS the relation to the enabling/disabling ACK/NACK based HARQ-ACK feedback for retransmission.
* FFS whether/how to allow UE not to react to the DCI signaling, but instead follow UE-specific RRC configuration for HARQ feedback.
* FFS whether/how to apply it to SPS group-common PDSCH.
* UE capability for enabling/ disabling function of group-common DCI indicating the enabling /disabling ACK/NACK based HARQ-ACK feedback is introduced and FFS details.
* Note: It is up to network implementation to avoid any potential HARQ ACK mismatch between different UEs in the same multicast group

Agreement

For UE supports both ACK/NACK-based and NACK-only based HARQ-ACK feedback for multicast SPS PDSCH without PDCCH scheduling, select one or more of the following alternatives:

* + Alt1: HARQ-ACK feedback option is configured per SPS configuration index.
  + Alt2: HARQ-ACK feedback option is indicated in the SPS activation DCI.
  + Note: enabling/disabling HARQ-ACK feedback for multicast SPS can be discussed separately.

**Basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs**

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.

# Appendix 7: Agreements in RANP#93 e-meetings

**Basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs**

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

# Appendix 8: Agreements in #106b e-meetings

**RAN1#106b-e**

**Mechanisms to support group scheduling for RRC\_CONNECTED UEs**

Agreement:

The starting PRB and the length of PRBs of CFR are jointly indicated reusing the RIV indication mechanism in the same way as *locationAndBandwidth* of a BWP.

Agreement:

RBG and PRG for multicast GC-PDSCH in CFR are defined using the same procedure as for unicast PDSCH in DL BWP.

* + - * For RBG, the size is defined based on the starting PRB of the CFR, size of the CFR and the higher layer parameter *rbg-Size* configured by *PDSCH-Config* for multicast in the CFR.
      * For PRG, the size is defined based on the starting PRB of the CFR, size of the CFR and precoding granularity for multicast which can be equal to one of the values among {2, 4, wideband}.
      * Note: Whether the RBG and PRG size for multicast (configured directly or indirectly) is the same as for unicast can be discussed separately.

Agreement:

The number of CFRs for multicast is no more than one per dedicated unicast BWP in Rel-17.

Agreement:

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

Agreement:

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

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

Agreement:

For multicast of RRC\_CONNECTED UEs, the G-RNTI(s) is/are configured

* Opt.2: per serving cell.
* FFS G-CS-RNTI(s)

Agreement:

The ‘TPC command for scheduled PUCCH’ field is not needed for the first DCI format for multicast.

* FFS: Whether the field should be reserved or should be removed.

Agreement:

The ‘TPC command for scheduled PUCCH’ field is not needed for the second DCI format for multicast.

* FFS: Whether the field should be reserved or should be removed.

Agreement:

The first and second DCI formats for multicast can be configured in the same or different search space sets belonging to type-x CSS.

Agreement:

For FDRA determination of the first DCI format for GC-PDCCH, Option 2 is supported.

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

Agreement:

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

Agreement:

For initializing scrambling sequence generator for GC-PDCCH with the second DCI format for RRC\_CONNECTED UEs, =0.

Agreement:

For initializing scrambling sequence generator for GC-PDSCH scheduled by the first DCI format for multicast received in Type-x CSS for RRC\_CONNECTED UEs,

* 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; otherwise.
* 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-PDSCH,

* and are given by the higher-layer parameters *scramblingID0* and *scramblingID1*, respectively, in the *DMRS-DownlinkConfig*IE if provided in *PDSCH-Config* in a CFR used for GC-PDSCH and the GC-PDSCH is scheduled by GC-PDCCH using the second DCI format
* is given by the higher-layer parameter *scramblingID0* if provided in *PDSCH-Config* in a CFR used for GC-PDSCH and the GC-PDSCH is scheduled by GC-PDCCH using the first DCI format;
* otherwise;
* FFS: is given by the DM-RS sequence initialization field, if present, in the DCI associated with the GC-PDSCH transmission if second DCI format is used, otherwise .

Agreement:

The association between a G-CS-RNTI and a SPS-Config-Multicast is indicated by the activation GC-PDCCH for SPS GC-PDSCH, i.e., a value of the HARQ process number field in a DCI format indicates an activation for a SPS GC-PDSCH configuration for multicast with a same value as provided by *sps-ConfigIndex* in a *SPS-Config-Multicast.*

Agreement:

For initializing scrambling sequence generator for GC-PDCCH with the first DCI format for RRC\_CONNECTED UEs,

*  equals the higher layer parameter *pdcch-DMRS-ScramblingID* if it is configured in the CORESET configured within CFR-Config-Multicast for the GC-PDCCH; otherwise.
*  = 0.

Agreement:

For initializing sequence generator for DMRS of GC-PDCCH with the first DCI format received in Type-x CSS for RRC\_CONNECTED UEs,

*  equals the higher layer parameter *pdcch-DMRS-ScramblingID* if it is configured in the CORESET configured within CFR-Config-Multicast for the GC-PDCCH;  otherwise.

Agreement:

Study the following options for the LBRM/TBS determination for PTP retransmission of multicast.

* Option 1: based on the LBRM/TBS determination of the PTM initial transmission using same HPID and NDI.
* Option 2: based on the LBRM/TBS determination of the legacy unicast PDSCH transmission.

**Mechanisms to improve reliability for RRC\_CONNECTED UEs**

Agreement:

The group-common DCI indicating the enabling/disabling ACK/NACK based HARQ-ACK feedback is configured per G-RNTI by UE RRC signalling.

Agreement:

If the group-common DCI indicating the enabling/disabling ACK/NACK based HARQ-ACK feedback is not configured, enabling/disabling ACK/NACK based HARQ-ACK feedback is configured per G-RNTI by UE RRC signalling.

Agreement:

When PUCCH transmission for the NACK-only based feedback for multicast collides with PUCCH transmissions for HARQ-ACK feedback/CSI for unicast for the same priority or PUSCH transmission for the same priority, support UE multiplexing the NACK-only based feedback with the HARQ-ACK feedback/CSI on PUCCH or on to PUSCH by transforming NACK-only into the ACK/NACK HARQ bit.

* This applies to at least the case of the feedback addressing one TB. NACK-only based feedback for more than one TBs is to be handled separately.
* Note: When the TB is correctly decoded, the ACK will be transmitted and multiplexed with others.
* FFS the case of PUCCH for SR.

Agreement:

When more than one NACK-only based feedback are available for transmission in the same PUCCH slot, further decide based on the following subset of alternatives (from previous agreement) with potential further down-selection:

* Alt1: Support UE multiplexing the HARQ-ACK bits by transforming NACK-only into ACK/NACK HARQ bits.
* ~~Alt2: Support sub-slot based PUCCH for this case.~~
* ~~Alt3: Support UE transmitting more than one slot-based PUCCHs in the same PUCCH slot.~~
* Alt4: Define combination of NACK-only which corresponds to a specific sequence or a PUCCH transmission.
* ~~Alt5: NACK-only bundling~~

Agreement:

Confirm the WA made in RAN1#106-e meeting regarding enabling/disabling HARQ-ACK feedback.

Agreement:

For group-common DCI indicating whether ACK/NACK based HARQ-ACK feedback is enabled/disabled, down-select from the following alternatives:

* Alt1: Reuse one existing field in the group-common DCI.
* Alt2: Introduce a new field in the group-common DCI.

Agreement:

For multicast SPS PDSCH without PDCCH scheduling, HARQ-ACK feedback option is configured by UE RRC signalling.

* FFS: Whether the configuration is per SPS configuration index or per G-CS-RNTI.
* Note: Whether there is a UE capability for support of NACK-only based HARQ-ACK or not will be discussed as part of UE features discussion.

Agreement:

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

Agreement:

For slot-level repetition for SPS GC-PDSCH for multicast RRC\_CONNECTED UEs.

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

Agreement:

For UE supporting both ACK/NACK based and NACK-only basedfeedback for multicast, for the same G-RNTI, support the following

* UE can be configured with either ACK/NACK based or NACK-only feedback for a single G-RNTI.
  + Note: Case1-1: if configured with ACK/NACK based feedback, UE can be optionally configured a separate *PUCCH-Config/PUCCH-ConfigurationList* for multicast. Otherwise, *PUCCH-Config/PUCCH-ConfigurationList* for unicast applies (This has been agreed.)
  + Case 1-2: if configured with NACK-only based feedback, when separate *PUCCH-Config/PUCCH-ConfigurationList* for NACK-onlyis not configured, *PUCCH-Config/PUCCH-ConfigurationList* for unicast applies.

Agreement:

For the priority index for the first DCI format for GC-PDCCH, support the following **Alt2** from the previous agreement:

* + ~~Alt1: Optionally configured to be included in the DCI format. If not configured, the priority index is not included in the DCI format and is low priory by default.~~
  + Alt2: Always low priority, i.e., the priority index is not included in the DCI format.

Agreement:

For TDM-ed unicast and multicast, for Type-1 HARQ-ACK codebook construction for ACK/NACK-based unicast and multicast to be multiplexed in the same PUCCH resource, determining PDSCH reception candidate occasions can be configuredbetween the following alternativesfrom the previous agreement:

* Alt 1:
  + for slot timing values in the intersection of set for unicast (termed set *A*) and set for multicast (termed set *B*), based on union of the PDSCH TDRA sets,
  + for slot timing values in set *A* but not in set *B*, based on PDSCH TDRA set for unicast, and
  + for slot timing values in set *B* but not in set *A,* based on PDSCH TDRA set for multicast.
* Alt 2: for slot timing values in the union of set for unicast and set for multicast, based on the union of the PDSCH TDRA sets.
* Support of Alt. 1 is a UE capability

Agreement:

For multiplexing the ACK/NACK-based HARQ-ACK feedback for multicast and unicast, determining the PUCCH resources for transmission is based on the PRI indicated in the “last DCI”, where the “last DCI” refers to the following **Alt1** from the previous agreement:

* Alt.1: The last DCI for unicast
* FFS: Any details when last DCI is missed by the UE if it is necessary to make them different from current specifications for this case.

**Basic functions for broadcast/multicast for RRC\_IDLE/RRC\_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 MTCH.

Agreement:

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

Agreement:

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

* equals the higher layer parameter *pdcch-DMRS-ScramblingID* if it is configured in a CFR used for the GC-PDCCH for MCCH/MTCH; otherwise.

Agreement:

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

Agreement:

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

* 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; otherwise.
* corresponds to the RNTI associated with the GC-PDSCH transmission.

Agreement:

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

* equals the higher layer parameter *pdcch-DMRS-ScramblingID* if it is configured in a CFR used for the GC-PDCCH for MCCH/MTCH; otherwise.

Agreement:

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

* 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;  otherwise.

Working assumption:

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

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

Agreement:

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

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

Agreement:

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

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

# Appendix 9: Agreements in #107 e-meetings

**RAN1#107-e**

**Mechanisms to support group scheduling for RRC\_CONNECTED UEs**

Agreement:

For multicast of RRC\_CONNECTED UEs, the G-CS-RNTI(s) is/are configured per serving cell.

Agreement:

For initializing sequence generator for DMRS of GC-PDSCH, are defined using the same procedure as for unicast PDSCH.

* given by

- if the higher-layer parameter *dmrs-Downlink* in the *DMRS-DownlinkConfig* IE in the *PDSCH-Config-Multicast* IE is provided

where λ is the CDM group defined in clause 7.4.1.1.2 in TS38.211.

- otherwise by

* The quantity is given by the DM-RS sequence initialization field, if present, in the DCI associated with the PDSCH transmission if multicast DCI format 1\_1 is used, otherwise .

Agreement:

The following information is transmitted by means of the DCI format 1\_0 with CRC scrambled by G-RNTI for multicast:

* Frequency domain resource assignment
* Time domain resource assignment – 4 bits as defined in Clause 5.1.2.1 of TS38.214
* VRB-to-PRB mapping – 1 bit according to Table 7.3.1.2.2-5 in TS38.212
* Modulation and coding scheme – 5 bits as defined in Clause 5.1.3 of TS38.214
* New data indicator – 1 bit
* Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2 in TS38.212
* HARQ process number – [4 or 5] bits
* Downlink assignment index – 2 bits as defined in Clause 9.1.3 of TS 38.213, as counter DAI
* PUCCH resource indicator – 3 bits as defined in Clause 9.2.3 of TS38.213
* PDSCH-to-HARQ\_feedback timing indicator – 3 bits as defined in Clause 9.2.3 of TS38.213
* Reserved bits –3 bits
* FFS: Some of the fields may be not useful and can be reserved in some conditions, and FFS the details of the conditions
* FFS: other fields, e.g. for HARQ enabling/disabling

Note: Whether new fields are defined for multicast DCI format 1\_0 can be discussed separately. The reserved bits can be used for new fields if needed.

Agreement:

For the LBRM/TBS determination for PTP retransmission of multicast, Option 2 is supported.

* Option 2: based on the LBRM/TBS determination of the legacy unicast PDSCH transmission
  + Note: The UE is not required to soft combine the PTM initial transmission and the PTP retransmission in case of different circular buffer
    - FFS: spec impact, if any

Conclusion:

For the RRC parameters that can be configured in *PDSCH-Config / PDCCH-Config / SPS-Config* in Rel-15/16, they can also be configured in *PDSCH-Config-Multicast / PDCCH-Config-Multicast / SPS-Config-Multicast*.

* If some of these RRC parameters need changes for multicast reception (e.g., modify the default values, delete some useless parameters), RAN1 will list them explicitly in the RRC parameter list that will be sent to RAN2.
* For other RRC parameters that do not need changes for multicast reception, RAN1 will not list them with postfix ‘-Multicast’ one by one in the RRC parameter list that will be sent to RAN2, and the default values of these parameters are the same as the default values of the corresponding parameters in dedicated unicast BWP.

Agreement:

PRB bundle and VRB bundle for multicast GC-PDSCH in CFR are defined using the same procedure as for unicast PDSCH scheduled with unicast DCI formats 1\_1 in DL BWP as defined in clause 7.3.1.6 in TS38.211. For interleaved mapping of downlink resource allocation type 1,

* the parameter *N*bundle  is interpreted as the number of bundles within the CFR,
* the size of the CFR is used instead of the size of the BWP,
* the starting PRB of the CFR is used instead of the starting PRB of the BWP
* the higher-layer parameter *vrb-ToPRB-Interleaver* in *PDSCH-Config-Multicast* for multicast, if provided, is used instead of the size of the higher-layer parameter *vrb-ToPRB-Interleaver* in *PDSCH-Config* for unicast.

Conclusion:

For multicast of RRC-CONNECTED UEs, support CFR associated with UE active BWP, where UE active BWP can be an RRC reconfigured initial DL BWP (using Option#2 for configuring initial BWP according to the Annex B.2 of TS 38.331).

Agreement:

Multicast DCI format 1\_1 includes all configurable fields of unicast DCI format 1\_1 except

* Identifier for DCI formats, TPC command for scheduled PUCCH, SRS request
* FFS: Scell dormancy indication
* One-shot HARQ-ACK request, PDSCH group index, New feedback indicator, Number of requested PDSCH group(s), ChannelAccess-Cpext
* CBGTI, CBGFI
* Minimum applicable scheduling offset indicator
* FFS: Carrier indicator, BWP indicator, ZP CSI-RS trigger
* FFS: MCS/NDI/RV for TB2

Conclusion:

If a CFR is configured in a dedicated unicast BWP for multicast in RRC-CONNECTED state, it is up to gNB’s configuration whether to use the CORESET configured in *PDCCH-config-Multicast* in the CFR for unicast transmission or PTP retransmission of multicast.

Agreement:

For MCS determination of SPS GC-PDSCH, *mcs-Table* of ‘qam64LowSE’ can be optionally configured in the *SPS-Config-Multicast*.

* If *mcs-Table* of ‘qam64LowSE’ is not configured in the *SPS-Config-Multicast*, the *mcs-Table* of *PDSCH-Config-Multicast* in the same *CFR-Config-Multicast* is used for the SPS GC-PDSCH to determine the MCS.
* If *mcs-Table* of ‘qam64LowSE’ is configured in the *SPS-Config-Multicast*, it is used for the SPS GC-PDSCH to determine the MCS.

Agreement:

A list of up to 8 k1 values can be configured by higher layer parameter *dl-DataToUL-ACK-MulticastDciFormat1\_0* to be applied to multicast DCI format 1\_0 for RRC\_CONNECTED UEs. If the higher layer parameter *dl-DataToUL-ACK-MulticastDciFormat1\_0* is not provided, k1 list {1, 2, 3, 4, 5, 6, 7, 8} is applied to multicast DCI format 1\_0.

* The size of ‘PDSCH-to-HARQ\_feedback timing indicator’ field of multicast DCI format 1\_0 is fixed at 3 bits.

Agreement:

If *locationAndBandwidth-Multicast* is not configured in a *cfr-Config-Multicast*, the default value is the *locationAndBandwidth* of the DL BWP in which the *cfr-Config-Multicast* is configured.

Agreement:

For applicable PDSCH time domain resource allocation for multicast DCI format,

* if *pdsch-TimeDomainAllocationList* in *PDSCH-Config-Multicast* is provided, the *pdsch-TimeDomainAllocationList* in *PDSCH-Config-Multicast* is applied,
* else if *pdsch-TimeDomainAllocationList* in *PDSCH-Config-Multicast* is not providedbut *pdsch-TimeDomainAllocationList* in *PDSCH-ConfigCommon* is provided, the *pdsch-TimeDomainAllocationList* in *PDSCH-ConfigCommon* is applied,
* else if both *pdsch-TimeDomainAllocationList* in *PDSCH-Config-Multicast* and *pdsch-TimeDomainAllocationList* in *PDSCH-ConfigCommon* are not provided, Default A table is applied irrespective of the SS/PBCH block and CORESET multiplexing pattern.

Agreement:

For multicast in RRC\_CONNECTED state,

* Only SPS-Config-Multicast(s) configured in CFR for multicast can be activated/deactivated by GC-PDCCH with G-CS-RNTI.
* SPS-Config-Multicast(s) configured in CFR for multicast cannot be activated by unicast PDCCH with CS-RNTI, but can be deactivated by unicast PDCCH with CS-RNTI.

Agreement:

For multicast of RRC\_CONNECTED UEs in Rel-17,

* DCI format 2\_x cannot be configured in the same CSS configuration with multicast DCI formats.

Agreement:

For multicast, if a UE is configured with a CFR in the active DL BWP, for timer-based active DL BWP switching to a default BWP, option 1 is supported.

* Option 1: UE also starts or restarts BWP-InactivityTimer when it successfully decodes a GC-PDCCH addressed to group-common RNTI (e.g., G-RNTI or G-CS-RNTI) for multicast on/for the active BWP or when a MAC PDU for is received in a configured downlink assignment for multicast.
  + UE does not start or restart BWP-InactivityTimer when it successfully decodes a GC-PDCCH addressed to group-common RNTI (e.g., G-RNTI or G-CS-RNTI) for broadcast.

**Mechanisms to improve reliability for RRC\_CONNECTED UEs**

Agreement:

When UE is configured with different codebook types for unicast and multicast and when UE is scheduled to multiplex HARQ-ACK for unicast and HARQ-ACK for multicast with the same priority in the same PUCCH slot,

* UE generates two separate sub-codebooks for unicast and multicast respectively and then concatenates them by appending sub-codebook for multicast to the sub-codebook for unicast.
  + Note: The PUCCH resource for transmitting the codebook is based on the last unicast DCI.
  + FFS: when Type-3 HARQ-ACK codebook or enhanced Type-2 codebook is used for unicast
  + Define a UE capability

Agreement:

For multicast SPS activation/deactivation, only ACK/NACK based feedback is supported.

Agreement:

UE is not expected to be configured with different PUCCH structures for unicast and multicast for which the HARQ-ACK are with the same priority and to be scheduled to multiplex the HARQ-ACK in the same PUCCH slot simultaneously.

Agreement:

For a UE that supports multicast, the same TDRA table applies to all G-RNTIs if configured ona given serving cell.

Agreement:

For a UE that supports multicast,when *PUCCH-Config* for ACK/NACK based feedback for multicast is configured separately from unicast, the *PUCCH-Config* is applied to all G-RNTIs with ACK/NACK based feedback with the same priority on a given serving cell.

* Note: The *dl-DataToUL-ACK* is included in *PUCCH-Config*

Agreement:

At least for ACK/NACK based feedback, for obtaining a transmission power for a PUCCH, for Type-2 codebook, is determined as follows:

* *,* where
  + is computed as in R15/R16.
  + is the total number of bits for all configured G-RNTIs.

Agreement:

* For PTM retransmission,
  + if UE is configured to enable/disable HARQ-ACK per group-common DCI indication for initial transmission, whether HARQ-ACK is enabled/disabled for PTM retransmission also follows the indication in the group-common DCI scheduling the PTM retransmission.
  + if UE is configured directly whether the HARQ-ACK is enabled/disabled, it applies to both PTM initial transmission and retransmission.
* For PTP retransmission, the HARQ-ACK is always enabled.

Agreement:

Support enabling/disabling HARQ-ACK for NACK-only based feedback.

* The relevant agreements made for ACK/NACK based feedback can be extended for the support of NACK-only, including:
  + RRC signalling configures the presence of the field “enabling/disabling HARQ-ACK feedback indication” in the group-common DCI and the configuration is per G-RNTI.
  + RRC signalling configures directly whether the HARQ-ACK feedback is enabled or disabled and the configuration is per G-RNTI.

Agreement:

HARQ-ACK feedback option is configured per G-CS-RNTI.

Agreement:

For group-common DCI indicating whether ACK/NACK based HARQ-ACK feedback is enabled/disabled, the “enabling/disabling HARQ-ACK feedback indication” is included in DCI format 1\_1 scrambled by G-RNTI

* For DCI format 1\_1 scrambled by G-CS-RNTI, it is discussed separately.

Agreement:

For the DCI format including the field of “enabling/disabling HARQ-ACK feedback indication” for multicast scheduling, the field is a new field with 1 bit.

Agreement:

For multicast SPS PDSCH without PDCCH scheduling, support the following:

* RRC signalling configures the presence of the field “enabling/disabling HARQ-ACK feedback indication” in the group-common DCI for multicast SPS activation.
  + The configuration is per G-CS-RNTI.
  + Separate UE capability is needed from that for dynamic scheduling for multicast.
* RRC signalling configures directly whether the HARQ-ACK feedback is enabled or disabled.
  + The configuration is per G-CS-RNTI.

Agreement:

For the Type-1 codebook construction for FDM-ed unicast and multicast via Opt 4 (from the previous agreement), when UE is configured with multiple G-RNTIs and UE is configured with *fdmed-Reception-Multicast*, the sub-codebook for multicast consists of the sub-codebooks for each G-RNTI by appending one to another in ascending order of G-RNTI value.

* The sub-codebook for each G-RNTI is generated per the *k1* and *TDRA* configurations for the same G-RNTI as the legacy procedure.
* FFS: whether/how to reduce the Type-1 codebook size when multiple G-RNTIs are configured.
* Note: The maximum number of G-RNTI(s) configured to UE for the FDMed unicast and multicast Type-1 codebook is up to UE capability which will be discussed in UE features.

**Basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs**

Agreement:

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

Working assumption:

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

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

R1-2112645 [DRAFT] Reply LS on MCCH change notification Moderator (BBC)

Final LS is endorsed in R1-2112646

Agreement:

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

Conclusion:

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

Agreement:

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

* Opt-1: DCI includes the VRB-to-PRB mapping field with 1 bit according to Table 7.3.1.2.2-5 in TS 38.212
  + Note: DL resource allocation type 0 is not supported in DCI format 1\_0

Working assumption:

For FDRA determination of the DCI format 1\_0 for GC-PDCCH for broadcast reception:

* is the size of CORESET 0if CORESET 0 is configured for the cell; and the size of initial DL bandwidth part if CORESET 0 is not configured for the cell.
* If the size of CFR (i.e.)is larger than the size of CORESET0/initial DL bandwidth part, the resource indication value (*RIV*) is defined as in section 5.1.2.2.2 in TS38.214, where *K* is the maximum value from set {1, 2, 4, 6, 8, 10, 12} which satisfies *;*otherwise*,*

Agreement:

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

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

Agreement:

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

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **RNTI** | **PDCCH search space** | **SS/PBCH block and CORESET multiplexing pattern** | **pdsch-ConfigCommon includes pdsch-TimeDomainAllocationList** | **pdsch-Config includes pdsch-TimeDomainAllocationList** | **pdsch-Config-broadcast includes pdsch-TimeDomainAllocationList** | **PDSCH time domain resource allocation to apply** |
| MCCH\_RNTI, G\_RNTI for broadcast | Type-x Common for broadcast | 1 | No | - | - | Default A |
| 2 | No | - | - | Default B |
| 3 | No | - | - | Default C |
|  |  |  |  |  |
| 1,2,3 | Yes | - | No | pdsch-TimeDomainAllocationList provided in pdsch-ConfigCommon |
| 1,2,3 | No/Yes | - | Yes | pdsch-TimeDomainAllocationList provided in pdsch-Config-broadcast |

Agreement:

The definition of the broadcast CFR frequency resources reuses the legacy definition of BWP frequency resources for unicast using the combination of Point A, *offsetToCarrier* and *locationAndBandwidth* to indicate the exact location of the CFR with respect to the carrier starting RB.

* Note: for Case A and Case C, the above parameters (Point A, *offsetToCarrier* and *locationAndBandwidth*) can be derived from the configurations in MIB and SIB1, respectively.

Agreement:

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

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

Agreement:

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

Agreement:

For LBRM and TBS determination for GC-PDSCH:

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

Agreement:

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

Agreement:

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

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

For LBRM and TBS determination for GC-PDSCH for broadcast reception:

* the maximum number of layers is 1
* the maximum modulation order can be determined from *mcs-Table* in *PDSCH-Config* for broadcast.
* If *mcs-Table* in *PDSCH-Config* is not configured in CFR for broadcast, Table 5.1.3.1-1 in TS38.214 is used.

Agreement:

Confirm the following working assumption with the following note:

* Note: Confirming this WA does not have impact on the down-selection decision for CFR cases

Working assumption

For FDRA determination of the DCI format 1\_0 for GC-PDCCH for broadcast reception:

* is the size of CORESET 0if CORESET 0 is configured for the cell; and the size of initial DL bandwidth part if CORESET 0 is not configured for the cell.
* If the size of CFR (i.e.)is larger than the size of CORESET0/initial DL bandwidth part, the resource indication value (*RIV*) is defined as in section 5.1.2.2.2 in TS38.214, where *K* is the maximum value from set {1, 2, 4, 6, 8, 10, 12} which satisfies *;*otherwise*,*

Conclusion:

RAN1 cannot get consensus on the support of Case D and/or Case E.

Conclusion:

Is up to RAN2 decision:

* the configuration of the MTCH scheduling window parameters: monitoring periodicity and the starting of the periodicity:
* whether the MTCH scheduling window is associated to one or multiple or all G-RNTIs

Send an LS to RAN2 to inform about RAN1 conclusion

R1-2112850 LS on MTCH scheduling window

# Appendix 10: Agreements in #107b e-meetings

**Mechanisms to support group scheduling for RRC\_CONNECTED UEs**

**Agreement**

DCI format 4\_2 doesn’t include the following fields:

* + Scell dormancy indication
  + BWP indicator

DCI format 4\_2 includes the following field (configurable):

* + MCS/NDI/RV for TB2
    - Support of this field is subject to UE capability

**Agreement**

DCI format 4\_2 includes ‘ZP CSI-RS trigger’ field.

**Agreement**

For DCI size alignment of DCI format 4\_2, the size of DCI format 4\_2 is configured by RRC signaling for RRC\_CONNECTED UEs (similar as the configuration for the size alignment among DCI format 2\_0/2\_1/2\_4/2\_5/2\_6).

**Conclusion**

For multicast of RRC\_CONNECTED UEs, the value range of *sps-ConfigIndex* in *SPS-Config-Multicast* is {0-7}, and *sps-ConfigIndex* in *sps-Config* and *SPS-Config-Multicast* cannot be configured with the same value.

The TP below for Clause 10.1 in TS 38.213v17.0.0 is endorsed.

----------------- Start of TP ----------------

**10.1 UE procedure for determining physical downlink control channel assignment**

**<**Unchanged text is omitted>

A UE does not expect to detect, in a same PDCCH monitoring occasion, a DCI format with CRC scrambled by a SI-RNTI, RA-RNTI, MsgB-RNTI, TC-RNTI, P-RNTI, C-RNTI, CS-RNTI, ~~or~~ MCS-RNTI, MCCH-RNTI, G-RNTI, or G-CS-RNTI and a DCI format with CRC scrambled by a SL-RNTI or a SL-CS-RNTI for scheduling respective PDSCH reception and PSSCH transmission on a same serving cell.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

The TP below for Clause 5.1.2.2 in TS 38.214v17.0.0 is endorsed.

----------------- Start of TP ----------------

**5.1.2.2 Resource allocation in frequency domain**

**<**Unchanged text is omitted>

Two downlink resource allocation schemes, type 0 and type 1, are supported. The UE shall assume that when the scheduling grant is received with DCI format 1\_0, DCI format 4\_0 or DCI format 4\_1, then downlink resource allocation type 1 is used.

If the scheduling DCI is configured to indicate the downlink resource allocation type as part of the '*Frequency domain resource assignment'* field by setting a higher layer parameter *resourceAllocation* in *PDSCH-Config* to 'dynamicSwitch', for DCI format 1\_1 or setting a higher layer parameter *resourceAllocationDCI-1-2* in *PDSCH-Config* to 'dynamicSwitch' for DCI format 1\_2 or setting a higher layer parameter *resourceAllocation* in *PDSCH-Config-Multicast* to 'dynamicSwitch' for DCI format 4\_2, the UE shall use downlink resource allocation type 0 or type 1 as defined by this DCI field. Otherwise the UE shall use the downlink frequency resource allocation type as defined by the higher layer parameter *resourceAllocation* in *PDSCH-Config* for DCI format 1\_1 or by the higher layer parameter *resourceAllocationDCI-1-2* for DCI format 1\_2 or by the higher layer parameter *resourceAllocation* in *PDSCH-Config-Multicast* for DCI format 4\_2.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

The TP below for Clause 5.1.2.3 in TS 38.214v17.0.0 is endorsed.

----------------- Start of TP ----------------

**<**Unchanged text is omitted>

The PRB bundling procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 1\_2, by applying the parameters of *prb-BundlingTypeDCI-1-2* instead of *prb-BundlingType* as well as *vrb-ToPRB-InterleaverDCI-1-2* instead of *vrb-ToPRB-Interleaver*. The PRB bundling procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 4\_2, by applying the parameters of *prb-BundlingType* given by *PDSCH-Config-Multicast* as well as *vrb-ToPRB-Interleaver* given by *PDSCH-Config-Multicast*.

A UE may assume that precoding granularity is  consecutive resource blocks in the frequency domain.  can be equal to one of the values among {2, 4, wideband}.

If  is determined as "wideband", the UE is not expected to be scheduled with non-contiguous PRBs and the UE may assume that the same precoding is applied to the allocated resource associated with a same TCI state or a same QCL assumption.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

**Agreement**

For DMRS of GC-PDSCH,

* + For GC-PDSCH scheduled by a DCI format 4\_0/4\_1, the UE assumes *dmrs-AdditionalPosition* = ‘pos2’, similar as that of DCI format 1\_0.
  + For GC-PDSCH scheduled by a DCI format 4\_2, the UE assumes *dmrs-AdditionalPosition* in *DMRS-Config* if configured in *PDSCH-Config-Multicast*, similar as that of DCI format 1\_1.
  + Adopt the following TP for Clause 5.1.6.2 in TS 38.214:

----------------- Start of TP ----------------

**5.1.6.2 DM-RS reception procedure**

**<**Unchanged text is omitted>

The DM-RS reception procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 1\_2, by applying the parameters of *dmrs-DownlinkForPDSCH-MappingTypeA-DCI-1-2* and *dmrs-DownlinkForPDSCH-MappingTypeB-DCI-1-2* instead of *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB*.

The DM-RS reception procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 4\_2, by applying the parameters of *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB* in *PDSCH-Config-Multicast* instead of *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB in PDSCH-Config*.

When receiving PDSCH scheduled by DCI format 1\_0, 4\_0, 4\_1 or receiving PDSCH before dedicated higher layer configuration of any of the parameters *dmrs-AdditionalPosition*, *maxLength* and *dmrs-Type,* the UE shall assume that the PDSCH is not present in any symbol carrying DM-RS except for PDSCH with allocation duration of 2 symbols with PDSCH mapping type B (described in clause 7.4.1.1.2 of [4, TS 38.211]), and a single symbol front-loaded DM-RS of configuration type 1 on DM-RS port 1000 is transmitted, and that all the remaining orthogonal antenna ports are not associated with transmission of PDSCH to another UE and in addition

- For PDSCH with mapping type A and type B, the UE shall assume *dmrs-AdditionalPosition*='pos2' and up to two additional single-symbol DM-RS present in a slot according to the PDSCH duration indicated in the DCI as defined in Clause 7.4.1.1 of [4, TS 38.211], and

- For PDSCH with allocation duration of 2 symbols with mapping type B, the UE shall assume that the PDSCH is present in the symbol carrying DM-RS.

When receiving PDSCH scheduled by DCI format 1\_1 by PDCCH with CRC scrambled by C-RNTI, MCS-C-RNTI, or CS-RNTI or DCI format 4\_2 by PDCCH with CRC scrambled by G-RNTI or G-CS-RNTI,

- the UE may be configured with the higher layer parameter *dmrs-Type*, and the configured DM-RS configuration type is used for receiving PDSCH in as defined in Clause 7.4.1.1 of [4, TS 38.211].

- the UE may be configured with the maximum number of front-loaded DM-RS symbols for PDSCH by higher layer parameter *maxLength* given by *DMRS-DownlinkConfig.*

- if *maxLength* is set to 'len1', single-symbol DM-RS can be scheduled for the UE by DCI, and the UE can be configured with a number of additional DM-RS for PDSCH by higher layer parameter *dmrs-AdditionalPosition,* which can be set to 'pos0', 'pos1', 'pos2' or 'pos3'.

- if *maxLength* is set to 'len2', both single-symbol DM-RS and double symbol DM-RS can be scheduled for the UE by DCI, and the UE can be configured with a number of additional DM-RS for PDSCH by higher layer parameter *dmrs-AdditionalPosition,* which can be set to 'pos0' or 'pos1'.

- and the UE shall assume to receive additional DM-RS as specified in Table 7.4.1.1.2-3 and Table 7.4.1.1.2-4 as described in Clause 7.4.1.1.2 of [4, TS 38.211].

**<**Unchanged text is omitted>

When receiving PDSCH scheduled by DCI format 1\_0, 4\_0, 4\_1, the UE shall assume the number of DM-RS CDM groups without data is 1 which corresponds to CDM group 0 for the case of PDSCH with allocation duration of 2 symbols, and the UE shall assume that the number of DM-RS CDM groups without data is 2 which corresponds to CDM group {0,1} for all other cases.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

**Agreement**

For PDSCH scheduled by a DCI format 4\_1/4\_2, the UE assumes *phaseTrackingRS* in *dmrs-DownlinkForPDSCH-MappingTypeA* or *dmrs-DownlinkForPDSCH-MappingTypeB* configured in *PDSCH-Config-Multicast*.

* + Adopt the following TP for Clause 5.1.6.3 in TS 38.214:

----------------- Start of TP ----------------

**5.1.6.3 PT-RS reception procedure**

**<**Unchanged text is omitted>

The procedures on PT-RS reception described in this clause apply to a UE receiving PDSCH scheduled by DCI format 1\_2 configured with the higher layer parameter *phaseTrackingRS* in *dmrs-DownlinkForPDSCH-MappingTypeA-DCI-1-2* or *dmrs-DownlinkForPDSCH-MappingTypeB-DCI-1-2* and to a UE receiving PDSCH scheduled by DCI format 1\_0 or DCI format 1\_1 configured with the higher layer parameter *phaseTrackingRS* in *dmrs-DownlinkForPDSCH-MappingTypeA* or *dmrs-DownlinkForPDSCH-MappingTypeB*. The procedures on PT-RS reception described in this clause apply to a UE receiving PDSCH scheduled by DCI format 4\_1 or DCI format 4\_2 configured with the higher layer parameter *phaseTrackingRS* in *dmrs-DownlinkForPDSCH-MappingTypeA* or *dmrs-DownlinkForPDSCH-MappingTypeB* in *PDSCH-Config-Multicast*.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

The TP below for Clause 5.1 in TS 38.214v17.0.0 is endorsed.

----------------- Start of TP ----------------

**5.1 UE procedure for receiving the physical downlink shared channel**

**<**Unchanged text is omitted>

A UE shall upon detection of a PDCCH with a configured DCI format 1\_0, 1\_1, 4\_0, 4\_1, 4\_2 or 1\_2 decode the corresponding PDSCHs as indicated by that DCI. For any HARQ process ID(s) in a given scheduled cell, the UE is not expected to receive a PDSCH that overlaps in time with another PDSCH. The UE is not expected to receive another PDSCH for a given HARQ process until after the end of the expected transmission of HARQ-ACK for that HARQ process, where the timing is given by Clause 9.2.3 of [6]. Except for the case when a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *coresetPoolIndex* in *ControlResourceSet* and PDCCHs that schedule two PDSCHs are associated to different *ControlResourceSets* having different values of *coresetPoolIndex,* in a given scheduled cell, the UE is not expected to receive a first PDSCH and a second PDSCH, starting later than the first PDSCH, with its corresponding HARQ-ACK assigned to be transmitted on a resource ending before the start of a different resource for the HARQ-ACK assigned to be transmitted for the first PDSCH, where the two resources are in different slots for the associated HARQ-ACK transmissions, each slot is composed of symbols [4] or a number of symbols indicated by *subslotLengthForPUCCH* if provided, and the HARQ-ACK for the two PDSCHs are associated with the HARQ-ACK codebook of the same priority. Except for the case when a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *coresetPoolIndex* in *ControlResourceSet* and PDCCHs that schedule two PDSCHs are associated to different *ControlResourceSets* having different values of *coresetPoolIndex,* in a given scheduled cell, the UE is not expected to receive a first PDSCH, and a second PDSCH, starting later than the first PDSCH, with its corresponding HARQ-ACK assigned to be transmitted on a resource ending before the start of a different resource for the HARQ-ACK assigned to be transmitted for the first PDSCH if the HARQ-ACK for the two PDSCHs are associated with HARQ-ACK codebooks of different priorities. For any two HARQ process IDs in a given scheduled cell, if the UE is scheduled to start receiving a first PDSCH starting in symbol *j* by a PDCCH ending in symbol *i*, the UE is not expected to be scheduled to receive a PDSCH starting earlier than the end of the first PDSCH with a PDCCH that ends later than symbol *i*. In a given scheduled cell, for any PDSCH corresponding to SI-RNTI, the UE is not expected to decode a re-transmission of an earlier PDSCH with a starting symbol less than *N* symbols after the last symbol of that PDSCH, where the value of *N* depends on the PDSCH subcarrier spacing configuration *m,* with *N*=13 for *m*=0, *N*=13 for *m*=1, *N*=20 for *m*=2, and *N*=24 for *m*=3.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

The TP below for Clause 5.1.3.2 in TS 38.214v17.0.0 is endorsed.

----------------- Start of TP ----------------

**5.1.3.2 Transport block size determination**

**<**Unchanged text is omitted>

In case the higher layer parameter *maxNrofCodeWordsScheduledByDCI* indicates that two codeword transmission is enabled, then one of the two transport blocks is disabled by DCI format 1\_1 if *IMCS* = 26 and if *rvid* = 1 for the corresponding transport block. If both transport blocks are enabled, transport block 1 and 2 are mapped to codeword 0 and 1 respectively. If only one transport block is enabled, then the enabled transport block is always mapped to the first codeword.

For the PDSCH assigned by a PDCCH with DCI format 1\_0, format 1\_1, format 4\_0, format 4\_1, format 4\_2 or format 1\_2 with CRC scrambled by C-RNTI, MCS-C-RNTI, TC-RNTI, CS-RNTI, G-RNTI, G-CS-RNTI or SI-RNTI, if Table 5.1.3.1-2 is used and *,* or a table other than Table 5.1.3.1-2 is usedand *,* the UE shall, except if the transport block is disabled in DCI format 1\_1, first determine the TBS as specified below:

**<**Unchanged text is omitted>

----------------- End of TP ----------------

The TP below for Clause 7.3.1.6 in TS 38.211v17.0.0 is endorsed.

----------------- Start of TP ----------------

**7.3.1.6 Mapping from virtual to physical resource blocks**

**<**Unchanged text is omitted>

- for PDSCH transmissions scheduled with DCI format 1\_0 in any common search space in bandwidth part with starting position , other than Type0-PDCCH common search space in CORESET 0 ~~and common search space associated with G-RNTI or G-CS-RNTI~~, the set of virtual resource blocks , where is the size of CORESET 0 if CORESET 0 is configured for the cell and the size of initial downlink bandwidth part if CORESET 0 is not configured for the cell, are divided into virtual resource-block bundles in increasing order of the virtual resource-block number and virtual bundle number and the set of physical resource blocks are divided into physical resource-block bundles in increasing order of the physical resource-block number and physical bundle number, where , is the bundle size, and is the lowest-numbered physical resource block in the control resource set where the corresponding DCI was received.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

The TP below for Clause 5.1.3.1 in TS 38.214v17.0.0 is endorsed.

----------------- Start of TP ----------------

**<**Unchanged text is omitted>

elseif the higher layer parameter *mcs-Table* given by *PDSCH-Config-Multicast* is set to 'qam256', and the PDSCH is scheduled by a PDCCH with DCI format 4\_1 or 4\_2 with CRC scrambled by G-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the higher layer parameter *mcs-Table* given by *PDSCH-Config-Multicast* is set to 'qam64LowSE', and the PDSCH is scheduled by a PDCCH with DCI format 4\_1 or 4\_2 with CRC scrambled by G-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

**Agreement**

For RRC\_CONNECTED UEs receiving broadcast MCCH/MTCH, the Type0B-PDCCH CSS set configured by *searchSpace-Broadcast* in *pdcch-Config-MCCH/pdcch-Config-MTCH* follows the same prioritization rule for search space set overbooking procedure as CSS set(s) configured by *searchSpace-Multicast*.

**Agreement**

Regarding the number of DCIs that a UE can process in a slot or span, multicast DCI is treated as unicast DCI scheduling DL following the current feature group 3-1/3-5a/3-5b.

**Agreement**

For multicast RRC\_CONNECTED UEs, *rateMatchPatternToAddModList*, *rateMatchPatternGroup1* and *rateMatchPatternGroup2* can be configured in *PDSCH-Config-Multicast* for GC-PDSCH rate matching, subject to UE capability. For PDSCH resource mapping with RB symbol level granularity,

* + The procedure for PDSCH scheduled by PDCCH with DCI format 4\_1is similar as that of DCI format 1\_0 and the procedure for PDSCH scheduled by PDCCH with DCI format 4\_2is similar as that of DCI format 1\_1, by applying the parameters of *rateMatchPatternToAddModList*, *rateMatchPatternGroup1* and *rateMatchPatternGroup2* configured in *PDSCH-Config-Multicast*.
  + *rateMatchPatternToAddModList*, *rateMatchPatternGroup1* and *rateMatchPatternGroup2* configured in *PDSCH-Config* for unicast do not apply for GC-PDSCHs.
  + *rateMatchPatternToAddModList*, *rateMatchPatternGroup1* and *rateMatchPatternGroup2* configured in *PDSCH-Config-Multicast* for multicast do not apply for unicast PDSCHs.

**Agreement**

PDSCH processing capability 2 is not applied to PDSCH scheduled by PDCCH with DCI format 4\_0/4\_1/4\_2.

**Agreement**

Regarding the size of DCI format 4\_2 for multicast of RRC\_CONNECTED UE,

* + the size is configured per CFR for all G-RNTIs (included in cfr-Config-Multicast).
  + the value range of the size is {[1]..140} (the same as for DCI format 2\_6)

**Agreement**

Regarding the size of DCI format 4\_2 for multicast of RRC\_CONNECTED UE,

* + the value range of the size is {20..140}

The TP below for Clause 5.1.4.1 in TS 38.214v17.0.0 is endorsed.

----------------- Start of TP ----------------

**5.1.4.1 PDSCH resource mapping with RB symbol level granularity**

**<**Unchanged text is omitted>

The procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 1\_2, by applying the parameters of *rateMatchPatternGroup1DCI-1-2*, *rateMatchPatternGroup2DCI-1-2* instead of *rateMatchPatternGroup1* and *rateMatchPatternGroup2*.

The procedures for PDSCH scheduled by PDCCH with DCI format 1\_0 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 4\_1, and the procedures for PDSCH scheduled by DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 4\_2 by applying the parameters of *rateMatchPatternToAddModList, rateMatchPatternGroup1* and *rateMatchPatternGroup2* configured in *PDSCH-Config-Multicast*.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

The TP below for Clause 5.1.4.2 in TS 38.214v17.0.0 is endorsed.

----------------- Start of TP ----------------

**5.1.4.2 PDSCH resource mapping with RE level granularity**

The procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 1\_2, by applying the parameters of *aperiodicZP-CSI-RS-ResourceSetsToAddModListDCI-1-2* instead of *aperiodic-ZP-CSI-RS-ResourceSetsToAddModList*. The procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 4\_2, by applying the parameters of *aperiodicZP-CSI-RS-ResourceSetsToAddModList in PDSCH-Config-Multicast* instead of *aperiodic-ZP-CSI-RS-ResourceSetsToAddModList in PDSCH-Config*.

**<**Unchanged text is omitted>

----------------- End of TP ----------------

**Agreement**

From RAN1 perspective, it is feasible for UE in RRC\_CONNECTED state to receive MBS broadcast on an activated SCell as long as UE has capability of supporting MBS broadcast on SCell. From RAN1 perspective, if a UE is to receive MBS broadcast on SCell,

* + The capability of supporting MBS broadcast on SCell is separate capability from the one of CA for unicast.
  + The UE is not required to monitor DCI formats associated with SI-RNTI, P-RNTI, RA-RNTI in SCell.
  + Overbooking for SCell is not supported.
  + MBS broadcast reception on SCell can be supported only for RRC\_CONNECTED UEs only with self-scheduling.
  + Type0-PDCCH CSS set is only configured on the primary cell of the MCG.
  + Configuring the search space on SCell for PDCCH monitoring of MBS DCI formats is via unicast RRC signaling.
  + The UE capability is expected to be defined by RAN2.
    - E.g. the total number of component carriers for receiving broadcast on SCell may be subject to UE capability
  + The UE is not required to receive broadcast on PCell and SCell simultaneously

**Agreement**

From RAN1 perspective, it is feasible for UE in RRC\_CONNECTED state to receive MBS broadcast on non-serving cell, which is up to UE implementation and transparent to the network.

* + It is assumed in RAN1 that UE receiving MBS broadcast on non-serving cell does not have any impact to operation on serving cell(s), e.g., does not require UE to obtain the related configuration from the serving cell, does not require the network to guarantee the scheduling doesn’t exceed UE’s capability on serving cell, etc.
  + RAN1 assumes that receiving MBS broadcast on non-serving cell could be on the same or on a different band, but on a different carrier frequency than a UE’s serving cell
  + No RAN1 spec impact and no optimization is pursued in Rel-17 for MBS broadcast reception on non-serving cell.
  + The UE capability(ies), if any, is(are) expected to be defined by RAN2.

R1-2200785 DRAFT LS reply to MBS broadcast reception on SCell and non-serving cell Moderator (Huawei)

Final LS to RAN2 is endorsed in R1-2200798.

**Mechanisms to improve reliability for RRC\_CONNECTED UEs**

**Agreement**

When PUCCH carrying multicast HARQ-ACK only overlaps with PUSCH with the same priority, support UL-DAI indicating the number of HARQ-ACK bits for multicast as defined in Rel-16 for unicast HARQ-ACK.

* + FFS it is applied to a single G-RNTI or applied to all configured G-RNTIs.

**Agreement**

Support multiplexing unicast and multicast HARQ-ACK onto the same PUSCH with the same priority for the following cases:

* + If the unicast and multicast HARQ-ACK codebooks are both Type-1
    - Option1-1: the 1-bit UL DAI with value “1” indicates multiplexing unicast and multicast HARQ-ACK codebooks onto the same PUSCH.
    - Option1-2: two bits UL DAI separately indicate whether multiplexing unicast and/or multicast HARQ-ACK codebooks onto the same PUSCH
      * FFS whether it is applied to a single G-RNTI or applied to all configured G-RNTIs.
  + If both unicast and multicast HARQ-ACK codebooks are Type-2, down-select from:
    - Option2-1: the 2-bit UL DAI is applicable to both HARQ-ACK codebooks.
    - Option2-2: 2-bit UL DAI(s) are included in DCI for multicast, in addition to the 2-bit UL DAI for unicast.
      * FFS whether a single UL DAI field is applied to all G-RNTIs, or separate UL DAI fields are applied for each configured G-RNTI.
  + FFS the unicast and multicast HARQ-ACK codebooks are different Types.

The TP below for TS38.213v17.0.0 section 18 is endorsed.

|  |
| --- |
| **<**Unchanged text is omitted>  If a UE is provided *pucch-Config-Multicast1* or *pucch-Config-Multicast2* for PUCCH transmissions with a priority value, the UE transmits a PUCCH with the priority value according to *pucch-Config-Multicast1* or *pucch-Config-Multicast2* for each G-RNTI or G-CS-RNTI that the UE provides associated HARQ-ACK information according to the first HARQ-ACK reporting mode or second HARQ-ACK reporting mode.  **<**Unchanged text is omitted> |

The TP below for TS38.213v17.0.0 section 18 is endorsed.

|  |
| --- |
| **<**Unchanged text is omitted>  A UE monitors PDCCH for scheduling PDSCH receptions or for activation/release of SPS PDSCH receptions for a corresponding SPS PDSCH configuration as described in clause 10.1. A UE can be configured by *harq-Feedback-Option-Multicast* for a G-RNTI or by *sps-HARQ-Feedback-Option-Multicast* for a G-CS-RNTI to provide HARQ-ACK information for a transport block reception associated with the G-RNTI or with the G-CS-RNTI, respectively, according to the first HARQ-ACK reporting mode or according to the second HARQ-ACK reporting mode. The second HARQ-ACK reporting mode is not applicable for DCI formats having associated HARQ-ACK information without scheduling a PDSCH reception. For the first HARQ-ACK reporting mode, the UE generates HARQ-ACK information with ACK value when a UE correctly decodes a transport block or detects a DCI format indicating an SPS PDSCH release; otherwise, the UE generates HARQ-ACK information with NACK value, as described in clauses 9 and 9.1 through 9.3. For the second HARQ-ACK reporting mode, the UE does not transmit a PUCCH that would include only HARQ-ACK information with ACK values.  **<**Unchanged text is omitted> |

The TP below for TS38.213v17.0.0 section 18 is endorsed.

|  |
| --- |
| 18 Multicast Broadcast Services  < Unchanged parts are omitted >  A UE determines a PUCCH resource for a PUCCH transmission with HARQ-ACK information as described in clauses 9.2 and 9.2.1 through 9.2.5. If the UE multiplexes HARQ-ACK information associated with unicast DCI formats and HARQ-ACK information associated with multicast DCI formats in a same PUCCH, the last DCI format that the UE uses to determine the PUCCH resource, as described in clause 9.2.3, is a last unicast DCI format.  A UE is not required to multiplex in a PUCCH multicast HARQ-ACK and unicast UCI of the same priority if the UE is provided *subslotLengthForPUCCH* for the PUCCH with the unicast UCI. |

**Agreement**

When HARQ-ACK for unicast SPS PDSCHs and multicast SPS PDSCHs with ACK/NACK based feedback are multiplexed on the same PUCCH for the same priority case, the PUCCH carrying the multiplexed HARQ-ACK is determined from the SPS-PUCCH-AN-List configured for unicast.

**Agreement**

When HARQ-ACK for unicast SPS PDSCHs and multicast dynamic grant PDSCHs with ACK/NACK based feedback are multiplexed on the same PUCCH for the same priority case, down-select from:

* + Option 1: the PUCCH carrying the multiplexed HARQ-ACK is determined from the SPS-PUCCH-AN-List configured for unicast.
  + Option 2: the PUCCH carrying the multiplexed HARQ-ACK is determined from PUCCH-Config/PUCCH-ConfigurationList configured for multicast.

**Agreement**

For the separate *PUCCH-Config/ PUCCH-ConfigurationList* configured to UE for NACK-only based feedback,

* + 1 PUCCH resource set in each *PUCCH-Config*.
  + up to 32 PUCCH resources in PUCCH resource set
  + Note: the separate *PUCCH-Config/PUCCH-ConfigurationList* applies to all configured G-RNTIs configured with NACK-only based feedback.

**Agreement**

Support *pdsch-AggregationFactor* configured in *PDSCH-Config-Multicast* for DCI formats 4\_0/4\_1, similar as that of DCI format 4\_2. The TP below for TS38.214v17.0.0 section 5.1.2.1 is endorsed:

|  |
| --- |
| 5.1.2.1 Resource allocation in time domain  \*\*\* Unchanged text is omitted \*\*\*  When receiving PDSCH scheduled by DCI format 4\_0/4\_1/4\_2 in PDCCH with CRC scrambled by G-RNTI or G-CS-RNTI with NDI=1, if the UE is configured with *pdsch-AggregationFactor* in the *pdsch-Config-Multicast* associated withthe corresponding G-RNTI or in the associated *SPS-Config-Multicast* activated by the DCI format 4\_0/4\_1/4\_2 with CRC scrambled by G-CS-RNTI, the same symbol allocation is applied across the *pdsch-AggregationFactor* consecutive slots. When receiving PDSCH scheduled by DCI format 4\_0/4\_1/4\_2 for multicast reception in PDCCH with CRC scrambled by G-CS-RNTI with NDI = 0, or PDSCH without corresponding PDCCH transmission using associated [*SPS-Config-Multicast*] and activated by the DCI format 4\_0/4\_1/4\_2 in PDCCH with CRC scrambled by G-CS-RNTI, the same symbol allocation is applied across the *pdsch-AggregationFactor*, in associated *SPS-Config-Multicast* if configured, or 1 otherwise, consecutive slots. When receiving PDSCH scheduled by DCI format 4\_0 in PDCCH with CRC scrambled by G-RNTI for MTCH, if the UE is configured with *pdsch-AggregationFactor* in the *pdsch-Config-Broadcast*, the same symbol allocation is applied across the *pdsch-AggregationFactor* consecutive slots.  When receiving PDSCH scheduled by DCI in PDCCH with CRC scrambled by G-CS-RNTI for multicast reception or G-RNTI, if the DCI field 'Time domain resource assignment' indicates an entry which contains *repetitionNumber* in *PDSCH-TimeDomainResourceAllocation* in the *PDSCH-Config-Multicast* or *PDSCH-Config-Broadcast*,the same SLIV is applied for all PDSCH transmission occasions across the *repetitionNumber* consecutive slots. When receiving PDSCH scheduled without corresponding PDCCH transmission using associated *SPS-Config-Multicast* and activated by DCI in PDCCH with CRC scrambled by G-CS-RNTI for multicast reception, if the DCI field 'Time domain resource assignment' of the activating DCI indicates an entry which contains *repetitionNumber* in *PDSCH-TimeDomainResourceAllocation* in the *PDSCH-Config-Multicast*,the same SLIV is applied for all PDSCH transmission occasions across the *repetitionNumber* consecutive slots.  \*\*\* Unchanged text is omitted \*\*\* |

**Agreement**

For multicast SPS PDSCH re-transmission, the *pdsch-AggregationFactor* in *pdsch-Config-Multicast* is applied as the repetition number. The TP below for TS38.214v17.0.0 section 5.1.2.1 is endorsed:

|  |
| --- |
| **for TS 38.214 section 5.1.2.1**  **<**Unchanged text is omitted>  When receiving PDSCH scheduled by DCI format 4\_2 in PDCCH with CRC scrambled by G-RNTI or G-CS-RNTI with NDI=1, if the UE is configured with *pdsch-AggregationFactor* in the *pdsch-Config-Multicast* associated withthe corresponding G-RNTI or G-CS-RNTI, the same symbol allocation is applied across the *pdsch-AggregationFactor* consecutive slots. When receiving PDSCH scheduled by DCI format 4\_2 for multicast reception in PDCCH with CRC scrambled by G-CS-RNTI with NDI = 0, or PDSCH without corresponding PDCCH transmission using associated *SPS-Config-Multicast* and activated by the DCI format 4\_2 in PDCCH with CRC scrambled by G-CS-RNTI, the same symbol allocation is applied across the *pdsch-AggregationFactor*, in associated *SPS-Config-Multicast* if configured, or 1 otherwise, consecutive slots. When receiving PDSCH scheduled by DCI format 4\_0 in PDCCH with CRC scrambled by G-RNTI for MTCH, if the UE is configured with *pdsch-AggregationFactor* in the *pdsch-Config-Broadcast*, the same symbol allocation is applied across the *pdsch-AggregationFactor* consecutive slots.  **<**Unchanged text is omitted> |

**Agreement**

When UE is configured with unicast SPS and multicast SPS with ACK/NACK based feedback for multiplexing on the same PUCCH for the same priority case, the HARQ-ACK codebook is constructed as for multiple SPS PDSCHs regardless of unicast SPS PDSCH or multicast SPS PDSCH.

**Agreement**

When HARQ-ACK for multicast dynamic grant PDSCHs and multicast SPS PDSCHs with ACK/NACK based feedback are multiplexed on the same PUCCH for the same priority case, the PUCCH carrying the multiplexed HARQ-ACK is determined from PUCCH-Config/PUCCH-ConfigurationList configured for multicast.

**Agreement**

Extending the fallback operation for Type-1 HARQ-ACK codebook to multicast PDSCH receptions.

* FFS how to handle the fallback operation for the case of multiple G-RNTIs/G-CS-RNTIs configured
* FFS how to handle the fallback operation for the case that PTP retransmission is used for PTM initial transmission.

**Basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs**

**Agreement**

For RRC\_IDLE/INACTIVE UEs, a UE is not required to support reception of FDMed MCCH PDSCH and MTCH PDSCH in PCell.

**Agreement**

For RRC\_IDLE/INACTIVE UEs, a UE is not required to support reception of FDMed multiple MTCH PDSCHs in PCell.

**Agreement**

For RRC\_IDLE/INACTIVE UEs, a UE is not required to support reception of FDMed MCCH/MTCH PDSCH and SIB1 or Paging PDSCH in PCell.

* + FFS: PBCH and other SIBs

**Conclusion**

Additional HARQ process(es) is(are) not introduced for Rel-17 MBS broadcast reception on serving cell.

* + Note: The UE is not expected to support hardware for more HARQ processes for receiving broadcast in Rel-17 in addition to the maximum number of HARQ processes supported for receiving unicast in Rel-16, i.e. the HARQ process resources are shared between broadcast, unicast and multicast

The TP below for Section 5.1.2.1 of TS 38.214v17.0.0 is endorsed.

|  |
| --- |
| 5.1.2.1 Resource allocation in time domain  < Unchanged parts are omitted >  When receiving PDSCH scheduled by DCI format 4\_2 in PDCCH with CRC scrambled by G-RNTI or G-CS-RNTI with NDI=1, if the UE is configured with *pdsch-AggregationFactor* in the *pdsch-Config-Multicast* associated withthe corresponding G-RNTI or in the associated *SPS-Config-Multicast* activated by the DCI format 4\_2 with CRC scrambled by G-CS-RNTI, the same symbol allocation is applied across the *pdsch-AggregationFactor* consecutive slots. When receiving PDSCH scheduled by DCI format 4\_2 for multicast reception in PDCCH with CRC scrambled by G-CS-RNTI with NDI = 0, or PDSCH without corresponding PDCCH transmission using associated [*SPS-Config-Multicast*] and activated by the DCI format 4\_2 in PDCCH with CRC scrambled by G-CS-RNTI, the same symbol allocation is applied across the *pdsch-AggregationFactor*, in associated *SPS-Config-Multicast* if configured, or 1 otherwise, consecutive slots. When receiving PDSCH scheduled by DCI format 4\_0 in PDCCH with CRC scrambled by G-RNTI for MTCH, if the UE is configured with *pdsch-AggregationFactor* in the *pdsch-Config-MTCH*, the same symbol allocation is applied across the *pdsch-AggregationFactor* consecutive slots. |

The TP below for Section 5.1.2.3 of TS 38.214v17.0.0 is endorsed.

|  |
| --- |
| ----------------------------------- **Start of Text proposal to 5.1.2.3 of 38.214** ------------------------------------------------  <Unchanged text omitted>  If a UE is scheduled a PDSCH with DCI format 1\_0 or DCI format 4\_0, the UE shall assume that  is equal to 2 PRBs.  <Unchanged text omitted>  ----------------------------------- **End of Text proposal to 5.1.2.3 of 38.214** ------------------------------------------------ |

The TP below for Section 5.1.3.1 of TS 38.214v17.0.0 is endorsed.

|  |
| --- |
| 5.1.3.1 Modulation order and target code rate determination  < Unchanged parts are omitted >  elseif the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to ‘qam256’, and the PDSCH is scheduled by a PDCCH with DCI format 1\_1 with CRC scrambled by C-RNTI  - the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate ® used in the physical downlink shared channel.  Elseif the higher layer parameter *mcs-Table* given by *PDSCH-Config-Multicast* is set to ‘qam256’, and the PDSCH is scheduled by a PDCCH with DCI format 4\_1 or 4\_2 with CRC scrambled by G-RNTI  - the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate ® used in the physical downlink shared channel.  Elseif the higher layer parameter *mcs-Table* given by *PDSCH-Config-MCCH and PDSCH-Config-MTCH* is set to ‘qam256’, and the PDSCH is scheduled by a PDCCH with DCI format 4\_0 with CRC scrambled by MCCH-RNTI or G-RNTI for MTCH  - the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate ® used in the physical downlink shared channel. |

The TP below for Section 5.1.6.2 of TS 38.214v17.0.0 is endorsed.

|  |
| --- |
| ----------------------------------- **Start of Text proposal to 5.1.6.2 of 38.214** ------------------------------------------------  <Unchanged text omitted>  When receiving PDSCH scheduled by DCI format 1\_0 or DCI format 4\_0 or receiving PDSCH before dedicated higher layer configuration of any of the parameters *dmrs-AdditionalPosition*, *maxLength* and *dmrs-Type,* the UE shall assume that the PDSCH is not present in any symbol carrying DM-RS except for PDSCH with allocation duration of 2 symbols with PDSCH mapping type B (described in clause 7.4.1.1.2 of [4, TS 38.211]), and a single symbol front-loaded DM-RS of configuration type 1 on DM-RS port 1000 is transmitted, and that all the remaining orthogonal antenna ports are not associated with transmission of PDSCH to another UE and in addition  <Unchanged text omitted>  When receiving PDSCH scheduled by DCI format 1\_0 or DCI format 4\_0, the UE shall assume the number of DM-RS CDM groups without data is 1 which corresponds to CDM group 0 for the case of PDSCH with allocation duration of 2 symbols, and the UE shall assume that the number of DM-RS CDM groups without data is 2 which corresponds to CDM group {0,1} for all other cases.  <Unchanged text omitted>  ----------------------------------- **End of Text proposal to 5.1.6.2 of 38.214** ------------------------------------------------ |

The TP below for Section 5.4.2.1 of TS 38.212v17.0.0 is endorsed.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **5.4.2.1 Bit selection**  ---------------------------- Other parts are omitted. ----------------------------  **Table 5.4.2.1-1: Value of**   |  |  | | --- | --- | | Maximum number of PRBs across all configured DL BWPs and UL BWPs of a carrier for DL-SCH and UL-SCH, respectively,  or  Maximum number of PRBs across all CFRs of a carrier for DL-SCH with PDSCH scheduled by DCI format 4\_0/4\_1/4\_2 |  | | Less than 33 | 32 | | 33 to 66 | 66 | | 67 to 107 | 107 | | 108 to 135 | 135 | | 136 to 162 | 162 | | 163 to 217 | 217 | | Larger than 217 | 273 |   ---------------------------- Other parts are omitted. ---------------------------- |

The TP below for Section 5.4.2.1 of TS 38.212v17.0.0 is endorsed.

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| 7.3.1.5.1 Format 4\_0 DCI format 4\_0 is used for the scheduling of PDSCH for broadcast in DL cell.  The following information is transmitted by means of the DCI format 4\_0 with CRC scrambled by MCCH-RNTI or G-RNTI for MTCH configured by *MBS-SessionInfo*:  - Frequency domain resource assignment – bits where equals to  - the size of CORESET 0 if CORESET 0 is configured for the cell; and  - the size of initial DL bandwidth part if CORESET 0 is not configured for the cell.  <Unchanged text omitted> |

**Agreement**

The *dataScramblingIdentityPDSCH-Broadcast, and scramblingID0-Broadcast* can be separately configured for MCCH-RNTI and for each MTCH G-RNTI.

**Agreement**

For broadcast RRC\_IDLE/INACTIVE UEs, *rateMatchPatternToAddModList* can be configured in *PDSCH-Config-MCCH* or *PDSCH-Config-MTCH* for GC-PDSCH rate matching.

* + Whether UE can receive the GC-PDSCH with rate matching based on the *rateMatchPatternToAddModList* is subject to UE capability.
  + Rel-15/16 UE capability of the supported maximum number of RE mapping patterns per symbol and per slot are kept unchanged to support rate matching for unicast/multicast/broadcast. The RateMatchPattern configured for MBS broadcast is counted into the ones that are configured per serving-cell.

**Agreement**

For RRC\_IDLE/INACTIVE UEs, a UE is not required to support reception of FDMed MCCH/MTCH PDSCH and SIB PDSCH in PCell.

**Agreement**

New data indicator is not indicated in DCI format 4\_0 for MCCH

**Agreement**

HARQ process ID is not indicated in DCI format 4\_0 for both MCCH and MTCH.

**Agreement**

New data indicator is not indicated in DCI format 4\_0 for MTCH

The TP below for Section 10 of TS 38.213v17.0.0 is endorsed.

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| **10.1 UE procedure for determining physical downlink control channel assignment**  A set of PDCCH candidates for a UE to monitor is defined in terms of PDCCH search space sets. A search space set can be a CSS set or a USS set. A UE monitors PDCCH candidates in one or more of the following search spaces sets  - a Type0-PDCCH CSS set configured by *pdcch-ConfigSIB1* in *MIB* or by *searchSpaceSIB1* in *PDCCH-ConfigCommon* or by *searchSpaceZero* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a SI-RNTI, or by *searchSpaceZero* in *PDCCH-ConfigCommon* when neither *pdcch-Config-MCCH nor pdcch-Config-MTCH* is not provided, for a DCI format with CRC scrambled by a MCCH-RNTI or a G-RNTI for MTCH, on the primary cell of the MCG  ---------------------------- Other parts are omitted. ---------------------------- |

**Agreement**

* + If the active DL BWP and the common MBS frequency resource for broadcast have same SCS and same CP length and the active DL BWP includes all RBs of the common MBS frequency resource configured for broadcast and if a UE is provided searchSpace for Type0B-PDCCH CSS set, the UE monitors PDCCH for Type0B-PDCCH CSS set on the DL BWP.
    - Note: It is up to the editor how to capture the above.
  + The TP below for section 10.1 of TS 38.213v17.0.0 is endorsed

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| ***----------------------------------------------------Text proposal starts------------------------------------***  10.1 UE procedure for determining physical downlink control channel assignment  < Unchanged parts are omitted >  For a DL BWP, if a UE is not provided *searchSpaceSIB1* for Type0-PDCCH CSS set by *PDCCH-ConfigCommon*, the UE does not monitor PDCCH candidates for a Type0-PDCCH CSS set on the DL BWP. The Type0-PDCCH CSS set is defined by the CCE aggregation levels and the number of PDCCH candidates per CCE aggregation level given in Table 10.1-1. If the active DL BWP and the initial DL BWP have same SCS and same CP length and the active DL BWP includes all RBs of the CORESET with index 0, or the active DL BWP is the initial DL BWP, or the active DL BWP includes all RBs of the common MBS frequency resource configured for broadcast, the CORESET configured for Type0-PDCCH CSS set has CORESET index 0 and the Type0-PDCCH CSS set has search space set index 0.  < Unchanged parts are omitted >  ***----------------------------------------------------Text proposal ends-------------------------------------*** |

The TP below for Section 7.3.1.5 of TS 38.211v17.0.0 is endorsed.

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| **TP-2.11-1 for TS38.211**  **7.3.1.5 Mapping to virtual resource blocks**  The UE shall, for each of the antenna ports used for transmission of the physical channel, assume the block of complex-valued symbols C:\Users\10240317\AppData\Local\Temp\ksohtml7920\wps1.jpg conform to the downlink power allocation specified in [6, TS 38.214] and are mapped in sequence starting with C:\Users\10240317\AppData\Local\Temp\ksohtml7920\wps2.jpg to resource elements C:\Users\10240317\AppData\Local\Temp\ksohtml7920\wps3.jpg in the virtual resource blocks assigned for transmission which meet all of the following criteria:  - they are in the virtual resource blocks assigned for transmission;  - the corresponding physical resource blocks are declared as available for PDSCH according to clause 5.1.4 of [6, TS 38.214];  - the corresponding resource elements in the corresponding physical resource blocks are  - not used for transmission of the associated DM-RS or DM-RS intended for other co-scheduled UEs as described in clause 7.4.1.1.2;  - not used for non-zero-power CSI-RS according to clause 7.4.1.5 if the corresponding physical resource blocks are for a PDSCH scheduled by a PDCCH with the CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI, G-RNTI for multicast, G-CS-RNTI, ~~MCCH-RNTI,~~ or a PDSCH with SPS, except if the non-zero-power CSI-RS is a CSI-RS configured by the higher-layer parameter *CSI-RS-Resource-Mobility* in the *MeasObjectNR* IE or except if the non-zero-power CSI-RS is an aperiodic non-zero-power CSI-RS resource;  - not used for PT-RS according to clause 7.4.1.2;  - not declared as 'not available for PDSCH according to clause 5.1.4 of [6, TS 38.214].  ---------------------------- Other parts are omitted. ---------------------------- |