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

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

**Agenda item:** 8.16.12

**Source:** Moderator (NTT DOCOMO, INC.)

**Title:** [draft]Summary on UE features for NR MBS

**Document for:** Discussion and Decision

# **Introduction**

This document summarizes contributions submitted to AI 8.16.12 regarding UE features for NR MBS and captures the following email discussion.

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| [108-e-R17-UE-features-MBS-01] Email discussion on UE features for NR MBS – Shinya (DOCOMO)* 1st check point: February 25
* Final check point: March 3
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In the Updated RAN1 UE features list for Rel-17 NR after RAN1 #107bis-e [1], there are following feature groups for NR MBS.

* 33-1 Broadcast
* 33-2 Dynamic scheduling for multicast
* 33-2a Support of ACK/NACK based HARQ-ACK feedback and RRC-based enabling/disabling ACK/NACK-based feedback for dynamic scheduling for multicast
* 33-2b DCI-based enabling/disabling ACK/NACK-based feedback for dynamic scheduling for multicast
* 33-2c PTM retransmission for multicast
* 33-2d PTP retransmission for multicast
* 33-2-x Multiple G-RNTIs for group-common PDSCHs
* 33-3-1 Dynamic Slot-level repetition for group-common PDSCH
* 33-3-2 FDM-ed unicast PDSCH and group-common PDSCH
* 33-3-3 Intra-slot TDM-ed unicast PDSCH and group-common PDSCH
* 33-3-4 Mode 1 for type1 codebook generation
* 33-3-5 Feedback multiplexing for unicast PDSCH and group-common PDSCH for multicast with same priority and different codebook type
* 33-4 NACK-only based HARQ-ACK feedback for multicast
* 33-4-1 DCI-based enabling/disabling NACK-only based feedback for dynamic scheduling for multicast
* 33-5-1 SPS group-common PDSCH for multicast
* 33-5-2 Multiple SPS group-common PDSCH configuration
* 33-6-1 DL priority indication for multicast in DCI
* 33-6-2 Two HARQ-ACK codebooks simultaneously constructed for supporting HARQ-ACK codebooks with different priorities for multicast or for unicast and multicast at a UE
* 33-6-3 More than one PUCCH for HARQ-ACK transmission for multicast or for unicast and multicast within a slot
* 33-7 Supporting group-common DCI indicating the enabling/disabling [ACK/NACK based] HARQ-ACK feedback
* 33-9 Supporting unicast PDCCH to release SPS group-common PDSCH

The issues to be discussed are tagged and colour coded with High priority, Medium priority, or Low priority, considering RAN2 impact especially for capability signaling design.

In this round of the discussion, companies are requested to provide comments on the proposals and questions tagged FL1.

# **33-1: Broadcast**

In [1], FG 33-1 is captured as below.

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 33. NR\_MBS | 33-1 | Broadcast | * + - 1. Support of group-common PDCCH/PDSCH with CRC scrambled by MCCH-RNTI.
			2. Support of group-common PDCCH/PDSCH with CRC scrambled by G-RNTI.
			3. Support of CFR configuration for broadcast.
			4. Support of CORESET and common search space for broadcast.
			5. Support of DCI format 1\_0 with CRC scrambled with G-RNTI/MCCH-RNTI for broadcast.
			6. Support of inter-slot TDM between unicast PDSCH and group-common PDSCH in different slots.
			7. Support MCCH change notification indication via DCI.
			8. support of higher layer configured slot-level repetition up to 8 for MTCH
			9. FFS DCI indicated slot-level repetition up to [8 or 16] for MTCH is defined as another FG
 |  | Yes |  |  | Per UE | No | No |  |  | Optional without capability signalling |

Following feedbacks are provided in contributions for the RAN1#108-e meeting.

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| [2] | Huawei, HiSilicon | Since DCI format 4\_0 is defined in TS 38.212 for scheduling broadcast, DCI format 1\_0 in the 3rd component needs to be updated to DCI format 4\_0. MBS broadcast includes MCCH and MTCH, both of which will be scheduled by G-RNTI. The 6th component needs to clarify that group-common PDSCH including MCCH and MTCH will be TDM-ed or either one will be TDM-ed with unicast in different slots. Broadcast reception targets UEs for all RRC states. As commented by some companies, FG33-1 can be reported so that network can at least manipulate the transmissions of MBS broadcast and unicast properly for UE in RRC\_CONNECTED state. From this sense, we can accept this capability reported to network. This report can be per band if per band is preferred from UE perspective. For UE receiving broadcast, RAN1#107bis-e meeting agreed that the rate matching pattern can be configured in *PDSCH-Config-MCCH* or *PDSCH-Config-MTCH* for GC-PDSCH rate matching subject to UE capability as follows:

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| ***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.*
 |

As mandatory for legacy UE supporting unicast, supporting semi-static rate-matching resource set configuration and supporting rate-matching around LTE CRS should be the components of FG33-1.Dynamic slot-level repetition was agreed to be a separate FG for multicast and it should be a separate FG for broadcast so as to keep the commonality of FG33-1 for broadcast and FG33-2 for multicast including the commonality of the maximum number of repetitions supported for multicast and broadcast. It can be merged to FG33-3-1 with FG33-1 as the prerequisite FG as discussed in section 2.4. Overall, the FG33-1 for broadcast can be updated as in the following proposal. ***Proposal 1: Updating FG33-1 as follows in red:***

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-1 | Broadcast | 1. Support of group-common PDCCH/PDSCH with CRC scrambled by MCCH-RNTI.
2. Support of group-common PDCCH/PDSCH with CRC scrambled by G-RNTI.
3. Support of CFR configuration for broadcast.
4. Support of CORESET and common search space for broadcast.
5. Support of DCI format 4\_0 with CRC scrambled with G-RNTI/MCCH-RNTI for broadcast.
6. Support of inter-slot TDM between unicast PDSCH and MCCH group-common PDSCH or MTCH group-common PDSCH, or between MCCH group-common PDSCH and MTCH group-common PDSCH, or among unicast PDSCH and MCCH group-common PDSCH and MTCH group-common PDSCH in different slots.
7. Support MCCH change notification indication via DCI.
8. support of higher layer configured slot-level repetition up to 8 for MTCH.
9. Support of semi-static rate-matching resource set configuration.
10. Support of rate-matching around LTE CRS.

~~FFS DCI indicated slot-level repetition up to [8 or 16] for MTCH is defined as another FG~~ |  | Yes |   |  | ~~Per UE~~Per band | No | No |  |  | Optional ~~without~~ with capability signalling |

 |
| [3] | vivo | For 33-1, higher layer configured slot-level repetition has been agreed for MTCH, and up to 8 repetitions is supported. Considering it is not necessary to support a flexible number of repetitions from 1 to 8 for broadcast, it is better to support fixed values, i.e., {2, 4, 8} times repetitions.Regarding DCI indicated slot-level repetition for MTCH, it should be a separated FG as agreed for multicast for better commonality. Furthermore, multiple G-RNTIs facilitate different services, and thus, support of  G-RNTIs should be included in 33-1. ***Proposal 1*** For higher layer configured slot-level repetition in FG 33-1, UE is mandated to support {2, 4, 8} times repetitions.***Proposal 2*** DCI indicated slot-level repletion is not included in FG33-1.***Proposal 3*** ‘Support of  G-RNTIs’ is included in FG 33-1.

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| --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-1 | Broadcast | 1. Support of group-common PDCCH/PDSCH with CRC scrambled by MCCH-RNTI.
2. Support of group-common PDCCH/PDSCH with CRC scrambled by G-RNTI.
3. Support of CFR configuration for broadcast.
4. Support of CORESET and common search space for broadcast.
5. Support of DCI format 4\_0 with CRC scrambled with G-RNTI/MCCH-RNTI for broadcast.
6. Support of inter-slot TDM between unicast PDSCH and group-common PDSCH in different slots.
7. Support MCCH change notification indication via DCI.
8. Support of higher layer configured slot-level repetition for MTCH：{2,4,8}
9. Support of G-RNTIs for broadcast.

FFS details of N |  | Yes | Optional without capability signalling |

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| [4] | ZTE | Rel-17 is the first release that supports broadcast and multicast for NR. To facilitate the MBS commercial process, it is beneficial to define some basic feature groups for MBS. For now, FG33-1 and FG33-2 can be set as the basic UE feature group for MBS. We can further merge or add more basic functionalities into FG33-1 and FG33-2 if needed.***Proposal 1****: FG 33-1 and FG 33-2 are the basic FG for broadcast and multicast, respectively.*In RAN1#107-e meeting, it has been agreed to have a separate FG for dynamic repetition for multicast, and the maximum value of repetition is 8 or 16. Similar mechanism can be reused for broadcast.

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| **Agreement*** Only the capability for semi-static repetition is included in FG 33-2
	+ For semi-static repetition, UE is mandated to support {2, 4, 8} times repetitions
	+ For dynamic repetition, a separate FG is introduced; UE reports one of the maximum values from {8, 16}
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***Proposal 2****: For broadcast, a separate FG is introduced for dynamic repetition; UE reports one of the maximum values from {8, 16}.*In Rel-15, semi-static RB-level rate-matching is a mandatory FG with capability signalling. It makes sense to include this into FG 33-1 for broadcast.

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|  | 5-26 | Semi-static rate-matching resource set configuration for DL | 1. Bitmap 1/2/3
2. controlResourceSet
 |  | Yes |  | Type 4 | No need | No need |  |  |  |  | Mandatory with capability signaling |

***Proposal 3****: Introduce “Semi-static rate-matching resource set configuration for broadcast” as a component of FG 33-1.* |
| [5] | OPPO | In RAN1#107bis-e meeting, it was agreed that a new component for support of higher layer configured slot-level repetition up to 8 for MTCH is added into FG 33-1. Another issue is left for further discussion on DCI indication of the repetition. Regarding the mechanism of slot-level, it has been merged into FG 33-1 which is considered as optional but basic function for Rel-17 NR MBS, even slot-level repetition is considered only optional in Rel-15/16. Using DCI to indicate the repetition dynamically is considered as flexible than higher layer configured. Furthermore, if DCI indication is split into a separate FG while higher signaling indication is kept into the FG33-1, the DCI indication FG might never be used as an optional and not basic feature. Regarding the repetition number 8 or 16, it is not necessary to restrict the repetition number to 8, while 16 can provide more flexibility by using DCI indication. By considering the DCI format, limiting it to 8 may also result in complicated TDRA table configuration.1. ***“DCI indicated slot-level repetition for MTCH” is kept as one of the components of FG 33-1.***
2. ***The repetition number of DCI indication for MTCH is up to 16.***

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| 33. NR\_MBS | 33-1 | Broadcast | 1. Support of group-common PDCCH/PDSCH with CRC scrambled by MCCH-RNTI.
2. Support of group-common PDCCH/PDSCH with CRC scrambled by G-RNTI.
3. Support of CFR configuration for broadcast.
4. Support of CORESET and common search space for broadcast.
5. Support of DCI format 1\_0 with CRC scrambled with G-RNTI/MCCH-RNTI for broadcast.
6. Support of inter-slot TDM between unicast PDSCH and group-common PDSCH in different slots.
7. Support MCCH change notification indication via DCI.
8. support of higher layer configured slot-level repetition up to 8 for MTCH
9. DCI indicated slot-level repetition up to 16 for MTCH.
 |  | Yes |  |  | Per UE | No | No |  |  | Optional without capability signalling |

According to the discussion in last meeting, one question is that whether 33-1 FG Broadcast is a basic FG for NR MBS. According to previous UE feature discussion, basic FG means broadcast itself is supported as an optional function group, UE has to indicate that this FG is supported when the UE supports NR MBS. From our understanding, UEs are required to receive system information in a cell through broadcast, but receiving NR MBS services through broadcast is not mandatory. On the other hand, some UE may not be able to connect to cellular network, and receiving NR MBS services through broadcast is the only method if it is interested for MBS reception. Furthermore, MBS services through broadcast transmission can also be received by RRC\_CONNETED UEs, so the design and component should consider all the UEs in different RRC states. Compared with other FGs in NR MBS, broadcast reception for UEs is more general and basic. Therefore, FG 33-1 is supported as a basic FG for Rel-17 NR MBS.1. ***FG 33-1 is supported as a basic FG for Rel-17 NR MBS broadcast.***

For capability signaling, it is not necessary for a UE to send capability signaling to inform network. First, the use case and motivation for reporting this capability by UE is not clear. Furthermore, for the transmission type of broadcast, there is no target UEs, in other word, any UE can be the target. There is no need for network to know which UE has this kind of capability, which seems useless for network.1. ***The capability signaling is not necessary for UEs supporting MBS broadcast in FG 33-1.***
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| [6] | Nokia, NSB | * **33-1:**
	+ Confirm it is per UE. Further discussion needed on whether there is a need for FR1/FR2 differentiation
	+ Optional with capability signalling. The network needs to know if any UE supports the feature. Alternatively, it can be left for RAN2 to decide on this aspect, as currently done for some UE power saving features (e.g. FG 29-1).
	+ Since this is a broadcast feature, it is preferred to have the DCI indicated slot-level repetition up to [8 or 16] for MTCH as a component to this FG, rather than a separate one.
	+ Per UE
 |
| [7] | NTT DOCOMO | At the last meeting, it was discussed whether to separate support of dynamic slot-level repetition for broadcast MTCH from FG 33-1. Broadcasts can be received by UEs in all RRC states. Since gNB cannot know the capabilities of RRC\_IDLE UEs, gNB will not be able to use dynamic slot-level repetition unless it is included in the basic FG. Therefore, we prefer to keep support of dynamic slot-level repetition in FG 33-1. FG 33-1 is basic operations for broadcast reception. So we support to make FG33-1 as a basic FG. We don’t really see the need for capability signalling. Because it is one thing to say that a UE has the capability to receive broadcast and another to say that the UE actually receives broadcast. We doubt that capability signalling is useful for PDSCH scheduling. ***Proposal 1: Support of dynamic slot-level repetition for broadcast MTCH is kept in FG 33-1.*** ***Proposal 2: FG 33-1 is supported as a basic FG for MBS.******Proposal 3: The capability signalling is not necessary for FG 33-1.*** |
| [8] | Intel | * FG 33-1
	+ Support of DCI indicated slot level repetition can be separated into a dependent FG 33-1a

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| 33. NR\_MBS | 33-1 | Broadcast | 1. Support of group-common PDCCH/PDSCH with CRC scrambled by MCCH-RNTI.
2. Support of group-common PDCCH/PDSCH with CRC scrambled by G-RNTI.
3. Support of CFR configuration for broadcast.
4. Support of CORESET and common search space for broadcast.
5. Support of DCI format 1\_0 with CRC scrambled with G-RNTI/MCCH-RNTI for broadcast.
6. Support of inter-slot TDM between unicast PDSCH and group-common PDSCH in different slots.
7. Support MCCH change notification indication via DCI.
8. support of higher layer configured slot-level repetition up to 8 for MTCH

~~FFS DCI indicated slot-level repetition up to [8 or 16] for MTCH is defined as another FG~~ |  |
|  33. NR\_MBS | 33-1a | Dynamic repetition indication for broadcast | 1. Support DCI indicated slot-level repetition up to [8 or 16] for MTCH
 | 33-1 |

 |
| [9] | Apple | Regarding the MTCH repetition indicated by dynamic signalling, the repetition number can be following legacy release design, i.e., maximum 16 repetition indicated by *repetitionNumber* in TDRA table. This number is aligned with RRC parameter clarification made in main session. But considering the agreements for multicast PDSCH repetition, the 8 repetitions is acceptable for MTCH PDSCH repetition.Regarding whether DCI indicated repetition is a separated FG or not, the repetition design principle is the same for multicast and broadcast. From implementation perspective, the difference between multicast PDSCH repetition and MTCH PDSCH repetition is minor. It’s preferred to have the same handling for DCI indicated slot-level repetition for broadcast and multicast. The multicast repetition agreements were showing below table.

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| **Agreement**[2]* Only the capability for semi-static repetition is included in FG 33-2
	+ For semi-static repetition, UE is mandated to support {2, 4, 8} times repetitions
	+ For dynamic repetition, a separate FG is introduced; UE reports one of the maximum values from {8, 16}
 |

**Proposal 1: It’s preferred to have the same handling for DCI indicated slot-level repetition for broadcast and multicast.** |
| [10] | Spreadtrum Communications | In latest 38.212 spec [2], DCI format for broadcast has been captured as DCI format 4\_0, and DCI format for multicast has been captured as DCI format 4\_1 and DCI format 4\_2. In order to align with the current spec, we have the following proposal:***Proposal 1***: Revise DCI format to align with 38.212,* In component 5 of FG 33-1, DCI format 1\_0 is adjusted as DCI format 4\_0;

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| 33. NR\_MBS | 33-1 | Broadcast | 1. Support of group-common PDCCH/PDSCH with CRC scrambled by MCCH-RNTI.
2. Support of group-common PDCCH/PDSCH with CRC scrambled by G-RNTI.
3. Support of CFR configuration for broadcast.
4. Support of CORESET and common search space for broadcast.
5. Support of DCI format 4\_0 with CRC scrambled with G-RNTI/MCCH-RNTI for broadcast.
6. Support of inter-slot TDM between unicast PDSCH and group-common PDSCH in different slots.
7. Support MCCH change notification indication via DCI.
8. support of higher layer configured slot-level repetition up to 8 for MTCH

FFS DCI indicated slot-level repetition up to [8 or 16] for MTCH is defined as another FG |  | Yes |  |  | Per UE | No | No |  |  | Optional without capability signalling |

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| [11] | CMCC | The most fundamental question is whether the FG 33-1 is a basic FG for MBS. Considering to proceed the commercial deployment of MR MBS and reduce the market fragmentation, especially considering there are much different capabilities in Rel-17 NR MBS, e.g., DCI based HARQ-ACK enable/disable, insertion type-1 codebook for multicast, we think it is necessary to define the basic FG both for broadcast and multicast.**Proposal 1. FG 33-1 is supported as a basic FG for MBS.**Another remaining issue is capability signaling of FG 33-1. Considering this feature is applied for three RRC states and RRC\_IDLE/IANCTIVE UEs can not report UE capability, we think the FG 33-1 should be optional without capability signaling.**Proposal 2. The signaling of FG 33-1 should be optional without capability signaling.**In last RAN1 meeting, RRC based slot-level repetition for MTCH has been merged into FG 33-1, one FFS is whether DCI indicated slot-level repetition is a separate FG or not.**Agreement*** A new component for support of higher layer configured slot-level repetition up to 8 for MTCH is added into FG 33-1
	+ FFS DCI indicated slot-level repetition up to [8 or 16] for MTCH is defined as another FG

We support both RRC based and DCI based slot-level repetition to be merged into FG 33-1, considering there is no significant technical difference between RRC based and DCI based slot-level repetition. In addition, If DCI based slot-level PDSCH repetition is a separate FG, gNB will never use it since gNB doesn’t know the UE capability which is harmful to broadcast MTCH transmission.**Proposal 3. DCI indicated slot-level repetition for MTCH is defined as a component in FG 33-1.** |
| [12] | Xiaomi | Considering it has been agreed that dynamic PDSCH repetition is a separate feature group from FG 33-2, the same mechanism can also be applied to FG 33-1. That is DCI indicated slot level repetition can be a separate UE group for broadcast PDSCH. Furthermore, we think the maximum number of 8 is sufficient for dynamic broadcast PDSCH repetition.**Proposal 1: DCI indicated slot-level repetition up to 8 for MTCH is defined as a separate FG.** |
| [13] | Samsung | For FG 33-1, this feature should be optional. Instead, it is proposed to note that this is a basic FG for MBS. If this is Optional without capability signaling, then “need for the gNB to know” should be no. Also, for the component 5, the DCI format should be 4\_0.

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| Features | Index | Feature group | Components | Mandatory/Optional |
| 33. NR\_MBS | 33-1 | Broadcast | 1. Support of group-common PDCCH/PDSCH with CRC scrambled by MCCH-RNTI.
2. Support of group-common PDCCH/PDSCH with CRC scrambled by G-RNTI.
3. Support of CFR configuration for broadcast.
4. Support of CORESET and common search space for broadcast.
5. Support of DCI format 4\_0 with CRC scrambled with G-RNTI/MCCH-RNTI for broadcast.
6. Support of inter-slot TDM between unicast PDSCH and group-common PDSCH in different slots.
7. Support MCCH change notification indication via DCI.
8. support of higher layer configured slot-level repetition up to 8 for MTCH
9. FFS DCI indicated slot-level repetition up to [8 or 16] for MTCH is defined as another FG
 | Optional ~~without capability signalling~~This is a basic FG for MBS. |

 |
| [14] | MediaTek | In the latest approved TS 38.212 spec, the three DCI formats were defined for MBS broadcast and multicast that DCI format 4\_0, DCI format 4\_1, and DCI format 4\_2 correspond to broadcast DCI format, multicast first DCI format and multicast second DCI format, respectively. In order to align the MBS DCI format naming, we suggest the following proposal:*Proposal 1: The MBS multicast broadcast DCI format naming in UE feature discussion should be aligned with that of latest approved TS 38.212 spec, i.e., MBS broadcast and multicast DCI format 4\_0, DCI format 4\_1, and DCI format 4\_2 correspond to broadcast DCI format, multicast first DCI format and multicast second DCI format, respectively.*Considering the concept of group-common PDCCH/PDSCH is used for broadcast and multicast and it only state “group-common PDCCH/PDSCH” in some FG, it may cause some reader confused, e.g., which means for broadcast or multicast? Therefore, we want to clarify the concept more clearly with some constrains, e.g., group-common PDCCH/PDSCH for multicast or broadcast, respectively.*Proposal 2: Clarify the wording of group-common PDCCH/PDSCH more clearly for broadcast and multicast respectively, e.g., group-common PDCCH/PDSCH for multicast or broadcast.*Regarding the discussion of which granularity type definition should be defined for MBS UE feature, from our view, the different carriers within the same band will have different characteristics or usage purpose, especially for considering the band n28 is a shared band by operators. What’s more, considering the IODT testing cost, we prefer the type definition for MBS UE features should be based on the granularity per FSPC.*Proposal 3: The type definition for MBS UE features should be based on the granularity per FSPC.*Regarding the number of MCCH-RNTI and G-RNTI for broadcast, there has not been discussed for now and need to make it clearer. For the MCCH-RNTI, we think only one MCCH-RNTI is sufficient for UE obtaining the MBS control information as similar with the legacy LTE SC-PTM mechanism. For the G-RNTI issue, RAN2 has achieved an agreement that “**one-to-many mapping between G-RNTI and MBS sessions is supported**” in previous meeting, which means the multiple services if existed can use only for G-RNTI for services reception. In addition, MBS UE has introduced the multiple RNTIs for MBS feature (e.g., multiple multicast G-RNTIs/G-CS-RNTIs, broadcast MCCH-RNTI) however, a total number RNTI supported by UE is limited. Considering the above reason and broadcast is a best-effort reception, we suggest only one G-RNTI is supported for broadcast reception.***Proposal 4: For FG 33-1, adding a note that “For component 1,*** ***only one MCCH-RNTI is supported for broadcast”.******Proposal 5: For FG 33-1, adding a note that “For component 2, only one G-RNTI is supported for broadcast”.***Regarding the CFR number for broadcast reception, it is no clear motivation to support multiple CFR. We had agreed that the number of CFRs for multicast is no more than one, and the corresponding agreement is copied as following. We suggest the similar mechanism can be reused for broadcast reception since we also have agreed that the CFR frequency for MCCH and MTCH can be configured by SIBx.

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| Agreement:The number of CFRs for multicast is no more than one per dedicated unicast BWP in Rel-17.AgreementFor broadcast reception with RRC\_IDLE/RRC\_INACTIVE UEs:* The CFR frequency resources used for MCCH and MTCH are configured by SIBx;
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***Proposal 6: For FG 33-1, adding a note that “******For component 3, only one CFR frequency resource is supported for broadcast and the CFR frequency resource is configured by SIBx”.***Regarding slot-level repetition for MTCH, the following agreement was achieved in last meeting:

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| **Agreement**: A new component for support of higher layer configured slot-level repetition up to 8 for MTCH is added into FG 33-1* + FFS DCI indicated slot-level repetition up to [8 or 16] for MTCH is defined as another FG
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Since the semi-static slot-level repetition added into FG33-1 has been agreed, the reliability concern for MTCH has been resolved. Besides, considering the dynamic slot-level indication was introduced in Rel-16 as a separate FG and it also has been agreed for multicast as a separate FG, we suggest the following mechanism can be reused for broadcast.***Proposal 7: Adding a new separate FG 33-1-1 to capture the dynamic slot-level repetition for broadcast MTCH.***

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| 33-1 | Broadcast | 1. Support of group-common PDCCH/PDSCH for broadcast with CRC scrambled by MCCH-RNTI.
2. Support of group-common PDCCH/PDSCH for broadcast with CRC scrambled by G-RNTI.
3. Support of CFR configuration for broadcast.
4. Support of CORESET and common search space for broadcast.
5. Support of DCI format ~~1\_0~~ 4\_0 with CRC scrambled with G-RNTI/MCCH-RNTI for broadcast.
6. Support of inter-slot TDM between unicast PDSCH and group-common PDSCH for broadcast in different slots.
7. Support MCCH change notification indication via DCI.
8. support of higher layer configured slot-level repetition up to 8 for MTCH

~~FFS DCI indicated slot-level repetition up to [8 or 16] for MTCH is defined as another FG~~ |  | Yes |  |  | ~~Per UE~~Per FSPC | No | No |  | For component 1, only one MCCH-RNTI is supported for broadcastFor component 2, only one G-RNTI is supported for broadcastFor component 3, only one CFR frequency resource is supported for broadcast and the CFR frequency resource is configured by SIBx | Optional without capability signalling |
| 33-1-1 | Dynamic slot-level repetition for broadcast MTCH | 1. Support up to X times dynamic slot-level repetition for broadcast MTCH.
 | 33-1 |  |  |  | Per FSPC |  |  |  | Candidate values for X is: {8, 16} | Optional with capability signalling |

 |
| [15] | Qualcomm | Based on the agreement, we suggest the changes on FG 33-1 as:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-1 | Broadcast | 1. Support of group-common PDCCH/PDSCH with CRC scrambled by MCCH-RNTI.
2. Support of group-common PDCCH/PDSCH with CRC scrambled by G-RNTI(s) for MTCH.
3. Support of CFR configuration for broadcast.
4. Support of CORESET and common search space in a CFR for broadcast.
5. Support of DCI format 4\_0 with CRC scrambled with G-RNTI/MCCH-RNTI for broadcast.
6. Support of inter-slot TDM between other PDSCH and group-common PDSCH for broadcast in different slots.
7. Support MCCH change notification indication via DCI.
8. Support of higher-layer configured slot-level repetition for group-common PDSCH for MTCH
9. FFS: Support of TRS for GC-PDCCH/PDSCH configured in a CFR for broadcast
 |  | Yes |  |  | Per Band | N/A | N/A |  | Max value for higher layer configured slot-level repetition = 8 | Optional without capability signalling |
| 33. NR\_MBS | 33-1a | Dynamic slot-level repetition for Broadcast | Support of DCI-indincated slot-level repetition for group-common PDSCH for MTCH | 33-1 | Yes |  |  | Per Band | N/A | N/A |  | Max value for DCI-indicated slot-level repetition = {8, 16} | Optional without capability signalling |

 |
| [16] | Ericsson | In our view, the use of DCI-based repetition could be a separate feature group. However, we note that any capabilities beyond 33-1 are subject to signalling from UEs in broadcast. This means that for such capability to be exploited by the gNB, all UEs in broadcast must first have been at least once in RRC\_CONNECTED state and connected to the network to report capability.  |

## **Discussion**

**[FL1] High priority question 2-1:**

* **Companies are encouraged to provide views on whether to separate the capability for support of dynamic slot-level repetition for MTCH from FG 33-1.**
	+ Keep in FG 33-1: OPPO, Nokia, NSB, NTT DOCOMO, CMCC
	+ Separate FG: vivo, ZTE, Intel, Apple, Xiaomi, MediaTek, Qualcomm, Ericsson

|  |  |
| --- | --- |
| Company | Comment |
| Spreadtrum | Support separated FG, and it keep alignment with multicast. |
|  |  |
|  |  |

**[FL1] Medium priority proposal 2-2:**

* **Companies are encouraged to provide views on maximum number of dynamic slot-level repetitions.**
	+ Up to 16: ZTE, OPPO, Intel, Apple, MediaTek, Qualcomm
	+ Up to 8: Xiaomi

|  |  |
| --- | --- |
| Company | Comment |
|  |  |
|  |  |
|  |  |

**[FL1] Medium priority proposal 2-3:**

* **Companies are encouraged to provide views on whether to add following components in FG 33-1.**
	+ **Support of semi-static rate-matching resource set configuration.**
		- Support: Huawei, ZTE
	+ **Support of rate-matching around LTE CRS.**
		- Support: Huawei
	+ **Support of**  **G-RNTIs.**
		- Support: vivo

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | Based on RAN1 agreement, ***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.*

We agree to define a UE capability but not sure whether it could be a separate FG or not. Considering the limited number of RM patterns for unicast/multicast/broadcast, a UE may not be able to support RM patterns for broadcast.  |
|  |  |
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**[FL1] Medium priority proposal 2-4:**

* **FG 33-1 is supported as a basic FG for MBS**
	+ Support: ZTE, OPPO, NTT DOCOMO, CMCC, Samsung,

|  |  |
| --- | --- |
| Company | Comment |
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**[FL1] Medium priority question 2-5:**

* **Companies are encouraged to provide views on** **whether capability signalling is necessary for FG 33-1, i.e., whether to support as optional with capability signalling or optional without capability ignalling**
	+ Optional with capability signalling: Huawei, HiSilicon, Nokia, NSB
	+ Optional without capability signalling: OPPO, NTT DOCOMO, CMCC
	+ Optional: Samsung

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | We prefer optional without capability signaling |
|  |  |
|  |  |

**[FL1] Medium priority question 2-6:**

* **Companies are encouraged to provide views on whether the type of FG 33-1 should be per UE, per band or per FSPC**
	+ Per UE: Nokia, NSB, OPPO, Spreadtrum Communications
	+ Per band: Huawei, HiSilicon, Qualcomm
	+ Per FSPC: MediaTek

|  |  |
| --- | --- |
| Company | Comment |
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|  |  |

**Low priority proposal 2-7:**

* **Components of FG 33-1 is revised as**
	+ **Component 1: Support of group-common PDCCH/PDSCH for broadcast with CRC scrambled by MCCH-RNTI.**
	+ **Component 2: Support of group-common PDCCH/PDSCH for broadcast with CRC scrambled by G-RNTI(s) for MTCH.**
	+ **Component 4: Support of CORESET and common search space in a CFR for broadcast.**
	+ **Component 5: Support of DCI format 4\_0 with CRC scrambled with G-RNTI/MCCH-RNTI for broadcast.**
	+ **Component 6: 6. Support of inter-slot TDM between unicast PDSCH and MCCH group-common PDSCH or MTCH group-common PDSCH, or between MCCH group-common PDSCH and MTCH group-common PDSCH, or among unicast PDSCH and MCCH group-common PDSCH and MTCH group-common PDSCH in different slots.**
	+ **Add a note that “For component 1, only one MCCH-RNTI is supported for broadcast”.**
	+ **Add a note that “For component 2, only one G-RNTI is supported for broadcast”.**
	+ **Add a note that “For component 3, only one CFR frequency resource is supported for broadcast and the CFR frequency resource is configured by SIBx”.**

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| Company | Comment |
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**Low priority question 2-8:**

* **Companies are encouraged to provide views on whether/how to revise any other contents in FG 33-1 which do not have capability signalling impacts**

|  |  |
| --- | --- |
| Company | Comment |
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# **33-2 to 33-2-x: Dynamic scheduling for multicast**

In [1], FGs 33-2 to 33-2-x are captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between Ues (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
|  33. NR\_MBS | 33-2 | Dynamic scheduling for multicast | 1. Support of group-common PDCCH/PDSCH with CRC scrambled by G-RNTI.
2. Support of CFR configuration for multicast.
3. Support of CORESET and common search space configuration for multicast.
4. Support of DCI format 1\_0 / 1\_1 with CRC scrambled with G-RNTI for multicast.
5. Support of inter-slot TDM between unicast PDSCH and group-common PDSCH in different slots.
6. Support {2, 4, 8} times semi-static slot-level repetition for group-common PDSCH for multicast

FFS whether to separate the capability for support of DCI format 1\_1 with CRC scrambled with G-RNTI for multicast |  | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-2a | Support of ACK/NACK based HARQ-ACK feedback and RRC-based enabling/disabling ACK/NACK-based feedback for dynamic scheduling for multicast | Support of ACK/NACK based HARQ-ACK feedback, and support of enabling/disabling ACK/NACK based HARQ-ACK feedback configured by RRC signallingAt least 33-2c or 33-2d is merged, FFS which one or both | 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-2b | DCI-based enabling/disabling ACK/NACK-based feedback for dynamic scheduling for multicast | Support of DCI-based enabling/disabling ACK/NACK based HARQ-ACK feedback configured per G-RNTI by RRC signaling | 33-2a | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-2c | PTM retransmission for multicast | Support of PTM retransmission for multicastFFS whether to merge with 33-2a | 33-2a | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-2d | PTP retransmission for multicast | Support of PTP retransmission for multicastFFS whether to merge with 33-2a | 33-2a | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-2-x | Multiple G-RNTIs for group-common PDSCHs | Capability on number of G-RNTI for groupcastFFS details. | 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |

Following feedbacks are provided in contributions for the RAN1#108-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [2] | Huawei, HiSilicon | Since components for FG33-1 for broadcast and components for FG33-2 for multicast are converging to be common, DCI format 4\_2 for scheduling multicast can be a separate FG (as FG33-2-1) from FG33-2 for facilitating UE implementation and early commercialization. The UE capability for multicast and broadcast is preferred to be separate although the basic feature sets for them are strived to be common. When considering UE capability for supporting both multicast and broadcast, it would be preferred to describe it in FG for multicast instead of defining additional FG for supporting both. For example, for the 5th component of inter-slot TDM between unicast PDSCH and group-common PDSCH in different slots where the group-common PDSCH is intended for multicast, it could be updated to consider broadcast group-common PDSCH as well if UE supports FG33-1. In addition, RAN2 has agreed that separate UE capabilities for MBS multicast and broadcast are used [2], so supporting FG33-2 for multicast does not need the support of FG33-1 for broadcast as the prerequisite FG. If merging one retransmission scheme into FG33-2a about support of ACK/NACK based feedback, from UE point of view, PTM retransmission is preferred because of the commonality to the PTM intimal transmission and PTP retransmission is preferred to be a separate FG. With PTM retransmission merged into FG33-2a, FG33-2c can be deleted. In addition, the report can be per FSBC. ***Proposal 2: Updating FG33-2, FG33-2a, FG33-2d, deleting FG33-2c, and adding FG33-2-1 as follows in red:***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-2 | Dynamic scheduling for multicast | 1. Support of group-common PDCCH/PDSCH with CRC scrambled by G-RNTI.
2. Support of CFR configuration for multicast.
3. Support of CORESET and common search space configuration for multicast.
4. Support of DCI format 4\_1 with CRC scrambled with G-RNTI for multicast.
5. Support of inter-slot TDM between unicast PDSCH and group-common PDSCH for multicast, or between group-common PDSCH for multicast and group-common PDSCH for broadcast (if UE supports FG33-1), or among unicast PDSCH and group-common PDSCH for multicast and group-common PDSCH for broadcast (if UE supports FG33-1) in different slots.
6. Support {2, 4, 8} times semi-static slot-level repetition for group-common PDSCH for multicast

~~FFS whether to separate the capability for support of DCI format 1\_1 with CRC scrambled with G-RNTI for multicast~~ |  | Yes |  |  | ~~Per UE~~Per FSBC | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-2-1 | Dynamic scheduling for multicast by DCI format 4\_2 | 1. Support of DCI format 4\_2 with CRC scrambled with G-RNTI for multicast.
 | 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signaling |
| 33. NR\_MBS | 33-2a | Support of ACK/NACK based HARQ-ACK feedback and RRC-based enabling/disabling ACK/NACK-based feedback for dynamic scheduling for multicast | 1. Support of ACK/NACK based HARQ-ACK feedback, and support of enabling/disabling ACK/NACK based HARQ-ACK feedback configured by RRC signalling.
2. Support of PTM retransmission for multicast.

~~At least 33-2c or 33-2d is merged, FFS which one or both~~ | 33-2 or 33-2-1 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-2b | DCI-based enabling/disabling ACK/NACK-based feedback for dynamic scheduling for multicast | Support of DCI-based enabling/disabling ACK/NACK based HARQ-ACK feedback configured per G-RNTI by RRC signaling | 33-2a | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| ~~33. NR\_MBS~~ | ~~33-2c~~ | ~~PTM retransmission for multicast~~ | ~~Support of PTM retransmission for multicast~~~~FFS whether to merge with 33-2a~~ | ~~33-2a~~ | ~~Yes~~ |  |  | ~~Per UE~~ | ~~No~~ | ~~No~~ |  |  | ~~Optional with capability signalling~~ |
| 33. NR\_MBS | 33-2d | PTP retransmission for multicast | Support of PTP retransmission for multicast~~FFS whether to merge with 33-2a~~ | 33-2a | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |

RAN2 has agreed to define UE capability for the number of simultaneous G-RNTIs / G-CS-RNTIs reception for multicast [2] and companies were invited to provide the views on the actual maximum number of G-RNTIs/G-CS-RNTIs (or their combination) for UE to simultenously monitor, for which RAN2 discussions seem to leave it to RAN1 [3]. Besides the capability of the maximum number of G-RNTIs supported for dynamic multicast scheduling, if UE supports multicast SPS, UE also needs to report the maximum number of G-CS-RNTIs supported. Since usually dynamic scheduling and SPS scheduling are separated UE capabilities. The maximum number of G-RNTIs and G-CS-RNTIs can be reported separately as well. FG33-2-x1 is added for the report of G-CS-RNTIs. FG33-2-x is currently worded for the number of supported G-RNTIs for multicast. In light of *avoiding device hardware impact* to facilitate implementation and deployment of the feature, receiving multicast and broadcast may take the resources built for unicast from UE implementation perspective without changing the existing hardware, e.g., the maximum number of RNTIs UE supports that was dimensioned for unicast will be shared with multicast as well when to support MBS multicast. Therefore, in addition to the value of the maximum number of G-RNTIs/G-CS-RNTIs supported for multicast in FG33-2-x/FG33-2-x1, UE reporting the total number of all RNTIs (e.g., as introduced in FG33-2-x2) that UE can support can also help network schedule unicast properly. There are two alternative that can be considered as following proposal:***Proposal 3: Consider the following two alternatives to modify the FG33-2-x:**** ***Alt1: Updating FG33-2-x and adding FG33-2-x1 and FG33-2-x2 as follows in red:***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-2-x | Multiple G-RNTIs for dynamic group-common PDSCHs | The maximum number of G-RNTIs supported for multicast dynamic scheduling.~~FFS details.~~ | 33-2 | Yes |  |  | Per UE | No | No |  | Candidate values for X is: {1, 2, 3, 4} | Optional with capability signalling |
| 33. NR\_MBS | 33-2-x1 | Multiple G-CS-RNTIs for SPS group-common PDSCHs | The maximum number of G-CS-RNTIs supported for multicast SPS scheduling. | 33-2 | Yes |  |  | Per UE | No | No |  | Candidate values for X is: {1, 2, 3, 4} | Optional with capability signalling |
| 33. NR\_MBS | 33-2-x2 | Total number of RNTIs | The maximum number of all RNTIs UE can support. |  | Yes |  |  | Per UE | No | No |  | Candidate values for X is: {16, 32} | Optional with capability signalling |

* ***Alt2: Updating FG33-2-x and adding FG33-2-x1 as follows in red:***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-2-x | Multiple G-RNTIs for group-common PDSCHs | 1. The maximum number of G-RNTIs supported for multicast.
2. Indication of whether the maximum number of G-RNTIs supported for multicast is to be added to the maximum number of supported RNTIs without multicast operation, or to be subtracted from the maximum number of supported RNTIs without multicast operation.
 | 33-2 | Yes |  |  | Per UE | No | No |  | For component 1：Candidate values for X is: {1, 2, 3, 4}For component 2: candidate value is {added, subtracted} | Optional with capability signalling |
| 33. NR\_MBS | 33-2-x1 | Multiple G-CS-RNTIs for SPS group-common PDSCHs | 1. The maximum number of G-CS-RNTIs supported for multicast SPS scheduling.
2. Indication of whether the maximum number of G-CS-RNTIs supported for multicast is to be added to the maximum number of supported RNTIs without multicast operation, or to be subtracted from the maximum number of supported RNTIs without multicast operation.
 | 33-2 | Yes |  |  | Per UE | No | No |  | For component 1：Candidate values for X is: {1, 2, 3, 4}For component 2: candidate value is {added, subtracted} | Optional with capability signalling |

 |
| [3] | vivo | It has been agreed that components 6/7/8 are separated from 33-2 and added as new FGs by leaving how to merge PTM and/or PTP retransmission to HAR-ACK feedback as FFS. Considering there exists ambiguity between unicast re-transmission and PTP retransmission for multicast when the same HPID is used, it is better to merge PTM retransmission only to HARQ-ACK feedback, but leave PTP retransmission as a separate UE capability.***Proposal 4*** Support to merge 33-2c to 33-a.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-2a | Support of ACK/NACK based HARQ-ACK feedback andRRC-based enabling/disabling ACK/NACK-based feedback for dynamic scheduling for multicast | 1. Support of ACK/NACK based HARQ-ACK feedback, and support of enabling/disabling ACK/NACK based HARQ-ACK feedback configured by RRC signalling.
2. Support of PTM retransmission for multicast
 | 33-2 | Yes |  |  | Per UE | No | No |
|  |  |  |  |  |  |  |  |  |  |  |
| 33. NR\_MBS | 33-2d | PTP retransmission for multicast | Support of PTP retransmission for multicast~~FFS whether to merge with 33-2a~~ | 33-2a | Yes |  |  | Per UE | No | No |

In RAN 1 #107bis meeting, it has been agreed that support of MCS/NDI/RV for TB2 is subject to UE capability, and thus, an FG can be added to reflect this.***Proposal 6*** Add an FG for support of MCS/NDI/RV for TB2.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-3-2e | Support two TBs for multicast | 1. Support of MCS/NDI/RV for TB2
 | 33-2  | Yes | Optional with capability signalling |

 |
| [4] | ZTE | Rel-17 is the first release that supports broadcast and multicast for NR. To facilitate the MBS commercial process, it is beneficial to define some basic feature groups for MBS. For now, FG33-1 and FG33-2 can be set as the basic UE feature group for MBS. We can further merge or add more basic functionalities into FG33-1 and FG33-2 if needed.***Proposal 1****: FG 33-1 and FG 33-2 are the basic FG for broadcast and multicast, respectively.*FG 33-2a is expected to be the basic FG for multicast feedback. From our perspective, we have the following proposal for FG 33-2a. It is beneficial to merge at least the PTM retransmission with FG 33-2a to avoid the situation when UE only supports UL feedback but doesn’t support retransmission. Furthermore, separate PUCCH-Config configuration for multicast should also be included in FG 33-2a as it is an essential component for UL feedback. There are two types of codebook for ACK/NACK based HARQ-ACK feedback for multicast, i.e., type-1 and type-2 HARQ-ACK codebook. At least one of them should be merged in FG 33-2a. Otherwise, if different UEs supporting different type of codebooks, it would be difficult for network to group them together. From our perspective, type-2 codebook can be merged with FG 33-2a.***Proposal 4****: Add the following components for FG 33-2a.*

|  |  |  |
| --- | --- | --- |
| 33-2a | Support of ACK/NACK based HARQ-ACK feedback ~~and RRC-based enabling/disabling ACK/NACK-based feedback for dynamic scheduling for multicast~~ | 1. Support of ACK/NACK based HARQ-ACK feedback, and support of enabling/disabling ACK/NACK based HARQ-ACK feedback configured by RRC signallingAt least 33-2c or 33-2d is merged, FFS which one or both2. Support of PTM retransmission for multicast3. Support of a PUCCH-Config for multicast ACK/NACK-based HARQ-ACK feedback, separate from that of unicast configurations4. Support of Type-2 HARQ-ACK codebook for multicast |

 |
| [5] | OPPO | In FG 33-2, one legacy issue for further discussion is whether to separate the capability for support of DCI format 4\_2 for multicast. With the agreement by now, DCI format 4\_1 in component 4 in FG 33-2, which is considered as sufficient for dynamic scheduling for multicast as the basic feature. DCI format 4\_2 can be separated from FG 33-2.1. ***For FG 33-2, support to separate the capability of DCI format 4\_2 with CRC scrambled with G-RNTI for multicast.***

In FG 33-2a, one legacy issue is which one of 33-2c and 33-2d is merged into 33-2a. For 33-2a, it is to support ACK/NACK based feedback and RRC signaling based enabling/disabling ACK/NACK feedback, therefore one type of retransmission scheme, either PTM or PTP, should be supported when HARQ-ACK feedback is supported. PTP retransmission for multicast for ACK/NACK based feedback is needed because the ACK/NACK feedbacks can be differentiated per UE through UL resources. PTM retransmission scheme for ACK/NACK based feedback can be then separated as in 33-2c.1. ***“Support 33-2d PTP retransmission for multicast” can be merged into FG 33-2a together with ACK/NACK based feedback for dynamic scheduling for multicast.***
2. ***“Support PTM retransmission for multicast” can be separated from FG 33-2a and kept in 33-2c.***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-2 | Dynamic scheduling for multicast | 1. Support of group-common PDCCH/PDSCH with CRC scrambled by G-RNTI.
2. Support of CFR configuration for multicast.
3. Support of CORESET and common search space configuration for multicast.
4. Support of DCI format 4\_1 ~~1\_0 / 1\_1~~ with CRC scrambled with G-RNTI for multicast.
5. Support of inter-slot TDM between unicast PDSCH and group-common PDSCH in different slots.
6. Support {2, 4, 8} times semi-static slot-level repetition for group-common PDSCH for multicast

~~FFS whether to separate the capability for support of DCI format 1\_1 with CRC scrambled with G-RNTI for multicast~~ |  | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-2a | Support of ACK/NACK based HARQ-ACK feedback andRRC-based enabling/disabling ACK/NACK-based feedback for dynamic scheduling for multicast | 1. Support of ACK/NACK based HARQ-ACK feedback, and support of enabling/disabling ACK/NACK based HARQ-ACK feedback configured by RRC signalling
2. Support of PTP retransmission for multicast
 | 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-2b | DCI-based enabling/disabling ACK/NACK-based feedback for dynamic scheduling for multicast | Support of DCI-based enabling/disabling ACK/NACK based HARQ-ACK feedback configured per G-RNTI by RRC signaling | 33-2a | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-2c | PTM retransmission for multicast | Support of PTM retransmission for multicastFFS whether to merge with 33-2a | 33-2a | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| ~~33. NR\_MBS~~ | ~~33-2d~~ | ~~PTP retransmission for multicast~~ | ~~Support of PTP retransmission for multicast~~~~FFS whether to merge with 33-2a~~ | ~~33-2a~~ | ~~Yes~~ |  |  | ~~Per UE~~ | ~~No~~ | ~~No~~ |  |  | ~~Optional with capability signalling~~ |
| 33. NR\_MBS | 33-2-x | Multiple G-RNTIs for group-common PDSCHs | Capability on number of G-RNTI for groupcastFFS details. | 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-2-Y | DCI format for dynamic scheduling for multicast | Support of DCI format 4\_2 with CRC scrambled with G-RNTI for multicast. | 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |

 |
| [6] | Nokia, NSB | * **33-2:**
	+ Add 33-1 as pre-requisite, it is unclear why a UE would support multicast but not broadcast.
	+ No need to separate the capability for support of DCI format 1\_1 with CRC scrambled with G-RNTI for multicast
	+ Merge 33-4 into this one
	+ Per UE
* **33-2-x:**
	+ Confirm FG and provide a proper FG numbering
	+ Per UE
 |
| [7] | NTT DOCOMO | At the last meeting, it was agreed to merge at least one of support of PTM retransmission for multicast (i.e., FG 33-2c) or support of PTP retransmission for multicast (i.e., FG 33-2d) into FG 33-2a. It is basic to use group-common PDSCH for multicast transmission [3]. So at least support of PTM retransmission for multicast (i.e., FG 33-2c) should be merged into FG 33-2a. UE supports retransmission using C-RNTI for unicast communication. The only difference between unicast retransmission and PTP retransmission for multicast is the RNTI type of the initial transmission. We don’t see the need to make support of PTP retransmission for multicast a separate capability. FG 33-2d can also be merged into FG 33-2a***Proposal 4: Merge both FG 33-2c and FG 33-2d into FG 33-2a.*** |
| [8] | Intel | * FG 33-2
	+ Separate support of DCI 4\_2 into a dependent FG
	+ The PTP and PTM retransmission for MBS should be separated from 33-2 and added to dependent FG on ACK/NACK based HARQ feedback
* FG 33-2a
	+ Merge 33-2c into FG 33-2a

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-2 | Dynamic scheduling for multicast | 1. Support of group-common PDCCH/PDSCH with CRC scrambled by G-RNTI.
2. Support of CFR configuration for multicast.
3. Support of CORESET and common search space configuration for multicast.
4. Support of DCI format ~~1\_0 / 1\_1~~ 4\_1 with CRC scrambled with G-RNTI for multicast.
5. Support of inter-slot TDM between unicast PDSCH and group-common PDSCH in different slots.

Support {2, 4, 8} times semi-static slot-level repetition for group-common PDSCH for multicast~~FFS whether to separate the capability for support of DCI format 1\_1 with CRC scrambled with G-RNTI for multicast~~ |  |
| 33. NR\_MBS | 33-2x | Support of DCI format 4\_2 for dynamic scheduling | 1. Support of DCI format 1\_1 with CRC scrambled with G-RNTI for multicast
 | 33-2 |
| 33. NR\_MBS | 33-2a | Support of ACK/NACK based HARQ-ACK feedback andRRC-based enabling/disabling ACK/NACK-based feedback for dynamic scheduling for multicast | 1. Support of ACK/NACK based HARQ-ACK feedback, and support of enabling/disabling ACK/NACK based HARQ-ACK feedback configured by RRC signalling
2. Support of PTM retransmission for multicast

~~At least 33-2c or 33-2d is merged, FFS which one or both~~ | 33-2 |
| 33. NR\_MBS | 33-2b | DCI-based enabling/disabling ACK/NACK-based feedback for dynamic scheduling for multicast | Support of DCI-based enabling/disabling ACK/NACK based HARQ-ACK feedback configured per G-RNTI by RRC signaling | 33-2a |
| ~~33. NR\_MBS~~ | ~~33-2c~~ | ~~PTM retransmission for multicast~~ | ~~Support of PTM retransmission for multicast~~~~FFS whether to merge with 33-2a~~ | 33-2a |
| 33. NR\_MBS | 33-2d | PTP retransmission for multicast | Support of PTP retransmission for multicastFFS whether to merge with 33-2a | 33-2a |
| 33. NR\_MBS | 33-2-x | Multiple G-RNTIs for group-common PDSCHs | Capability on number of G-RNTI for groupcastFFS details. | 33-2 |

 |
| [9] | Apple | For DCI format 4\_2, it could be better to treat as an independent FG. As this format supports some enhanced sub-features, such as two TBs, dynamic enabling/disabling HARQ feedback. These features differentiae DCI format 4\_2 from DCI format 4\_1. DCI format 4\_1 is the basic format to support multicast.**Proposal 2: Supporting DCI format 4\_2 with CRC scrambled with G-RNTI for multicast as independent FG from FG33-2.** |
| [10] | Spreadtrum Communications | In latest 38.212 spec [2], DCI format for broadcast has been captured as DCI format 4\_0, and DCI format for multicast has been captured as DCI format 4\_1 and DCI format 4\_2. In order to align with the current spec, we have the following proposal:***Proposal 1***: Revise DCI format to align with 38.212,* In component 4 of FG 33-2, DCI format 1\_0/1\_1 is adjusted as DCI format 4\_1/4\_2;

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-2 | Dynamic scheduling for multicast | 1. Support of group-common PDCCH/PDSCH with CRC scrambled by G-RNTI.
2. Support of CFR configuration for multicast.
3. Support of CORESET and common search space configuration for multicast.
4. Support of DCI format 4\_1 / 4\_2 with CRC scrambled with G-RNTI for multicast.
5. Support of inter-slot TDM between unicast PDSCH and group-common PDSCH in different slots.
6. Support {2, 4, 8} times semi-static slot-level repetition for group-common PDSCH for multicast

FFS whether to separate the capability for support of DCI format 1\_1 with CRC scrambled with G-RNTI for multicast |  | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |

 |
| [11] | CMCC | As the discussion above, it is necessary to define basic FG both for broadcast and multicast.**Proposal 4. FG 33-2 is supported as a basic FG for MBS.**One remaining issue is whether DCI format 4\_2 is kept in FG 33-2, we think it should be kept. The most important consideration is the scheduling restriction of only using DCI format 4\_1, e.g., the frequency scheduling graduality, priority indication and so on. To maintain the DCI format 4\_2 as the basic feature for multicast is better for MBS commercial deployment.**Proposal 5. Don’t support to separate the capability for support of DCI format 4\_2 with CRC scrambled with G-RNTI for multicast in FG 33-2.**Although ACK/NACK based HARQ-ACK feedback is separated from FG 33-2, one FSS is which retransmission scheme or both transmission schemes are merged with FG 33-2a. From our point of view, both PTM retransmission and PTP retransmission should be merged with it, since the PTM retransmission and PTP retransmission are applied in different scenarios, e.g., PTM retransmission is used when large number of UE don’t decode the GC-PDSCH correctly and PTP retransmission is used when only small number of UE fail decoding. If only PTM retransmission is kept in FG 33-2a, the ACK/NACK based HARQ feedback has no technique advantage than NACK-only based HARQ feedback, and is also not the intention to design ACK/NACK based HARQ feedback for NR multicast. If only PTP retransmission is kept in FG 33-2a, gNB will always use UE-specific PDCCH for retransmission scheduling, which may cause much resource overhead when larger number of UEs don’t decode the GC-PDSCH correctly. Thus, keeping both PTM retransmission and PTP retransmission in FG 33-2a is a best solution for gNB to handle all retransmission cases and can also achieve the best network performance.**Proposal 6. Merge both FG 33-2c and FG 33-2d into FG 33-2a.** |
| [12] | Xiaomi | For support of DCI format 4\_2 in addition to DCI format 4\_1, we don’t see additional complexity. There is no necessity to split the support of DCI format 4\_2 with CRC scrambled with G-RNTI from FG 33-2.**Proposal 2: Support of DCI format 4\_2 with CRC scrambled with G-RNTI scheduling multicast is a component of FG 33-2.**In RAN1#107bis e-meeting, the following agreement on how to processing multicast DCI was agreed:

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

The above agreement address MBS UE capability related to DCI processing. It should be captured in FG 33-2. We propose to add the following component for FG 33-2 in order to address the newly achieved agreement in main session.* Multicast DCI is treated as unicast DCI scheduling DL following the current feature group 3-1/3-5a/3-5b.

**Proposal 3: Add the following component for FG 33-2:*** ***Multicast DCI is treated as unicast DCI scheduling DL following the current feature group 3-1/3-5a/3-5b.***

The difference between PTP retransmission and PTM retransmission is summarized as below:* PTP retransmission is scheduled by a DCI format with CRC scrambled with C-RNTI. The retransmitted TB is carried by a unicast PDSCH and can be received by a dedicated UE.
* PTM retransmission is scheduled by a DCI format with CRC scrambled with G-RNTI. The retransmitted TB is carried by a multicast PDSCH and can be received by a group of UE.

From feedback perspective, it is does not matter how the PDSCH is scheduled if UE supports ACK/NACK based HARQ feedback. From PDSCH reception and soft combination perspective, we believe there is no difference for UE implementation. **Proposal 4: Both FG 33-2c and FG 33-2d can be merged into FG 33-2a.** |
| [13] | Samsung | Also, DCI format 0\_1 and 1\_1 in FG 33-2 and 33-6-1 should be replaced with DCI format 4\_1 and 4\_2, respectively. Regarding which 33-2c (PTM reTx) or 33-2d (PTP reTx) to be merged 33-2a, we prefer to have 33-2d as a separate FG and use it as a pre-requisite of the capability to indicate whether a UE can support combining a PTM initial transmission and a PTP retransmission in case of different circular buffer. |
| [14] | MediaTek | There is a remaining issue that “At least 33-2c or 33-2d is merged, FFS which one or both”. From our perspective, considering PTM transmission is a basic feature for MBS services and can enhance the spectrum resource utilization, we prefer the FG 33-2c can be merged into FG 33-2a, and PTP retransmission can be split as a separate FG.*Proposal 8: The FG 33-2c (i.e., PTM retransmission for multicast) can be merged into FG 33-2a.* *Proposal 9: The FG 33-2d (i.e., PTP retransmission for multicast) is split as a separate FG.* Regarding the CFR number for multicast reception, the following agreement was achieved in previous RAN1 meeting:

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

Thus, we prefer to update the 2nd component based on the latest agreement.*Proposal 10: For FG 33-2, adding a note that “for component 2, only one CFR is supported for multicast reception”.* Regarding whether to separate the capability for support of DCI format 4\_2 for multicast, we think the DCI format 4\_1 for multicast is sufficient and the DCI format 4\_2 can be defined as the similar with DCI format 1\_2 that as a separate UE capability.*Proposal 11: For FG 33-2, monitoring DCI format 4\_2 can be as a separate FG.*

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33-2 | Dynamic scheduling for multicast | 1. Support of group-common PDCCH/PDSCH for multicast with CRC scrambled by G-RNTI.
2. Support of CFR configuration for multicast.
3. Support of CORESET and common search space configuration for multicast.
4. Support of DCI format ~~1\_0 / 1\_1~~ 4\_1/4\_2 with CRC scrambled with G-RNTI for multicast.
5. Support of inter-slot TDM between unicast PDSCH and group-common PDSCH for multicast in different slots.
6. Support {2, 4, 8} times semi-static slot-level repetition for group-common PDSCH for multicast

~~FFS whether to separate the capability for support of DCI format 1\_1 with CRC scrambled with G-RNTI for multicast~~ |  | Yes |  |  | ~~Per UE~~Per FSPC | No | No |  | For component 2, only one CFR is supported for multicast reception | Optional with capability signalling |
| 33-2a | Support of ACK/NACK based HARQ-ACK feedback andRRC-based enabling/disabling ACK/NACK-based feedback for dynamic scheduling for multicast | 1. Support of ACK/NACK based HARQ-ACK feedback, and support of enabling/disabling ACK/NACK based HARQ-ACK feedback configured by RRC signalling

~~At least 33-2c or 33-2d is merged, FFS which one or both~~1. Support of PTM retransmission for multicast
 | 33-2 | Yes |  |  | ~~Per UE~~Per FSPC | No | No |  |  | Optional with capability signalling |
| ~~33-2c~~ | ~~PTM retransmission for multicast~~ | ~~Support of PTM retransmission for multicast~~~~FFS whether to merge with 33-2a~~ | ~~33-2a~~ | ~~Yes~~ |  |  | ~~Per UE~~~~Per FSPC~~ | ~~No~~ | ~~No~~ |  |  | ~~Optional with capability signalling~~ |
| 33-2d | PTP retransmission for multicast | Support of PTP retransmission for multicast~~FFS whether to merge with 33-2a~~ | 33-2a | Yes |  |  | ~~Per UE~~Per FSPC | No | No |  |  | Optional with capability signalling |
| 33-2-1 | Monitoring DCI format 4\_2 | Support monitoring DCI format 4\_2 for multicast DL scheduling | 33-2 |  |  |  | Per FSPC |  |  |  |  | Optional with capability signalling |

In the RAN2#116-e meeting, one-to-many mapping between G-RNTI and MBS sessions/services was agreed as following.

|  |
| --- |
| * one-to-many mapping between G-RNTI and MBS sessions is supported and it is assumed that this does not introduce additional specification work.
 |

Since the multiple MBS sessions associated with one G-RNTI is supported, the motivation for supporting multiple G-RNTIs for group-common PDSCH is not clear, and supporting multiple G-RNTIs will increase the probability of false alarm for PDCCH detection, which will degrade the system performance. In addition, MBS UE has introduced the multiple RNTIs for MBS feature (e.g., multicast G-RNTI/G-CS-RNTI, broadcast MCCH-RNTI/G-RNTI), however, a total number RNTI supported by UE is limited. Considering the reason above, We think one G-NRTI is sufficient for Rel-17 UE supporting multicast services.*Proposal 12: Only one multicast G-RNTI is sufficient for Rel-17 UE supporting multicast services.**Proposal 13: For FG 33-2-X, RAN1 needs to re-consider the motivation for UE supporting multiple G-RNTIs.**Proposal 14: For FG 33-2-X, adding a note that “For component 1, the candidate value for M is: {0, 1}”.*

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33-2-x | Multiple G-RNTIs for group-common PDSCHs | 1. ~~Capability on number of~~ Support up to M G-RNTI for multicast ~~groupcast~~

FFS details. | 33-2 | Yes |  |  | ~~Per UE~~Per FSPC | No | No |  | For component 1, the candidate value for M is: {0, 1} | Optional with capability signalling |

 |
| [15] | Qualcomm | Based on the above agreements, we suggest the following changes on FG 33-2 as:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-2 | Dynamic scheduling for multicast | 1. Support of group-common PDCCH/PDSCH with CRC scrambled by G-RNTI(s) for multicast.
2. Support of CFR configuration for multicast.
3. Support of CORESET and common search space configuration in a CFR for multicast.
4. Support of DCI format 4\_1with CRC scrambled with G-RNTI for multicast.
5. Support of inter-slot TDM between unicast PDSCH and group-common PDSCH for multicast in different slots.
6. Support of higher-layer configured slot-level repetition for group-common PDSCH scheduled associated with G-RNTI
 |  | Yes |  |  | Per FSPC | N/A | N/A |  | Max value for higher layer configured slot-level repetition = {2, 4, 8} | Optional with capability signalling |
| 33. NR\_MBS | 33-2a | Support of ACK/NACK based HARQ-ACK feedback andRRC-based enabling/disabling ACK/NACK-based feedback for dynamic scheduling for multicast | Support of ACK/NACK based HARQ-ACK feedback, and support of enabling/disabling ACK/NACK based HARQ-ACK feedback configured by RRC signalling.Support of PTM retransmission for dynamically scheduled multicast associated with G-RNTI | 33-2 | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-2b | Dynamic multicast with DCI format 4\_2 | Support of DCI format 4\_2 with CRC scrambled with G-RNTI for multicast | 33-2 | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-2c | DCI-based enabling/disabling ACK/NACK-based feedback for dynamic scheduling for multicast | Support of DCI-based enabling/disabling ACK/NACK-based HARQ-ACK feedback per G-RNTI for multicast by RRC signaling via DCI format 4\_2 | 33-2a, 33-2b | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 33. NR\_MBS | 33-2d | PTP retransmission for multicast | Support of PTP retransmission associated with C-RNTI for multicast  | 33-2a | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-2e | Dynamic Slot-level repetition for group-common PDSCH | Support DCI-indicated slot-level repetition for group-common PDSCH for multicast associated with G-RNTI. | 33-2 | Yes |  |  | Per FSPC | N/A | N/A |  | Max value of DCI-indicated slot-level repeition = {8, 16} | Optional with capability signalling |
| 33. NR\_MBS | 33-2f | TCI-state configuration for multicast group-common PDSCH | Support of M’ TCI-state configurations within the PDSCH-Config-Multicast | 33-2 | Yes |  |  | Per FSPC | N/A | N/A |  | FFS: values of M’ | Optional with capability signalling |

For FG33-2-x, we think it is for UE to report the capability of monitoring group-common PDCCHs with multiple G-RNTIs in a slot in the serving cell. So, we suggest the following modification as:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-2-x | Multiple G-RNTIs for dynamic group-common PDSCHs | Max number of G-RNTIs for multicast per slot per CC | 33-2 | Yes |  |  | Per FSPC | N/A | N/A |  | FFS: max number = {2, …} | Optional with capability signalling |

 |
| [16] | Ericsson | In the feature description, the DCI formats should be corrected to DCI 4\_1 and 4\_2 to reflect the changes in 38.212. Regarding the support of DCI 4\_2 (referred as multicast 1\_1 in the UE feature document), we believe that UE should support both non-fallback and fallback DCI for multicast as part of the core functionality. Fragmenting the feature further will result in making the non-fallback DCI useless for group scheduling in practice. The changes in the feature are reflected changed marks below:

|  |  |  |  |
| --- | --- | --- | --- |
| 33. NR\_MBS | 33-2 | Dynamic scheduling for multicast | 1. Support of group-common PDCCH/PDSCH with CRC scrambled by G-RNTI.
2. Support of CFR configuration for multicast.
3. Support of CORESET and common search space configuration for multicast.
4. Support of DCI format 1\_0 / 1\_1 with CRC scrambled with G-RNTI for multicast.
5. Support of inter-slot TDM between unicast PDSCH and group-common PDSCH in different slots.

Support {2, 4, 8} times semi-static slot-level repetition for group-common PDSCH for multicast |

During RAN1#107b-e the merging of 33-2c and or 33-2d into 33-2a was discussed with the possibility of merging at last one of them, or both:In our view, we do not see a case where a UE will not support at last one of PTM or PTP retransmission. Since clearly retransmission should be supported if HARQ feedback of any type is supported, we propose to remove components 33-2c and 33-2d, and introduce a component for “type of retransmission for multicast” which could take values “PTP” or “PTM”. The changes are shown below:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-2a | Support of ACK/NACK based HARQ-ACK feedback andRRC-based enabling/disabling ACK/NACK-based feedback for dynamic scheduling for multicast | 1. Support of ACK/NACK based HARQ-ACK feedback, and support of enabling/disabling ACK/NACK based HARQ-ACK feedback configured by RRC signalling
2. Type of retransmission for multicast
 | 33-2 | Yes |  |  | Per UE | No | No |  | Candidate values for (2) are {PTP,PTM} | Optional with capability signalling |

 |

## **Discussion**

**[FL1] High priority question 3-1:**

* **Companies are encouraged to provide views on whether to merge either FG 33-2c or FG 33-2d into FG 33-2a.**
	+ FG 33-2c (PTM retx): Huawei, HiSilicon, vivo, ZTE, Intel, MediaTek, Qualcomm, Spreadtrum
	+ FG 33-2d (PTP retx): OPPO
	+ Both: NTT DOCOMO, CMCC, Xiaomi, Ericsson

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | As proposed in our tdoc, we prefer to merge FG 33-2c into FG 33-2a and leave FG 33-2d as a separate FG. |
| Spreadtrum | Prefer 33-2c merge into 33-2a, and 33-2d as separated FG. Also add our position. |
|  |  |

 **[FL1] High priority question 3-2:**

* **Companies are encouraged to provide views on whether to separate the capability for support of DCI format 4\_2 with CRC scrambled with G-RNTI for multicast from FG 33-2.**
	+ Keep in FG 33-2: Nokia, NSB, CMCC, Xiaomi, Ericsson
	+ Separate FG: Huawei, HiSilicon, OPPO, Intel, Apple, MediaTek, Qualcomm, Spreadtrum

|  |  |
| --- | --- |
| Company | Comment |
| Spreadtrum | Add our positioin |
|  |  |
|  |  |

**[FL1] High priority question 3-3:**

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

* Support of MCS/NDI/RV for TB2: vivo
* Support of M’ TCI-state configurations within the PDSCH-Config-Multicast: Qualcomm
* Supported maximum number of all RNTIs: HW/HiSi

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | For max number of all RNTIs, is it per CC or across all CCs? Since all RNTIs may not be only for MBS, we are not sure it should be under discussion of MBS feature.  |
| Spreadtrum | 1st bullet: ok2nd bullet: It is being discussed in AI8.12.1. We can wait the progress of 8.12.1.3rd bullet: share the same view with Qualcomm. |
|  |  |

**[FL1] Medium priority question 3-4:**

* **Companies are encouraged to provide views on whether FG 33-2 is supported as a basic FG for MBS**
	+ Support: ZTE, CMCC

|  |  |
| --- | --- |
| Company | Comment |
|  |  |
|  |  |
|  |  |

**[FL1] Medium priority question 3-5:**

* **Companies are encouraged to provide views on whether the type of FGs 33-2 to 33-2-x should be per UE or per FSPC.**
	+ FG 33-2
		- Per UE: Nokia, NSB, OPPO, Spreadtrum Communications
		- Per FSPC: MediaTek, Huawei, HiSilicon, Qualcomm
	+ FG 33-2a
		- Per UE: Huawei, HiSilicon, vivo, OPPO, Ericsson
		- Per FSPC: MediaTek, Qualcomm
	+ FG 33-2b
		- Per UE: Huawei, HiSilicon, OPPO
		- Per FSPC: MediaTek, Qualcomm
	+ FG 33-2-x
		- Per UE: Huawei, HiSilicon, Nokia, NSB, OPPO
		- Per FSPC: MediaTek, Qualcomm

|  |  |
| --- | --- |
| Company | Comment |
|  |  |
|  |  |
|  |  |

**Low priority proposal 3-6:**

* **Components of FG 33-2 are revised as**
	+ **Component 1: Support of group-common PDCCH/PDSCH with CRC scrambled by G-RNTI(s) for multicast**
	+ **Component 3: Support of CORESET and common search space configuration in a CFR for multicast.**
	+ **Component 4: Support of DCI format 4\_1 / 4\_2 with CRC scrambled with G-RNTI for multicast.**
	+ **Component 5: Support of inter-slot TDM between unicast PDSCH and group-common PDSCH for multicast, or between group-common PDSCH for multicast and group-common PDSCH for broadcast (if UE supports FG33-1), or among unicast PDSCH and group-common PDSCH for multicast and group-common PDSCH for broadcast (if UE supports FG33-1) in different slots.**
	+ **Component 6: Support of NACK-only based HARQ-ACK feedback for dynamic multicast scheduling, and support of enabling/disabling NACK-only based HARQ-ACK feedback per configuration of RRC signaling.**
	+ **Add a note that “Multicast DCI is treated as unicast DCI scheduling DL following the current feature group 3-1/3-5a/3-5b”.**
	+ **Add a note that “for component 2, only one CFR is supported for multicast reception”.**
* **Components of FG 33-2c is revised as “Support of DCI-based enabling/disabling ACK/NACK-based HARQ-ACK feedback per G-RNTI for multicast by RRC signaling via DCI format 4\_2”**
* **Components of FG 33-2-x is revised as “Max number of G-RNTIs for multicast per slot per CC”.**

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| Company | Comment |
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**Low priority question 3-7:**

* **Companies are encouraged to provide views on whether/how to revise the prerequisite feature groups for FGs 33-2 to 33-2-x**

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| Company | Comment |
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**Low priority question 3-8:**

* **Companies are encouraged to provide views on whether/how to revise any other contents in FGs 33-2 to 33-2-x which do not have capability signalling impacts**

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| Company | Comment |
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# **33-3-1: Dynamic Slot-level repetition for group-common PDSCH**

In [1], FG 33-3-1 is captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the Gnb to know if the feature is supported | Applicable to the capability signalling exchange between Ues (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 33. NR\_MBS | 33-3-1 | Dynamic Slot-level repetition for group-common PDSCH | 1. Support up to X times dynamic slot-level repetition for group-common PDSCH for multicast.
 | 33-2 | Yes |  |  | Per UE | No | No |  | Candidate values for X is: {8, 16} | Optional with capability signalling |

Following feedbacks are provided in contributions for the RAN1#108-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| [2] | Huawei, HiSilicon | As discussed in section 2.1, dynamic slot-level repetition is proposed to be a separate FG from FG33-1 for broadcast and it can be merged into FG33-3-1 with FG33-1 as prerequisite FG for broadcast. The FG33-3-1 can be updated as the following proposal. ***Proposal 4: Updating FG33-3-1 as follows in red:***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-3-1 | Dynamic Slot-level repetition for group-common PDSCH | 1. Support up to X times dynamic slot-level repetition for group-common PDSCH for multicast or for broadcast MTCH.
 | 33-1 or 33-2 | Yes |  |  | Per UE | No | No |  | Candidate values for X is: {8, 16} | Optional with capability signalling |

 |

## **Discussion**

**[FL1] Medium priority question 4-1:**

* **Companies are encouraged to provide views on whether the type of FG 33-3-1 should be per UE or per FSPC.**
	+ Per UE: Huawei, HiSilicon
	+ Per FSPC: MediaTek,

|  |  |
| --- | --- |
| Company | Comment |
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**Low priority proposal 4-2:**

* **Components of FG 33-3-1 are revised as “Support up to X times dynamic slot-level repetition for group-common PDSCH for multicast or for broadcast MTCH”.**

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| Company | Comment |
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**Low priority question 4-3:**

* **Companies are encouraged to provide views on whether/how to revise the prerequisite feature groups for FG 33-3-1**

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| Company | Comment |
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**Low priority question 4-4:**

* **Companies are encouraged to provide views on whether/how to revise any other contents in FG 33-3-1 which do not have capability signalling impacts.**

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| Company | Comment |
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# **33-3-2 to 33-3-5: Multiplexing of unicast PDSCH and group-common PDSCH**

In [1], FGs 33-3-2 to 33-3-5 are captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between Ues (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
|  33. NR\_MBS | 33-3-2 | FDM-ed unicast PDSCH and group-common PDSCH | 1. Support FDM between one unicast PDSCH and one group-common PDSCH in a slot.
2. Support FDM-ed Type-1 HARQ-ACK codebook for multicast.
3. Support FDM-ed Type-2 HARQ-ACK codebook for multicast.

FFS whether/how to separate the capability for HARQ-ACK codebook | 33-1, 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-3-3 | Intra-slot TDM-ed unicast PDSCH and group-common PDSCH | 1. Support TDM between one unicast PDSCH and one group-common PDSCH in a slot.
2. Support TDM between M (M>1) TDMed unicast PDSCHs and one group-common PDSCH in a slot per CC
3. Support TDM among N (N>1) group-common PDSCHs in a slot per CC
4. Support TDM between K (K>1) TDMed unicast PDSCHs and L (L>1) TDMed group-common PDSCHs in a slot per CC
5. 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.
	1. Note:  Group-common PDSCH(s) are counted as unicast PDSCH(s).
6. Support TDM-ed Type-1 HARQ-ACK codebook for multicast.
7. Support TDM-ed Type-2 HARQ-ACK codebook for multicast.

FFS whether/how to separate the capability for HARQ-ACK codebook | 33-1, 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-3-4 | Mode 1 for type1 codebook generation | Supports type1-Codebook-Generation-Mode configured as mode 1 | TBD | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-3-5 | Feedback multiplexing for unicast PDSCH and group-common PDSCH for multicast with same priority and different codebook type | Support of multiplexing HARQ-ACK for unicast and multicast with the same priority and different HARQ-ACK codebook types in the same PUCCH slot | 33-2b | Yes |  |  | Per FSPC | No | No |  |  | Optional with capability signalling |

Following feedbacks are provided in contributions for the RAN1#108-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [2] | Huawei, HiSilicon | The IE *FeatureSetDownlinkPerCC* indicates a set of features that the UE supports on the corresponding carrier of one band entry of a band combination including *supportedBandwidthDL*, *maxNumberMIMO-LayersPDSCH* and *supportedModulationOrderDL* that can determine an maximum TB size in a slot. For UE supporting FDM-ed unicast PDSCH and one group-common PDSCH in a slot, the maximum TBS size should be reported and is supposed to be the total maximum TB size for both unicast and group-common PDSCH. It should be noted that two cases (i.e., FDM-ed unicast and multicast and FDM-ed unicast and broadcast) are included depending on FG33-1 or FG33-2 is prerequisite FG for FG33-3-2. Given FG33-2 has no HARQ-ACK feedback or NACK-only as the component, it makes sense to separate the support of FDM-ed Type1/Type2 HARQ-ACK codebook from FG33-3-2 and define additional UE capability. ***Proposal 5: Updating FG33-3-2 and adding FG33-3-2a as follows in red:***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-3-2 | FDM-ed unicast PDSCH and one group-common PDSCH in a slot | 1. Support of FDM between one unicast PDSCH and one group-common PDSCH in a slot.
2. The maximum TB size supported in a slot
3. ~~Support FDM-ed Type-1 HARQ-ACK codebook for multicast.~~
4. ~~Support FDM-ed Type-2 HARQ-ACK codebook for multicast.~~

~~FFS whether/how to separate the capability for HARQ-ACK codebook~~ | 33-1 or 33-2 | Yes |  |  | Per FSPC | NA | NA |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-3-2a | ACK/NACK feedback multiplexing for FDM-ed unicast PDSCH and one group-common PDSCH for multicast | Support of FDM-ed ACK/NACK-based HARQ-ACK codebook for unicast and group-common PDSCH in a slot. | 33-3-2 | Yes |  |  | Per FSPC | NA | NA |  | Values = {Type-1 HARQ-ACK codebook only, Type-2 HARQ-ACK codebook only, both} | Optional with capability signalling |

Similar rationale for the update for FG33-3-2, the maximum TBS size supported in a slot or a separate FG for reporting the maximum data rate per slot should be reported and reasonable to add another feature group for the ACK/NACK based feedback multiplexing for the TDM-ed scheduling. It should be noted that two cases (i.e., FDM-ed unicast and multicast and FDM-ed unicast and broadcast) are included depending on FG33-1 or FG33-2 is prerequisite FG for FG33-3-3.In addition, as discussed in [4], a good balance between network and UE could be that UE does not need to report more than two group-common PDSCHs for MBS broadcast in the same slot. In case repetition is configured and TDM-ed two group-common PDSCHs could be scheduled in the same slot, at most two HARQ processes are needed for MBS broadcast scheduling.***Proposal 6: Updating FG33-3-3 and adding FG33-3-3a as follows in red:***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-3-3 | Intra-slot TDM-ed unicast PDSCH and group-common PDSCH | 1. Support TDM between one unicast PDSCH and one group-common PDSCH in a slot.
2. Support TDM between M (M>1) TDMed unicast PDSCHs and one group-common PDSCH in a slot per CC
3. Support TDM among N (N>1) group-common PDSCHs in a slot per CC
	1. N=2 for FG33-1 as prerequisite
4. Support TDM between K (K>1) TDMed unicast PDSCHs and L (L>1) TDMed group-common PDSCHs in a slot per CC
	1. L=2 for FG33-1 as prerequisite
5. 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.
	1. Note:  Group-common PDSCH(s) are counted as unicast PDSCH(s).
6. The maximum TB size supported in a slot
7. ~~Support TDM-ed Type-1 HARQ-ACK codebook for multicast.~~
8. ~~Support TDM-ed Type-2 HARQ-ACK codebook for multicast.~~

~~FFS whether/how to separate the capability for HARQ-ACK codebook~~ | 33-1 or 33-2 | Yes |  |  | Per FSPC | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-3-3a | ACK/NACK feedback multiplexing for intra-slot TDM-ed unicast PDSCH and one group-common PDSCH for multicast based on the union of *K1 sets* | Support of TDM-ed ACK/NACK based HARQ-ACK codebook for M>= 1 unicast and N>=1 multicast in a slot.Note: For Type-1 HARQ-ACK codebook, it is based on the union of *K1* sets for unicast and multicast. | 33-3-3 |  |  |  | Per FSPC | N/A | N/A |  | Values = {Type-1 HARQ-ACK codebook only, Type-2 HARQ-ACK codebook only, both} | Optional with capability signalling |

FG33-3-4 was agreed in RAN1#107bis-e meeting but FFS on which FG is prerequisite FG. Since mode1 Type-1 codebook generation is decided by the intersection of k1 sets configured to unicast and multicast, it is mainly used for TDM-ed unicast and multicast, so FG33-3-3a should be the prerequisite FG. ***Proposal 7: Updating FG33-3-4 as follows in red:***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-3-4 | Mode 1 for type1 codebook generation | Supports type1-Codebook-Generation-Mode configured as mode 1 | 33-3-3a | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |

 |
| [3] | vivo | For FG33-3-2 and FG33-3-3, the HARQ-ACK codebook should be separated from multiplexing of unicast PDSCH and group-common PDSCH, and similar as that in NR Rel-15, support of type 1 and type 2 codebook should be separated as different UE capabilities. Furthermore, as there is no difference between FDMed and TDMed type-2 codebok, it is not necessary to differentiate them, and thus, option 1 in [1] should be supported.***Proposal 5*** Regarding HARQ-ACK codebook* Add an FG for TDM-ed Type-1 HARQ-ACK codebook for multicast
* Add an FG for FDM-ed Type-1 HARQ-ACK codebook for multicast
* Add an FG for Type-2 HARQ-ACK codebook for multicast

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-3-2 | FDM-ed unicast PDSCH and group-common PDSCH | 1. Support FDM between one unicast PDSCH and one group-common PDSCH in a slot.
 | 33-1 or 33-2 | Yes | Optional with capability signalling |
| 33. NR\_MBS | 33-3-2a | FDM-ed Type-1 HARQ-ACK codebook for multicast | 1. Support FDM-ed Type-1 HARQ-ACK codebook for multicast.
 | 33-2,33-3-2  | Yes | Optional with capability signalling |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-3-3 | Intra-slot TDM-ed unicast PDSCH and group-common PDSCH | 1. Support TDM between one unicast PDSCH and one group-common PDSCH in a slot.
2. Support TDM between M (M>1) TDMed unicast PDSCHs and one group-common PDSCH in a slot per CC
3. Support TDM among N (N>1) group-common PDSCHs in a slot per CC
4. Support TDM between K (K>1) TDMed unicast PDSCHs and L (L>1) TDMed group-common PDSCHs in a slot per CC
5. 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.
	1. Note:  Group-common PDSCH(s) are counted as unicast PDSCH(s).
 | 33-1 or 33-2 | Yes | Optional with capability signalling |
| 33. NR\_MBS | 33-3-3a | TDM-ed Type-1 HARQ-ACK codebook for multicast | 1. Support TDM-ed Type-1 HARQ-ACK codebook for multicast.
 | 33-2, 33-3-3, | Yes | Optional with capability signalling |
| 33. NR\_MBS | 33-3-4 | Type 2 HARQ-ACK codebook for multicast | 1. Support Type-2 HARQ-ACK codebook for multicast.
 | 33-2, 33-3-2 or 33-3-3 | Yes | Optional with capability signalling |

 |
| [4] | ZTE | Another issue is how to capture agreements for FG33-3-3. From our perspective, UE can share the same maximum PDSCH receptions in a slot per CC between unicast and multicast. Thus, the FG33-3-3 can be updated as following.***Proposal 5****: Update the components description as following.*

|  |  |  |
| --- | --- | --- |
| 33-3-3 | Intra-slot TDM-ed unicast PDSCH and group-common PDSCH | 1. Support TDM between X unicast PDSCH(s) and Y group-common PDSCH(s) in a slot, where X+Y <= Z. Z is the maximum number of TDMed PDSCH receptions capability in a slot per CC according to 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). |

 |
| [5] | OPPO | For FG 33-3-2, FDM-ed Tx/Rx and FDM-ed Type-1/2 codebook have not to be merged into one FG, while support FDM-ed Tx/Rx of unicast PDSCH and multicast PDSCH does not mean that the FDM-ed codebook should be supported. Therefore, FDM-ed Type-1/2 codebook should be separated from 33-3-2. FG 33-3-3 also has the similar reason to on TDM-ed Type-1/2 codebook to be separated from FG 33-3-3.1. ***For FG 33-3-2, separate the capability for FDM-ed Type-1/2 HARQ-ACK codebook for multicast.***
2. ***For FG 33-3-3, separate the capability for TDM-ed Type-1/2 HARQ-ACK codebook for multicast.***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  33. NR\_MBS | 33-3-2 | FDM-ed unicast PDSCH and group-common PDSCH | 1. Support FDM between one unicast PDSCH and one group-common PDSCH in a slot.
2. ~~Support FDM-ed Type-1 HARQ-ACK codebook for multicast.~~
3. ~~Support FDM-ed Type-2 HARQ-ACK codebook for multicast.~~

~~FFS whether/how to separate the capability for HARQ-ACK codebook~~ | 33-1, 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
|  33. NR\_MBS | 33-3-2a | FDM-ed HARQ-ACK codebook for multicast | 1. Support FDM-ed Type-1 HARQ-ACK codebook for multicast.
2. Support FDM-ed Type-2 HARQ-ACK codebook for multicast.
 | 33-1, 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-3-3 | Intra-slot TDM-ed unicast PDSCH and group-common PDSCH | 1. Support TDM between one unicast PDSCH and one group-common PDSCH in a slot.
2. Support TDM between M (M>1) TDMed unicast PDSCHs and one group-common PDSCH in a slot per CC
3. Support TDM among N (N>1) group-common PDSCHs in a slot per CC
4. Support TDM between K (K>1) TDMed unicast PDSCHs and L (L>1) TDMed group-common PDSCHs in a slot per CC
5. 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).
6. ~~Support TDM-ed Type-1 HARQ-ACK codebook for multicast.~~
7. ~~Support TDM-ed Type-2 HARQ-ACK codebook for multicast.~~

~~FFS whether/how to separate the capability for HARQ-ACK codebook~~ | 33-1, 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-3-3a | TDM-ed HARQ-ACK codebook for multicast | 1. Support TDM-ed Type-1 HARQ-ACK codebook for multicast.
2. Support TDM-ed Type-2 HARQ-ACK codebook for multicast.
 | 33-1, 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-3-4 | Mode 1 for type1 codebook generation | Supports type1-Codebook-Generation-Mode configured as mode 1 | TBD | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-3-5 | Feedback multiplexing for unicast PDSCH and group-common PDSCH for multicast with same priority and different codebook type | Support of multiplexing HARQ-ACK for unicast and multicast with the same priority and different HARQ-ACK codebook types in the same PUCCH slot | 33-2b | Yes |  |  | Per FSPC | No | No |  |  | Optional with capability signalling |

 |
| [6] | Nokia, NSB | * **33-3-2:**
	+ If CONNECTED\_MODE UEs can receive broadcast without supporting multicast, component 1 may need to be separated from 2/3. More clarification needed here.
	+ Per UE
* **33-3-3:**
	+ Same comment as for 33-3-2.
	+ Per UE
 |
| [7] | NTT DOCOMO | Type-2 codebook generation process is the same for TDM-ed PDSCHs and for FDM-ed PDSCHs. So we don’t see the need to separate Type-2 HARQ-ACK codebook capabilities for FDM and TDM. Therefore, we prefer Option 1.***Proposal 6: For the capability for HARQ-ACK codebook, support Option 1.*** |
| [9] | Apple | For the separation of capability for HARQ-ACK codebook in FG33-3-2 and Fg33-3-3, according to last meeting discussion, there are two options to split the FGs for HARQ-ACK codebook.* + Option 1:
		- add an FG for TDM-ed Type-1 HARQ-ACK codebook for multicast
		- add an FG for FDM-ed Type-1 HARQ-ACK codebook for multicast
		- add an FG for Type-2 HARQ-ACK codebook for multicast
	+ Option 2:
		- add an FG for FDM-ed Type-1/2 HARQ-ACK codebooks for multicast
		- add an FG for TDM-ed Type-1/2 HARQ-ACK codebook for multicast

For option1, the type-2 HARQ-ACK codebook construction is applied to both TDM-ed and FDM-ed reception, i.e., DAI is separately counted and codebooks for unicast and multicast are concatenated. Thus, supporting Type -2 HARQ-ACK codebook should be an independent feature.For Option 2, each FG requires to support both Type-1 and Type-2 HARQ-ACK codebook construction. From implementation and specification perspective, Type-1 and Type-2 HARQ-ACK codebook construction are fully independent features and can’t be combined together.**Proposal 3: For splitting UE capability for HARQ-ACK codebook, Option 1 is supported,*** + - **add an FG for TDM-ed Type-1 HARQ-ACK codebook for multicast**
		- **add an FG for FDM-ed Type-1 HARQ-ACK codebook for multicast**
		- **add an FG for Type-2 HARQ-ACK codebook for multicast**
 |
| [10] | Spreadtrum Communications | Last meeting, we have discussed on whether the HARQ-ACK feedback for multicast is optional UE capability. After extensive discussion, finally we have agreed that HARQ-ACK feedback for multicast is optional UE capability. For FG33-3-2, in our understanding, the intention is to state the feature of FDMed multiplexing. It is not proper to combine the multiplexing issue and HARQ-ACK feedback. For example, one UE can support FDMed multiplexing, but can not support HARQ-ACK feedback operation. Thus, we prefer to split component 2 and 3 in FG33-3-2 as separated FG.***Proposal 2***: Component 2 and 3 in FG33-3-2 can be split as separated FG, and as optional UE capability.Given the above, like FG33-3-2, we also think it is not proper to combine the multiplexing issue and HARQ-ACK feedback. Thus, we prefer to split component 6 and 7 in FG33-3-3 as separated FG.***Proposal 3***: Component 6 and 7 in FG33-3-3 can be split as separated FG, and as optional UE capability.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-3-2 | FDM-ed unicast PDSCH and group-common PDSCH | 1. Support FDM between one unicast PDSCH and one group-common PDSCH in a slot.

FFS whether/how to separate the capability for HARQ-ACK codebook | 33-1, 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-3-3 | Intra-slot TDM-ed unicast PDSCH and group-common PDSCH | 1. Support TDM between one unicast PDSCH and one group-common PDSCH in a slot.
2. Support TDM between M (M>1) TDMed unicast PDSCHs and one group-common PDSCH in a slot per CC
3. Support TDM among N (N>1) group-common PDSCHs in a slot per CC
4. Support TDM between K (K>1) TDMed unicast PDSCHs and L (L>1) TDMed group-common PDSCHs in a slot per CC
5. 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.
	1. Note:  Group-common PDSCH(s) are counted as unicast PDSCH(s).

FFS whether/how to separate the capability for HARQ-ACK codebook | 33-1, 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |

 |
| [11] | CMCC | As the comments from companies, it is not necessary to differentiate TDM/FDM-ed Type-2 HARQ-ACK codebook, thus we support Option 1 to separate the capability for HARQ-ACK codebook from FGs 33-3-2 and 33-3-3. Besides since ACK/NACK-based HARQ-ACK feedback has been separated from FG 33-2, at least one of the HARQ-ACK codebook should also be included FG 33-2a.**Proposal 7. Support Option 1 to** **separate the capability for HARQ-ACK codebook from FGs 33-3-2 and 33-3-3.** |
| [12] | Xiaomi | These two feature group define UE capability on whether UE supports FDMed or TDMed PDSCHs respectively, including multicast-to-unicast and multicast-to-multicast. The component related to HARQ-ACK codebooks are actually irrelevant. Furthermore, there is no FDMed/TDMed type-1 codebook or FDMed/TDMed type-2 codebook. HARQ-ACK construction should be separate from that of PDSCH transmission. Actually we already have the following separate FGs for different codebook construction:* FG 33-3-5: *Support of multiplexing HARQ-ACK for unicast and multicast with the same priority and different HARQ-ACK codebook types in the same PUCCH slot*
* FG 33-6-2: *Supports two HARQ-ACK codebooks with different priorities to be simultaneously constructed different priorities for multicast or for unicast and multicast at a UE*

The only thing missed is the support of multiplexing HARQ-ACK for unicast and multicast with the same priority and same HARQ-ACK codebook type in the same PUCCH slot, which can be a separate FG or a component of FG 33-3-2 and FG 33-3-3.**Proposal 5: Remove the following two components for FG 33-3-2*** + ***Support FDM-ed Type-1 HARQ-ACK codebook for multicast.***
	+ ***Support FDM-ed Type-2 HARQ-ACK codebook for multicast.***

**Proposal 6: Remove the following two components for FG 33-3-3*** + ***Support TDM-ed Type-1 HARQ-ACK codebook for multicast.***
	+ ***Support TDM-ed Type-2 HARQ-ACK codebook for multicast.***

**Proposal 7: Adopt one of the following options to cover the case wherein multiplexing HARQ-ACK for unicast and multicast with the same priority and same HARQ-ACK codebook type in the same PUCCH slot*** + **Option 1: Define a component for FG 33-3-2 and FG 33-3-3 respectively such as: *support of multiplexing HARQ-ACK for unicast and multicast with the same priority and same HARQ-ACK codebook type in the same PUCCH slot***
	+ **Option 2:Define a new FG 33-3-6: *support of multiplexing HARQ-ACK for unicast and multicast with the same priority and same HARQ-ACK codebook type in the same PUCCH slot***

Furthermore, the prerequisite feature groups for FG 33-3-2 and FG 33-3-3 should be FG 33-2 as there is no HARQ-ACK feedback for broadcast.**Proposal 8: The prerequisite feature groups for FG 33-3-2 and FG 33-3-3 should be FG 33-2 instead of FG 33-1 and FG 33-2.** |
| [13] | Samsung | For 33-3-2/3, pre-requisite can be either 33-1 or 33-2, but should not be both.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups |
|  33. NR\_MBS | 33-3-2 | FDM-ed unicast PDSCH and group-common PDSCH | 1. Support FDM between one unicast PDSCH and one group-common PDSCH in a slot.
2. Support FDM-ed Type-1 HARQ-ACK codebook for multicast.
3. Support FDM-ed Type-2 HARQ-ACK codebook for multicast.

FFS whether/how to separate the capability for HARQ-ACK codebook | 33-1 or 33-2 |
| 33. NR\_MBS | 33-3-3 | Intra-slot TDM-ed unicast PDSCH and group-common PDSCH | 1. Support TDM between one unicast PDSCH and one group-common PDSCH in a slot.
2. Support TDM between M (M>1) TDMed unicast PDSCHs and one group-common PDSCH in a slot per CC
3. Support TDM among N (N>1) group-common PDSCHs in a slot per CC
4. Support TDM between K (K>1) TDMed unicast PDSCHs and L (L>1) TDMed group-common PDSCHs in a slot per CC
5. 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.
6. Note:  Group-common PDSCH(s) are counted as unicast PDSCH(s).
7. Support TDM-ed Type-1 HARQ-ACK codebook for multicast.
8. Support TDM-ed Type-2 HARQ-ACK codebook for multicast.

FFS whether/how to separate the capability for HARQ-ACK codebook | 33-1 or 33-2 |

 |
| [14] | MediaTek | codebook. Thus, we suggest to separate the FDM-ed HARQ-ACK from the FG 33-3-2.*Proposal 15: For FG 33-3-2, the FDM-ed HARQ-ACK codebook capability should be as a separate FG.*Regarding the prerequisite feature groups 33-1, we think the broadcast reception is “best-effort” reception and the UE in RRC IDLE/INACTIVE cannot report capability. So, we think FDMed reception for MBS is supported for multicast and not broadcast.*Proposal 16: For FG 33-3-2, the prerequisite feature groups 33-1 should be deleted.*

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| 33-3-2 | FDM-ed unicast PDSCH and group-common PDSCH | 1. Support FDM between one unicast PDSCH and one group-common PDSCH for multicast in a slot.
2. ~~Support FDM-ed Type-1 HARQ-ACK codebook for multicast.~~
3. ~~Support FDM-ed Type-2 HARQ-ACK codebook for multicast~~.

FFS whether/how to separate the capability for HARQ-ACK codebook | ~~33-1,~~ 33-2 | Yes |  |  | ~~Per UE~~  Per FSPC | No | No |  |  | Optional with capability signalling |
| 33-3-2-1 | HARQ-ACK codebook for FDM-ed unicast and multicast | 1. Support FDM-ed Type-1 HARQ-ACK codebook for multicast.
2. Support FDM-ed Type-2 HARQ-ACK codebook for multicast
 | 33-3-2 |  |  |  | ~~Per UE~~  Per FSPC |  |  |  |  | Optional with capability signalling |

Regarding the FG 33-3-3 we need to further discuss whether/how to separate the capability for HARQ-ACK codebook. We share the similar view as that of FG 33-3-2 and have the following proposals:*Proposal 17: For FG 33-3-3, the TDM-ed HARQ-ACK codebook capability should be as a separate FG.**Proposal 18: For FG 33-3-3, the prerequisite feature groups 33-1 should be deleted.*

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| 33-3-3 | Intra-slot TDM-ed unicast PDSCH and group-common PDSCH | 1. Support TDM between one unicast PDSCH and one group-common PDSCH for multicast in a slot.
2. Support TDM between M (M>1) TDMed unicast PDSCHs and one group-common PDSCH for multicast in a slot per CC
3. Support TDM among N (N>1) group-common PDSCHs for multicast in a slot per CC
4. Support TDM between K (K>1) TDMed unicast PDSCHs and L (L>1) TDMed group-common PDSCHs for multicast in a slot per CC
5. 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.
	1. Note:  Group-common PDSCH(s) for multicast  are counted as unicast PDSCH(s).
6. ~~Support TDM-ed Type-1 HARQ-ACK codebook for multicast.~~
7. ~~Support TDM-ed Type-2 HARQ-ACK codebook for multicast~~.

FFS whether/how to separate the capability for HARQ-ACK codebook | ~~33-1,~~ 33-2 | Yes |  |  | ~~Per UE~~  Per FSPC | No | No |  |  | Optional with capability signalling |
| 33-3-2-1 | HARQ-ACK codebook for FDM-ed unicast and multicast | 1. Support TDM-ed Type-1 HARQ-ACK codebook for multicast.
2. Support TDM-ed Type-2 HARQ-ACK codebook for multicast
 |  |  |  |  | ~~Per UE~~  Per FSPC |  |  |  |  | Optional with capability signalling |

 |
| [15] | Qualcomm | Among the options, we prefer Option 2 and propose the following changes.

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| 33. NR\_MBS | 33-3-2 | FDM-ed unicast PDSCH and group-common PDSCH | 1. Support of FDM between one unicast PDSCH and one group-common PDSCH in a slot.
 | 33-1, 33-2 | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-3-2a | FDM-ed pattern of feedback codebook for unicast PDSCH and group-common PDSCH | Support of FDM-ed ACK/NACK-based Type-1 HARQ-ACK codebook for one unicast and one multicast in a slot.Max number of G-RNTI(s) configured to UE for the FDMed unicast and multicast Type-1 HARQ-ACK codebook | 33-2a, 33-3-2 | Yes |  |  | Per FSPC | N/A | N/A |  | FFS: value | Optional with capability signalling |
| 33. NR\_MBS | 33-3-2b | Maximum data rate of FDMed unicast PDSCH and group-common PDSCH for multicast | Max data rate of FDMed unicast PDSCH and group-common PDSCH for multicast respectively in a slot per CC. | 33-3-2 | Yes |  |  | Per FSPC | N/A | N/A |  | FFS: value | Optional with capability signalling |
| 33. NR\_MBS | 33-3-3 | Intra-slot TDM-ed unicast PDSCH and group-common PDSCH for multicast | 1. Support TDM between one unicast PDSCH and one group-common PDSCH in a slot.
2. Support TDM between M (M>1) TDMed unicast PDSCHs and one group-common PDSCH in a slot per CC
3. Support TDM among N (N>1) group-common PDSCHs in a slot per CC
4. Support TDM between K (K>1) TDMed unicast PDSCHs and L (L>1) TDMed group-common PDSCHs in a slot per CC
5. 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). | 33-1, 33-2 | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-3-3a | Feedback multiplexing for intra-slot TDM-ed unicast PDSCH and group-common PDSCH for multicast | Support of TDM-ed ACK/NACK-based HARQ-ACK codebook for M (M>= 1) unicast and N (N>=1) multicast in a slot. | 33-2b, 33-3-3 | Yes |  |  | Per FSPC | N/A | N/A |  | Values = {Type-1 HARQ-ACK codebook only, Type-2 HARQ-ACK codebook only, both} | Optional with capability signalling |
| 33. NR\_MBS | 33-3-3b | Maximum data rate of TDMed unicast PDSCH and group-common PDSCH for multicast | Max data rate for TDMed unicast PDSCH(s) and group-common PDSCH(s) for multicast respectively in a slot per CC. | 33-3-3 | Yes |  |  | Per FSPC | N/A | N/A |  | FFS: value | Optional with capability signalling |

We suggest the changes for FG 33-3-4 as

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| 33. NR\_MBS | 33-3-4 | Mode 1 for type1 codebook generation | Supports type1-Codebook-Generation-Mode configured as mode 1 | 33-2a | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |

We suggest minor changes for FG 33-3-5 as

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| 33-3-5 | Feedback multiplexing for unicast PDSCH and group-common PDSCH for multicast with same priority and different codebook type | Support of multiplexing HARQ-ACK for unicast and multicast with the same priority and different HARQ-ACK codebook types in the same PUCCH slot | 33-2a | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |

 |
| [16] | Ericsson | create a common codebook. Moreover, It is understood that both TDM and FDM are “advanced” features, and therefore we think that UE capable of FDM or intra slot TDM will also be capable of HARQ feedback. The following change is proposed:

|  |  |  |  |
| --- | --- | --- | --- |
|  33. NR\_MBS | 33-3-2 | FDM-ed unicast PDSCH and group-common PDSCH | 1. Support FDM between one unicast PDSCH and one group-common PDSCH in a slot.
2. Support FDM-ed Type-1 HARQ-ACK codebook for multicast and unicast..
3. Support FDM-ed Type-2 HARQ-ACK codebook for multicast and unicast..
 |
| 33. NR\_MBS | 33-3-3 | Intra-slot TDM-ed unicast PDSCH and group-common PDSCH | 1. Support TDM between one unicast PDSCH and one group-common PDSCH in a slot.
2. Support TDM between M (M>1) TDMed unicast PDSCHs and one group-common PDSCH in a slot per CC
3. Support TDM among N (N>1) group-common PDSCHs in a slot per CC
4. Support TDM between K (K>1) TDMed unicast PDSCHs and L (L>1) TDMed group-common PDSCHs in a slot per CC
5. 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.
	1. Note:  Group-common PDSCH(s) are counted as unicast PDSCH(s).
6. Support TDM-ed Type-1 HARQ-ACK codebook for multicast and unicast..
7. Support TDM-ed Type-2 HARQ-ACK codebook for multicast and unicast..
 |

 |

## **Discussion**

**[FL1] High priority question 5-1:**

* **Companies are encouraged to provide views on how to separate the capability for** **HARQ-ACK codebook from FGs 33-3-2 and 33-3-3.**
	+ **Option 1:**
		- **add an FG for TDM-ed Type-1 HARQ-ACK codebook for multicast**
		- **add an FG for FDM-ed Type-1 HARQ-ACK codebook for multicast**
		- **add an FG for Type-2 HARQ-ACK codebook for multicast**
	+ **Option 2:**
		- **add an FG for FDM-ed Type-1/2 HARQ-ACK codebooks for multicast**
		- **add an FG for TDM-ed Type-1/2 HARQ-ACK codebook for multicast**

|  |  |
| --- | --- |
| Company | Comment |
| Moderator | Summary of companies view* Option 1: Option 1: vivo, NTT DOCOMO, Apple, CMCC,
* Option 2: Huawei, HiSilicon, OPPO, MediaTek, Qualcomm, Spreadtrum
 |
| Spreadtrum | Add our position |
|  |  |

**[FL1] High priority question 5-2:**

* **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.**
	+ Support: Qualcomm

|  |  |
| --- | --- |
| Company | Comment |
| Spreadtrum | Not understand the motivation. Clarification is needed. |
|  |  |
|  |  |

**[FL1] Medium priority question 5-3:**

* **Companies are encouraged to provide views on whether the type of FGs 33-3-2 to 33-3-5 should be per UE or per FSPC.**
	+ FG 33-3-2
		- Per UE: OPPO, Nokia, NSB, Spreadtrum Communications
		- Per FSPC: MediaTek, Huawei, HiSilicon, Qualcomm
	+ FG 33-3-3
		- Per UE: OPPO, Nokia, NSB, Spreadtrum Communications
		- Per FSPC: MediaTek, Huawei, HiSilicon, Qualcomm
	+ FG 33-3-4
		- Per UE: Huawei, HiSilicon, OPPO
		- Per FSPC: MediaTek, Qualcomm
	+ FG 33-3-5
		- Per UE:
		- Per FSPC: MediaTek, OPPO, Qualcomm

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| Company | Comment |
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**Low priority question 5-4:**

* **Companies are encouraged to provide views on whether/how to revise the prerequisite feature groups for FGs 33-3-2 to 33-3-5**

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| Company | Comment |
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**Low priority question 5-5:**

* **Companies are encouraged to provide views on whether/how to revise any other contents in FGs 33-3-2 to 33-3-5 which do not have capability signalling impacts**

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| Company | Comment |
|  |  |
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# **33-4 to 33-4-1: NACK-only based HARQ-ACK feedback for multicast**

In [1], FGs 33-4 to 33-4-1 are captured as below.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between Ues (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 33. NR\_MBS | 33-4 | NACK-only based HARQ-ACK feedback for multicast | 1. Support NACK-only based HARQ-ACK feedback.
 | 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-4-1 | DCI-based enabling/disabling NACK-only based feedback for dynamic scheduling for multicast | Support of DCI-based enabling/disabling NACK-only based HARQ-ACK feedback configured per G-RNTI by RRC signaling | 33-4 | Yes |  |  | Per UE |  |  |  |  | Optional with capability signalling |

Following feedbacks are provided in contributions for the RAN1#108-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [2] | Huawei, HiSilicon | Similar to the support of ACK/NACK-only based feedback for multicast as in FG33-2a, the support of NACK-only based feedback and RRC based enabling/disabling NACK-only based feedback as well as PTM retransmission can be merged into a single FG33-4. Since UE does not feedback ACK when the TB is decoded correctly and the PUCCH resources might be shared among UEs for reporting NACK if the TB is failed in decoding, network cannot differentiate which UE is failed in decoding so UE does not need to support PTP retransmission for NACK-only based feedback. ***Proposal 8: Updating FG33-4 as follows in red:***

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-4 | Support of NACK-only based HARQ-ACK feedback and RRC-based enabling/disabling NACK-only based feedback for dynamic scheduling for multicast | 1. Support NACK-only based HARQ-ACK feedback for multicast SPS group-common PDSCH without PDCCH scheduling
2. support of enabling/disabling NACK-only based HARQ-ACK feedback for multicast SPS scheduling per the configuration of RRC signalling.
3. Support PTM retransmission for multicast SPS.
 | 33-2 or 33-2-1 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |

 |
| [5] | OPPO | Similar with ACK/NACK based feedback in FG 33-2a, enabling/disabling of NACK-only based feedback by RRC signaling can be within the same FG. Supporting NACK-only based HARQ-ACK feedback requires enabling/disabling mechanism, while DCI-based mechanism is not the only one. Furthermore, using RRC-based signaling to enable/disable NACK-only based HARQ-ACK feedback is considered as a default method.1. ***For FG 33-4, “and support enabling/disabling NACK-only based HARQ-ACK feedback configured by RRC signaling” should be added to the component.***

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-4 | NACK-only based HARQ-ACK feedback for multicast | 1. Support NACK-only based HARQ-ACK feedback, and support of enabling/disabling NACK-only based HARQ-ACK feedback configured by RRC signaling.
 | 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-4-1 | DCI-based enabling/disabling NACK-only based feedback for dynamic scheduling for multicast | Support of DCI-based enabling/disabling NACK-only based HARQ-ACK feedback configured per G-RNTI by RRC signaling | 33-4 | Yes |  |  | Per UE |  |  |  |  | Optional with capability signalling |

 |
| [6] | Nokia, NSB | * **33-4:**
	+ To be merged in 33-2, or at least to be mandatorily indicated for UEs supporting 33-2, as it is an essencial functionality for groupcast.
	+ Per UE
 |
| [8] | Intel | * FG 33-4
	+ Add component for support of enabling/disabling NACK-only based HARQ-ACK feedback configured by RRC signaling

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-4 | NACK-only based HARQ-ACK feedback for multicast | Support NACK-only based HARQ-ACK feedback and support of enabling/disabling ACK/NACK based HARQ-ACK feedback configured by RRC signalling | 33-2 |

 |
| [9] | Apple | As it was agreed HARQ-ACK based feedback is an independent FG33-2a from FG33-2, FG33-4 should be an independent FG as well. In addition, the prerequisite feature group should include FG33-2c, i.e., PTM retransmission for multicast.**Proposal 4: Keeping FG33-4 as independent feature and include FG33-2c as prerequisite feature group.** |
| [10] | Spreadtrum Communications | During previous RAN1 meetings, we have the common understanding on reusing the design for ACK/NACK based feedback for NACK-only as far as possibly. For the basic function of ACK/NACK based feedback, i.e., FG33-2a, supporting of enabling/disabling ACK/NACK based HARQ-ACK feedback configured by RRC signaling is also included. Likewise, for the basic function of NACK-only feedback, we also think the function of NACK-only enabling/disabling by RRC also should be included. Thus, we have the following proposal:***Proposal 4***: Component 1 of FG33-4 can be revised as ‘Support NACK-only based HARQ-ACK feedback, and support of enabling/disabling NACK-only based HARQ-ACK feedback configured by RRC signalling’.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-4 | NACK-only based HARQ-ACK feedback for multicast | 1. Support NACK-only based HARQ-ACK feedback, and support of enabling/disabling NACK-only based HARQ-ACK feedback configured by RRC signalling.
 | 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |

 |
| [15] | Qualcomm |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-4 | NACK-only based HARQ-ACK feedback for multicast | Support of NACK-only based HARQ-ACK feedback for dynamically scheduled multicast associated with G-RNTISupport PTM retransmission for dynamically scheduled multicast associated with G-RNTI | 33-2 | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-4a | More than one NACK-only based HARQ-ACK feedback for multicast in a PUCCH resource | Support of more than one NACK-only based HARQ-ACK feedback for dynamically scheduled multicast in a PUCCH resource | 33-4 | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |

We suggest minor changes for FG 33-4-1 as

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| 33. NR\_MBS | 33-4-1 | DCI-based enabling/disabling NACK-only based feedback for dynamic scheduling for multicast | Support of DCI-based enabling/disabling NACK-only based HARQ-ACK feedback configured per G-RNTI by RRC signaling via DCI format 4\_2 | 33-4, 33-2b | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |

 |
| [16] | Ericsson | We are OK with this feature in general but would like to clarify that this should exclude multicast SPS, which needs specific features to be supported.  |

## **Discussion**

**[FL1] High priority question 6-1:**

* **Companies are encouraged to provide views on whether to introduce a new FG for the support of more than one NACK-only based HARQ-ACK feedback for dynamically scheduled multicast in a PUCCH resource**
	+ Support: Qualcomm

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| Company | Comment |
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**[FL1] Medium priority question 6-3:**

* **Companies are encouraged to provide views on whether the type of FGs 33-4 and 33-4-1 should be per UE or per FSPC**
	+ FG 33-4
		- Per UE: Huawei, HiSilicon, OPPO, Nokia, NSB, Spreadtrum Communications
		- Per FSPC: MediaTek, Qualcomm
	+ FG 33-4-1
		- Per UE: OPPO,
		- Per FSPC: MediaTek, Qualcomm

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| Company | Comment |
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**Low priority proposal 6-3:**

* **Add a component in FG 33-4 “Support of enabling/disabling NACK-only based HARQ-ACK feedback for multicast configured by RRC signaling”**
* **Component of FG 33-4-1 are revised as “Support of DCI-based enabling/disabling NACK-only based HARQ-ACK feedback configured per G-RNTI by RRC signaling via DCI format 4\_2”**

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| Company | Comment |
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**Low priority question 6-5:**

* **Companies are encouraged to provide views on whether/how to revise the prerequisite feature groups for FGs 33-4 and 33-4-1.**

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| Company | Comment |
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**Low priority question 6-6:**

* **Companies are encouraged to provide views on whether/how to revise any other contents in FGs 33-4 and 33-4-1 which do not have capability signalling impacts**

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| Company | Comment |
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# **33-5-1 to 33-5-2:** **SPS group-common PDSCH for multicast**

In [1], FGs 33-5-1 to 33-5-2 are captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between Ues (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
|  33. NR\_MBS | 33-5-1 | SPS group-common PDSCH for multicast | 1. Support one SPS group-common PDSCH configuration for multicast
2. Support ACK/NACK based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.
3. Support NACK-only based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.
4. FFS: HARQ-ACK feedback for SPS group-common with PDCCH scheduling and SPS release PDCCH.
5. Support slot-level repetition for SPS group-common PDSCH

FFS whether/how to separate the above capabilities from FG 33-5-1 | 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
|  33. NR\_MBS | 33-5-2 | Multiple SPS group-common PDSCH configuration | 1. Support [N>1] SPS group-common PDSCH configuration for multicast
2. Support M>=1 activated SPS group-common PDSCH configurations among the N SPS group-common PDSCH configurations per CFR for multicast
 | 33-2 | Yes |  |  | Per UE | No | No |  | FFS: Candidate values for M | Optional with capability signalling |

Following feedbacks are provided in contributions for t he RAN1#108-e meeting.

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| [2] | Huawei, HiSilicon | How to group the UE features for multicast SPS could refer to the UE features for multicast dynamic scheduling. Similar to MBS broadcast FG33-1 and multicast FG33-2, support of slot-level repetition for SPS group-common PDSCH can be the component of FG33-5-1. Support of DCI format 4\_2 with CRC scrambled with G-CS-RNTI for multicast SPS scheduling can be a separate FG in FG33-5-1a. Support of ACK/NACK based HARQ-ACK feedback, support of enabling/disabling ACK/NACK based HARQ-ACK feedback, and support of PTM retransmission can be grouped into FG33-5-1b. Support of enabling/disabling HARQ-ACK feedback in the group-common DCI for multicast SPS activation per the configuration of RRC signaling for each G-CS-RNTI can be separate in FG33-5-1c. Support of PTP retransmission can be separate in FG33-5-1d. Support of NACK-only based HARQ-ACK feedback for multicast SPS group-common PDSCH without PDCCH scheduling, support of PTM retransmission for multicast SPS, and support of enabling/disabling NACK-only based HARQ-ACK feedback per configuration of RRC signaling can be grouped into FG33-5-1e. ***Proposal 9: Updating FG33-5-1/2, adding FG33-5-1a/1b/1c/1d/1e as follows in red:***

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| 33. NR\_MBS | 33-5-1 | SPS group-common PDSCH for multicast | 1. Support of one SPS group-common PDSCH configuration for multicast
2. Support of one SPS group-common PDSCH activated/deactivated by group-common PDCCH scrambled with G-CS-RNTI.
3. Support of DCI format 4\_1 with CRC scrambled with G-CS-RNTI for multicast SPS scheduling.
4. ~~Support ACK/NACK based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.~~
5. ~~Support NACK-only based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.~~
6. ~~FFS: HARQ-ACK feedback for SPS group-common with PDCCH scheduling and SPS release PDCCH.~~
7. Support semi-static slot-level repetition for SPS group-common PDSCH

~~FFS whether/how to separate the above capabilities from FG 33-5-1~~ | 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1a | Multicast SPS scheduled by DCI format 4\_2 | 1. Support of DCI format 4\_2 with CRC scrambled with G-CS-RNTI for multicast SPS scheduling.
 | 33-5-1 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1b | ACK/NACK based HARQ-ACK feedback for multicast SPS | 1. Support of ACK/NACK based HARQ-ACK feedback for multicast SPS group-common PDSCH without PDCCH scheduling.
2. Support of enabling/disabling ACK/NACK based HARQ-ACK feedback for multicast SPS scheduling per the configuration of RRC signaling
3. Support of PTM retransmission for multicast SPS.
 | 33-5-1 or 33-5-1a | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1c | Group-common DCI indicating the enabling/disabling HARQ-ACK feedback for multicast SPS | Support of enabling/disabling HARQ-ACK feedback in the group-common DCI for multicast SPS activation per the configuration of RRC signaling for each G-CS-RNTI. | 33-5-1b | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1d | PTP retransmission for multicast SPS | Support of PTP retransmission for multicast SPS. | 33-5-1b | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1e | Support of NACK-only based HARQ-ACK feedback for multicast SPS | 1. Support of ACK/NACK based HARQ-ACK feedback for multicast SPS group-common PDSCH without PDCCH scheduling.
2. Support of enabling/disabling ACK/NACK based HARQ-ACK feedback for multicast SPS scheduling per the configuration of RRC signaling
3. Support of PTM retransmission for multicast SPS.
 | 33-5-1 or 33-5-1a | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-2 | Multiple SPS group-common PDSCH configuration | 1. Support [N>1] SPS group-common PDSCH configuration for multicast
2. Support M>=1 activated SPS group-common PDSCH configurations among the N SPS group-common PDSCH configurations per CFR for multicast.
 | 33-5-1 | Yes |  |  | Per UE | No | No |  | FFS: Candidate values for M | Optional with capability signalling |

 |
| [5] | OPPO | For FG 33-5-1, at least supporting one SPS GC-PDSCH configuration for multicast is the basic function. The rest components 2~5 can be separated from FG 33-5-1. HARQ-ACK feedback is can be enabled/disabled with different feedback schemes. Furthermore, slot-level repetition can also be separated to an independent FG.1. ***For FG 33-5-1, component 2/3/4/5 can be separated from this FG as in 33-5-4, 33-5-5, 33-5-6 and 33-5-7.***

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| 33. NR\_MBS | 33-5-1 | SPS group-common PDSCH for multicast | 1. Support one SPS group-common PDSCH configuration for multicast
2. ~~Support ACK/NACK based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.~~
3. ~~Support NACK-only based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.~~
4. ~~FFS: HARQ-ACK feedback for SPS group-common with PDCCH scheduling and SPS release PDCCH.~~
5. ~~Support slot-level repetition for SPS group-common PDSCH~~

~~FFS whether/how to separate the above capabilities from FG 33-5-1~~ | 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
|  33. NR\_MBS | 33-5-2 | Multiple SPS group-common PDSCH configuration | 1. Support [N>1] SPS group-common PDSCH configuration for multicast
2. Support M>=1 activated SPS group-common PDSCH configurations among the N SPS group-common PDSCH configurations per CFR for multicast
 | 33-2 | Yes |  |  | Per UE | No | No |  | FFS: Candidate values for M | Optional with capability signalling |
| 33. NR\_MBS | 33-5-4 | SPS group-common PDSCH for multicast | Support ACK/NACK based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling. | 33-5-1 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-5 | SPS group-common PDSCH for multicast | Support NACK-only based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling. | 33-5-1 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-6 | SPS group-common PDSCH for multicast | HARQ-ACK feedback for SPS group-common with PDCCH scheduling and SPS release PDCCH.  | 33-5-1 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-7 | SPS group-common PDSCH for multicast | Support slot-level repetition for SPS group-common PDSCH | 33-5-1 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |

 |
| [6] | Nokia, NSB | * **33-5-1**:
	+ Per UE
* **33-5-2**:
	+ Per UE
 |
| [7] | NTT DOCOMO | Capabilities for SPS GC-PDSCH should be structured similarly to FGs for dynamic scheduled GC-PDSCH.***Proposal 7: Divide FG 33-5-1 as follows.***

|  |  |  |  |
| --- | --- | --- | --- |
| 33-5-1 | SPS group-common PDSCH for multicast | 1. Support one SPS group-common PDSCH configuration for multicast
2. ~~Support ACK/NACK based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.~~
3. ~~Support NACK-only based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.~~
4. FFS: HARQ-ACK feedback for SPS group-common with PDCCH scheduling and SPS release PDCCH.
5. Support slot-level repetition for SPS group-common PDSCH
 | 33-2 |
| 33-5-1a | ACK/NACK based HARQ-ACK feedback for SPS GC-PDSCH | 1. Support ACK/NACK based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.
 | 33-5-1 |
| 33-5-1b | NACK-only based HARQ-ACK feedback for SPS GC-PDSCH | 1. Support NACK-only based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.
 | 33-5-1 |

 |
| [8] | Intel | * FG 33-5-1
	+ Separate HARQ-ACK feedback and slot repetition support into separate dependent FGs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-5-1 | SPS group-common PDSCH for multicast | 1. Support one SPS group-common PDSCH configuration for multicast
2. ~~Support ACK/NACK based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.~~
3. ~~Support NACK-only based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.~~
4. ~~FFS: HARQ-ACK feedback for SPS group-common with PDCCH scheduling and SPS release PDCCH.~~
5. ~~Support slot-level repetition for SPS group-common PDSCH~~

~~FFS whether/how to separate the above capabilities from FG 33-5-1~~ | 33-2 |
|  | 33-5-1a | HARQ-ACK Feedback for SPS group-common PDSCH for multicast | 1. Support ACK/NACK based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.
2. Support NACK-only based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.
 | 33-5-1 |
|  | 33-5-1b | Slot level repetition for SPS group-common PDSCH for multicast | 1. Support slot-level repetition for SPS group-common PDSCH
 | 33-5-1 |

 |
| [10] | Spreadtrum Communications | Like FG33-2, we also think HARQ-ACK feedback is not the basic feature for group-common SPS operation. Thus, we prefer to split component 2, 3 in FG33-5-1 as separated FG.***Proposal 5***: Component 2, 3 in FG33-5-1 can be split as separated FG, and as optional UE capability.Regarding repetition for SPS, we have the following agreement made in RAN1#106b-e:Agreement:For slot-level repetition for SPS GC-PDSCH for multicast RRC\_CONNECTED UEs.* Config A or Config B can be configured to UE:
	+ (Config A) UE can be optionally configured with *pdsch-AggregationFactor* per *SPS-Config-Multicast*.
	+ (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
	+ Alt1: equal to 1.

Dynamic repetition number indication and semi-static repetition number indication for SPS group-common PDSCH are considered. It is similar to repetition indication for dynamic group-common PDSCH. In our mind, there is no necessary to have additional FG for SPS. We are fine that FG 33-3-1 is also applied for SPS group-common PDSCH, and only semi-static repetition is included in FG33-5-1.***Proposal 6:*** For FG33-5-1, suggest to revise component 5 as ‘Support semi-static slot-level repetition for SPS group-common PDSCH’.For the component 1 of FG33-5-2, if taking FG12-2 as reference, it shall be per CFR configuration, and further constraint on per cell or cell group can also be considered.***Proposal 7***: Component 1 in FG33-5-2 can be revised as ‘Support up to [N>1] SPS group-common PDSCH configuration per CFR for multicast, and up to K SPS group-common PDSCH configuration in a cell group’.

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| 33. NR\_MBS | 33-5-1 | SPS group-common PDSCH for multicast | 1. Support one SPS group-common PDSCH configuration for multicast
2. Support ACK/NACK based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.
3. Support NACK-only based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.
4. FFS: HARQ-ACK feedback for SPS group-common with PDCCH scheduling and SPS release PDCCH.
5. Support semi-static slot-level repetition for SPS group-common PDSCH

FFS whether/how to separate the above capabilities from FG 33-5-1 | 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
|  33. NR\_MBS | 33-5-2 | Multiple SPS group-common PDSCH configuration | 1. Support [N>1] SPS group-common PDSCH configuration per CFR for multicast, and up to K SPS group-common PDSCH configuration in a cell group
2. Support M>=1 activated SPS group-common PDSCH configurations among the N SPS group-common PDSCH configurations per CFR for multicast
 | 33-2 | Yes |  |  | Per UE | No | No |  | FFS: Candidate values for M | Optional with capability signalling |

 |
| [11] | CMCC | There were also some discussions about whether to separate the capabilities in FG 33-5-1 similar the discussion in FG 33-2. In general, we think the same principle of multicast dynamic scheduling and multicast SPS should be applied, e.g., RRC based slot-level repetition and DCI format 4\_2 are kept as components of FG 33-5-1, DCI based slot-level repetition and ACK/NACK based HARQ-ACK feedback are introduced as separate FGs. Thus, we suggest the following proposal.**Proposal 8. For FG 33-5-1:*** **Don’t support to separate the capability for support of DCI format 4\_2 with CRC scrambled with G-CS-RNTI for multicast SPS transmission;**
* **RRC based slot-level repetition is merged with FG 33-5-1;**
* **A separate FG is introduced for DCI based slot-level repetition.**

**Proposal 9. Add following FG for ACK/NACK based HARQ-ACK feedback for SPS:**

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| 33-5-3 | Support of ACK/NACK based HARQ-ACK feedback and RRC-based enabling/disabling ACK/NACK-based feedback for SPS for multicast | 1.Support of ACK/NACK based HARQ-ACK feedback, and support of enabling/disabling ACK/NACK based HARQ-ACK feedback configured by RRC signalling.2.Support of PTM retransmission for multicast SPS.3.Support of PTP retransmission for multicast SPS. | 33-5-1 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |

 |
| [14] | MediaTek | Regarding the SPS group-common PDSCH for multicast, we need to further discuss whether/how to separate the capabilities from FG 33-5-1. Actually, we think the capability for SPS should be align with the dynamic scheduling and have the following proposal:*Proposal 19: For FG 33-5-1, the similar separate capability for dynamic scheduling can be reused for SPS group-common PDSCH for multicast.*

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| 33-5-1 | SPS group-common PDSCH for multicast | 1. Support one SPS group-common PDSCH configuration for multicast
2. Support {2, 4, 8} times semi-static slot-level repetition for SPS group-common PDSCH for multicast
3. ~~Support ACK/NACK based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.~~
4. ~~Support NACK-only based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.~~
5. ~~FFS: HARQ-ACK feedback for SPS group-common with PDCCH scheduling and SPS release PDCCH.~~
6. ~~Support slot-level repetition for SPS group-common PDSCH~~

FFS whether/how to separate the above capabilities from FG 33-5-1 | 33-2 | Yes |  |  | ~~Per UE~~Per FSPC | No | No |  |  | Optional with capability signalling |
| 33-5-1a | ACK/NACK based HARQ-ACK feedback for SPS multicast | 1. Support ACK/NACK based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.
 | 33-5-1 |  |  |  | Per FSPC |  |  |  |  | Optional with capability signalling |
| 33-5-1b | NACK only based HARQ-ACK feedback for SPS multicas | 1. Support NACK only based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.
 | 33-5-1 |  |  |  | Per FSPC |  |  |  |  | Optional with capability signalling |
| 33-5-1c | PTM retransmission for SPS multicast | 1. Support PTM retransmission of SPS group common PDSCH for multicast
 | 33-5-1 |  |  |  | Per FSPC |  |  |  |  | Optional with capability signalling |
| 33-5-1d | PTP retransmission for SPS multicast | 1. Support PTP retransmission of SPS group common PDSCH for multicast
 | 33-5-1 |  |  |  | Per FSPC |  |  |  |  | Optional with capability signalling |
| 33-5-1f | Dynamic Slot-level repetition for SPS multicast | 1. Support up to X times dynamic slot-level repetition for group-common PDSCH for SPS multicast.
 | 33-2 | Yes |  |  | ~~Per UE~~Per FSPC | No | No |  | Candidate values for X is: {8, 16} | Optional with capability signalling |

 |
| [15] | Qualcomm |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| 33. NR\_MBS | 33-5-1 | SPS group-common PDSCH for multicast | 1. Support of one SPS group-common PDSCH configuration for multicast
2. Support of group-common PDCCH/PDSCH with CRC scrambled by G-CS-RNTI(s) for multicast
3. Support of DCI format 4\_1 with CRC scrambled with G-CS-RNTI for multicast.
4. Support of higher-layer configured slot-level repetition for group-common PDSCH scheduled associated with G-CS-RNTIACK/NABK-based HARQ-ACK feedback for SPS group-common PDCCH activation and SPS release associated with G-CS-RNTI.
 | 33-2 | Yes |  |  | Per FSPC | N/A | N/A |  | Max value of higher layer configured slot-level repetition = {2, 4, 8} | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1a | ACK/NACK-based HARQ ACK feedback for SPS multicast | Support of ACK/NACK based HARQ-ACK feedback, and support of enabling/disabling ACK/NACK based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling configured by RRC signalling.Support of PTM retransmission for SPS multicast associated with G-CS-RNTI | 33-5-1 | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1b | SPS multicast using DCI format 4\_2 | Support of DCI format 4\_2 with CRC scrambled with G-CS-RNTI for multicast SPS transmission. | 33-5-1 | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1c | DCI-based enabling/disabling ACK/NACK-based feedback for SPS multicast | Support of DCI-based enabling/disabling ACK/NACK-based HARQ-ACK feedback per G-CS-RNTI for multicast by RRC signaling by using DCI format 4\_2 | 33-5-1a, 33-5-1b | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1d | PTP retransmission for SPS multicast | Support PTP retransmission associated with CS-RNTI for SPS multicast  | 33-5-1b | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1e | Dynamic slot-level repetition of SPS group-common PDSCH for multicast | Support of DCI-indicated slot-level repetition for group-common PDSCH with CRC scrambled with G-CS-RNTI | 33-5-1 | Yes |  |  | Per FSPC | N/A | N/A |  | Max value of DCI-indicated slot-level repetition = {8, 16} | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1f | NACK-only-based HARQ ACK feedback for SPS multicast | Support of NACK-only-based HARQ-ACK feedback , and support of enabling/disabling ACK/NACK based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling configured by RRC signalling.Support of PTM retransmission for SPS group-common PDSCH associated with G-CS-RNTI | 33-5-1 | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1g | DCI-based enabling/disabling NACK-only-based feedback for SPS multicast | Support of DCI-based enabling/disabling NACK-only-based HARQ-ACK feedback per G-CS-RNTI for multicast by RRC signaling by using DCI format 4\_2 | 33-5-1f, 33-5-1b | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-5-2 | Multiple SPS group-common PDSCH configuration | 1. Support [N>1] SPS group-common PDSCH configurations ~~per CFR~~ for multicast
2. Support [N>=M>=1] activated SPS group-common PDSCH configurations among the N SPS group-common PDSCH configurations per CFR for multicast
 | 33-2 | Yes |  |  | Per FSPC | N/A | N/A |  | FFS: value of N, M | Optional with capability signalling |

Similar as FG33-2-x, we suggest adding a new FG33-5-x for the capability of monitoring group-common PDCCHs with multiple G-CS-RNTIs for SPS multicast per slot per CC.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-5-x | Multiple G-CS-RNTIs for SPS group-common PDSCHs | Max number of G-CS-RNTIs for SPS multicast per slot per CC | 33-5-1 | Yes |  |  | Per FSPC | N/A | N/A |  | FFS: max number = {2, …} | Optional with capability signalling |

 |
| [16] | Ericsson | For SPS for multicast, we have the following comments:* For SPS, retransmission can be done via PTM or PTP. Therefore how retransmission is supported for SPS should also be a separate feature component.
* Regarding SPS with NACK only feedback we propose that feature 4 is clarified to be relevant for SPS activation and release. Additionally,in our view either NACK-only (sub-feature 3) and support for the use of HARQ ACK-NACK feedback for activation and release (sub-feature 4) are dependent on each otherand could be a separate feature group if needed. Therefore we propose to either remove the FFS or brand out NACK-only support for SPS in a separate FG.

The following change is proposed:

|  |  |  |  |
| --- | --- | --- | --- |
| 33. NR\_MBS | 33-5-1 | SPS group-common PDSCH for multicast | 1. Support one SPS group-common PDSCH configuration for multicast
2. Support ACK/NACK based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.
3. Support NACK-only based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.
4. ~~FFS:~~ HARQ-ACK feedback for SPS group-common activation with PDCCH scheduling and SPS release PDCCH.
5. Support slot-level repetition for SPS group-common PDSCH
6. Support of PTM retransmission for SPS multicast
7. Support of PTP retransmission for SPS multicast
 |

 |

## **Discussion**

**[FL1] High priority question 7-1:**

* **FG 33-5-1 is updated as follows**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-5-1 | SPS group-common PDSCH for multicast | 1. Support one SPS group-common PDSCH configuration for multicast
2. ~~Support ACK/NACK based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.~~
3. ~~Support NACK-only based HARQ-ACK feedback for SPS group-common PDSCH without PDCCH scheduling.~~
4. ~~FFS: HARQ-ACK feedback for SPS group-common with PDCCH scheduling and SPS release PDCCH.~~
5. Support {2, 4, 8} times semi-static slot-level repetition for SPS group-common PDSCH

FFS whether~~/how~~ to separate ~~the above capabilities from FG 33-5-1~~ the capability for support of DCI format 4\_2 with CRC scrambled with G-CS-RNTI for multicast SPS scheduling | 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1a | Support of ACK/NACK based HARQ-ACK feedback and RRC-based enabling/disabling ACK/NACK-based feedback for SPS group-common PDSCH for multicast | Support of ACK/NACK based HARQ-ACK feedback, and support of enabling/disabling ACK/NACK based HARQ-ACK feedback configured by RRC signalling for SPS group-common PDSCH without PDCCH scheduling, SPS group-common PDSCH activation, and SPS release PDCCH | 33-5-1 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1b | DCI-based enabling/disabling ACK/NACK-based feedback for SPS group-common PDSCH for multicast | Support of DCI-based enabling/disabling ACK/NACK based HARQ-ACK feedback configured per G-CS-RNTI for multicast by RRC signaling | 33-2a | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1c | PTM retransmission for SPS group-common PDSCH for multicast | Support of PTM retransmission associated with G-CS-RNTI for SPS multicastFFS whether to merge with 33-5-1a | 33-5-1a | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1d | PTP retransmission for SPS group-common PDSCH for multicast | Support of PTP retransmission for associated with G-CS-RNTI for SPS multicastFFS whether to merge with 33-5-1a | 33-5-1a | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1e | Dynamic Slot-level repetition for SPS group-common PDSCH for multicast | Support up to X times dynamic slot-level repetition for SPS group-common PDSCH for multicast. | 33-5-1 | Yes |  |  | Per UE | No | No |  | Candidate values for X is: {8, 16} | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1f | NACK-only based HARQ-ACK feedback for multicast RRC-based enabling/disabling NACK-only based feedback for SPS group-common PDSCH for multicast | Support NACK-only based HARQ-ACK feedback, and support of enabling/disabling NACK-only based HARQ-ACK feedback configured by RRC signalling for SPS group-common PDSCH without PDCCH scheduling, SPS group-common PDSCH activation, and SPS release PDCCH | 33-5-1 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1g | DCI-based enabling/disabling NACK-only based feedback for SPS group-common PDSCH for multicast | Support of DCI-based enabling/disabling NACK-only based HARQ-ACK feedback configured per G-CS-RNTI for multicast by RRC signaling | 33-5-1f | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1h | Multiple G-CS-RNTIs for SPS group-common PDSCHs | Max number of G-CS-RNTIs for SPS multicast per lost per CC | 33-5-1 | Yes |  |  | Per UE | No | No |  | FFS max number = {2, …} | Optional with capability signalling |

|  |  |
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| Company | Comment |
| Qualcomm | In FG 33-5-1a, “RRC signalling for SPS group-common PDSCH without PDCCH scheduling~~, SPS group-common PDSCH activation, and SPS release PDCCH~~”. ACK/NACK-based feedback for SPS activation/release should be included in 33-5-1.In FG 33-5-1f, “RRC signalling for SPS group-common PDSCH without PDCCH scheduling~~, SPS group-common PDSCH activation, and SPS release PDCCH~~”. NACK-only-based feedback is not supported for SPS activation/release.In FG 33-5-1c, it can be merged into 33-5-1a and 44-5-1f, respectively. We suggest changing FFS as "FFS whether to merge with 33-5-1a and 33-5-1f respectively” |
| Spreadtrum | The prerequisite FG of FG33-5-1b should be FG33-5-1a.Others are fine. |
|  |  |

**[FL1] Medium priority question 7-2:**

* **Companies are encouraged to provide views on whether to update component 1 in FG 33-5-2 as follows**
	+ **Support [N>1] SPS group-common PDSCH configuration per CFR for multicast, and up to K SPS group-common PDSCH configuration in a cell group**
		- **FFS the value range for K**

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| --- | --- |
| Company | Comment |
| Qualcomm | Support |
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**[FL1] Medium priority question 7-2:**

* **Companies are encouraged to provide views on whether the type of FGs 33-5-1 and 33-5-2 should be per UE or per FSPC**
	+ FG 33-5-1
		- Per UE: Huawei, HiSilicon, OPPO, Nokia, NSB, Spreadtrum Communications
		- Per FSPC: MediaTek, Qualcomm
	+ FG 33-5-2
		- Per UE: Huawei, HiSilicon, OPPO, Nokia, NSB, Spreadtrum Communications
		- Per FSPC: MediaTek, Qualcomm

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| Company | Comment |
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**Low priority proposal 7-3:**

* **Component 2 of FG 33-5-2 is revised as:** **Support [N>=M>=1] activated SPS group-common PDSCH configurations among the N SPS group-common PDSCH configurations per CFR for multicast.**

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| Company | Comment |
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**Low priority question 7-4:**

* **Companies are encouraged to provide views on whether/how to revise the prerequisite feature groups for FG 33-5-1 and 33-5-2.**

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| Company | Comment |
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**Low priority question 7-5:**

* **Companies are encouraged to provide views on whether/how to revise any other contents in FGs 33-5-1 and 33-5-2 which do not have capability signaling impacts**

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| Company | Comment |
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# **33-6-1 to 33-6-3: HARQ-ACK with different priorities for multicast**

In [1], FGs 33-6-1 to 33-6-3 are captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 33. NR\_MBS | 33-6-1 | DL priority indication for multicast in DCI | 1. Support of priority indicator field configured in DCI formats 1\_1 with CRC scrambled with G-RNTI for multicast.FFS whether/how to separate the above capability from FG 33-6-1 | 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-6-2 | Two HARQ-ACK codebooks simultaneously constructed for supporting HARQ-ACK codebooks with different priorities for multicast or for unicast and multicast at a UE. | 1. Supports two HARQ-ACK codebooks with different priorities to be simultaneously constructed different priorities for multicast or for unicast and multicast at a UE. | 33-6-1 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-6-3 | More than one PUCCH for HARQ-ACK transmission for multicast or for unicast and multicast within a slot | 1. Supports two non-overlapping slot-based PUCCHs for ACK/NACK based HARQ-ACK feedback for multicast or for unicast and multicast with different priorities in a slot. | 33-6-1, 33-6-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |

Following feedbacks are provided in contributions for the RAN1#108-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [2] | Huawei, HiSilicon | For dynamic scheduling, the priority indication can be included in DCI format 4\_2 for multicast. The priority index cannot be directly configured by RRC signalling, although it means low priority when the priority indication is not included in the DCI format. Therefore, separating UE capabilities of supporting priority configuration from supporting priority indication included in DCI format does not seem necessary. For multicast SPS scheduling, the priority index is configured together with the configuration for SPS. There could be an UE capability of support of priority configuration for multicast SPS but it is not needed to have a capability defined for support of priority indicator field in the DCI format just for multicast SPS scheduling. ***Proposal 10: Updating FG33-6-1 and adding FG33-6-1a as follows in red:***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-6-1 | DL priority indication in DCI for multicast dynamic scheduling | Support of priority indicator field configured in DCI format 4\_2 with CRC scrambled with G-RNTI for multicast dynamic scheduling. | 33-2-1 | Yes |  |  | Per UE | No | No |  | Notes: - Two priority indexes are introduced for multicast, with index 0 meaning low priority and index 1 meaning high priority.- 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. | Optional with capability signalling |
| 33. NR\_MBS | 33-6-1a | DL priority configuration for multicast SPS scheduling | Support of priority index configuration for multicast SPS scheduling. | 33-5-1 | Yes |  |  | Per UE | No | No |  | Notes: - Two priority indexes are introduced for multicast, with index 0 meaning low priority and index 1 meaning high priority.- 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. | Optional with capability signalling |

 |
| [5] | OPPO | For FG 33-6-1, support of priority indicator field configured in DCI format 4\_1 with CRC scrambled with G-RNTI for multicast.1. ***For FG 33-6-1, there is no need to separate the capability.***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-6-1 | DL priority indication for multicast in DCI | 1. Support of priority indicator field configured in DCI formats 4\_1 ~~1\_1~~ with CRC scrambled with G-RNTI for multicast.~~FFS whether/how to separate the above capability from FG 33-6-1~~ | 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-6-2 | Two HARQ-ACK codebooks simultaneously constructed for supporting HARQ-ACK codebooks with different priorities for multicast or for unicast and multicast at a UE. | 1. Supports two HARQ-ACK codebooks with different priorities to be simultaneously constructed different priorities for multicast or for unicast and multicast at a UE. | 33-6-1 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-6-3 | More than one PUCCH for HARQ-ACK transmission for multicast or for unicast and multicast within a slot | 1. Supports two non-overlapping slot-based PUCCHs for ACK/NACK based HARQ-ACK feedback for multicast or for unicast and multicast with different priorities in a slot. | 33-6-1, 33-6-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |

 |
| [6] | Nokia, NSB | * **33-6-1:**
	+ Per UE
* **33-6-2:**
	+ Per UE
* **33-6-3:**
	+ Per UE
 |
| [10] | Spreadtrum Communications | In latest 38.212 spec [2], DCI format for broadcast has been captured as DCI format 4\_0, and DCI format for multicast has been captured as DCI format 4\_1 and DCI format 4\_2. In order to align with the current spec, we have the following proposal:***Proposal 1***: Revise DCI format to align with 38.212,* In component 1 of FG 33-6-1, DCI format 1\_1 is adjusted as DCI format 4\_2;

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-6-1 | DL priority indication for multicast in DCI | 1. Support of priority indicator field configured in DCI formats 4\_2 with CRC scrambled with G-RNTI for multicast.FFS whether/how to separate the above capability from FG 33-6-1 | 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |

 |
| [13] | Samsung | Also, DCI format 0\_1 and 1\_1 in FG 33-2 and 33-6-1 should be replaced with DCI format 4\_1 and 4\_2, respectively. For 33-6-1, we assume that activation DCI with G-CS-RNTI would also indicate priority. Then, G-CS-RNTI needs to be added as well.

|  |  |  |  |
| --- | --- | --- | --- |
| Features | Index | Feature group | Components |
| 33. NR\_MBS | 33-6-1 | DL priority indication for multicast in DCI | 1. Support of priority indicator field configured in DCI formats 1\_1 with CRC scrambled with G-RNTI and G-CS-RNTI for multicast.FFS whether/how to separate the above capability from FG 33-6-1. |

 |
| [15] | Qualcomm |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-6-1a | DL priority of multicast HARQ-ACK feedback for dynamically scheuled multicast | 1. Support of priority configured for multicast HARQ-ACK feedback of dynamically scheuled multicastNotes: * Two priority indexes are introduced for multicast, with index 0 meaning low priority and index 1 meaning high priority.
* 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.
 | 33-2a or 33-4 | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-6-1b | DL priority indication for dynamically scheduled multicast in DCI | 1.    Support of priority indicator field configured in DCI formats 4\_2 with CRC scrambled with G-RNTI for multicast. | 33-2b, 33-6-1a | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-6-1c | DL priority of multicast HARQ-ACK feedback SPS multicast | 1. Support of priority configured for multicast HARQ-ACK feedback of SPS multicast | 33-5-1a or 33-5-1d | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-6-1d | DL priority indication for SPS multicast with PDCCH scheduling | 1. Support of priority indicator field configured in DCI format 4\_2 with CRC scrambled with G-CS-RNTI for SPS multicast. | 33-5-1b, 33-6-1c | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-6-2 | Two HARQ-ACK codebooks simultaneously constructed for supporting HARQ-ACK codebooks with different priorities for multicast or for unicast and multicast at a UE. | 1. Supports two HARQ-ACK codebooks with different priorities to be simultaneously constructed different priorities for multicast or for unicast and multicast at a UE. | 33-6-1a | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-6-3 | More than one PUCCH for HARQ-ACK transmission for multicast or for unicast and multicast within a slot | 1. Supports two non-overlapping slot-based PUCCHs for ACK/NACK based HARQ-ACK feedback for multicast or for unicast and multicast with different priorities in a slot. | 33-6-2 | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |

 |

## **Discussion**

**[FL1] High priority question 8-1:**

* **Companies are encouraged to provide views on** **whether to separate the following capabilities from FG 33-6-1.**
	+ **Support of priority index configuration for dynamically scheduled multicast**
	+ **Support of priority index configuration for multicast SPS scheduling**
	+ **Support of priority indicator field configured in DCI format 4\_2 with CRC scrambled with G-CS-RNTI for SPS multicast**

|  |  |
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| Company | Comment |
| Qualcomm | Support |
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|  |  |

**[FL1] Medium priority question 8-2:**

* **Companies are encouraged to provide views on whether the type of FGs 33-6-1 to 33-6-3 should be per UE or per FSPC**
	+ FGs 33-6-1
		- Per UE: Huawei, HiSilicon, OPPO, Nokia, NSB, Spreadtrum Communications
		- Per FSPC: MediaTek, Qualcomm
	+ FGs 33-6-2
		- Per UE: OPPO, Nokia, NSB
		- Per FSPC: MediaTek, Qualcomm
	+ FGs 33-6-3
		- Per UE: OPPO, Nokia, NSB
		- Per FSPC: MediaTek, Qualcomm

|  |  |
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| Company | Comment |
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|  |  |
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**Low priority proposal 8-3:**

* **Components of FG 33-6-1 are revised as “Support of priority indicator field configured in DCI formats 4\_2 with CRC scrambled with G-RNTI for multicast”.**

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| Company | Comment |
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**Low priority question 8-4:**

* **Companies are encouraged to provide views on whether/how to revise the prerequisite feature groups for FG 33-6-1 to 33-6-3.**

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| Company | Comment |
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**Low priority question 8-5:**

* **Companies are encouraged to provide views on whether/how to revise any other contents in FGs 33-6-1 to 33-6-3 which do not have capability signaling impacts**

|  |  |
| --- | --- |
| Company | Comment |
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# **33-7: Supporting group-common DCI indicating the enabling/disabling [ACK/NACK based] HARQ-ACK feedback**

In [1], FG 33-7 is captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 33. NR\_MBS | 33-7 | Supporting group-common DCI indicating the enabling/disabling [ACK/NACK based] HARQ-ACK feedback | 1. Supports the function of group-common DCI indicating the enabling/disabling [ACK/NACK based] HARQ-ACK feedback | 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |

Following feedbacks are provided in contributions for the RAN1#108-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [5] | OPPO | As the difference between FG 33-7 and FG 33-2b has been clarified during RAN1#107bis-e meeting, FG 33-7 is a separate feature for UE to support GC-DCI enabling/disabling HARQ-ACK feedback. By considering FG 33-2 and FG 33-4, both ACK/NACK and NACK-only based HARQ-ACK feedback should be considered. However, the two types of feedback mechanism can be separated since they are two independent features based on different UE capabilities and use cases.1. ***For FG 33-7, group-common DCI indicating the enabling/disabling ACK/NACK and NACK-only based HARQ-ACK feedback should be supported.***
2. ***For FG 33-7, ACK/NACK based feedback and NACK-only based feedback should be separated into two sub-FGs.***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-7-1 | Supporting group-common DCI indicating the enabling/disabling [ACK/NACK based] HARQ-ACK feedback | 1. Supports the function of group-common DCI indicating the enabling/disabling ~~[~~ACK/NACK based~~]~~ HARQ-ACK feedback | 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-7-2 | Supporting group-common DCI indicating the enabling/disabling [ACK/NACK based] HARQ-ACK feedback | 1. Supports the function of group-common DCI indicating the enabling/disabling NACK-only based HARQ-ACK feedback | 33-2 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |

 |
| [6] | Nokia, NSB | * **33-7:**
	+ Per UE
 |
| [7] | NTT DOCOMO | The feature of FG 33-7 is redundant with FG 33-2b. FG 33-7 can be removed.***Proposal 8: Remove FG 33-7.*** |
| [8] | Intel | * FG 33-7:
	+ Add NACK-only feedback also to this FG

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-7 | Supporting group-common DCI indicating the enabling/disabling  ~~[~~ACK/NACK and NACK-only based~~]~~ HARQ-ACK feedback | 1. Supports the function of group-common DCI indicating the enabling/disabling ~~[~~ACK/NACK and NACK-only based~~]~~ HARQ-ACK feedback | 33-2 |

 |
| [10] | Spreadtrum Communications | Since FG33-2b has captured the function of supporting DCI-based enabling/disabling ACK/NACK based HARQ-ACK feedback configured per G-RNTI by RRC signaling, and FG33-4-1 has captured the function of supporting DCI-based enabling/disabling NACK-only based HARQ-ACK feedback configured per G-RNTI by RRC signaling, in order to avoid duplication, we suggest to delete FG33-7.***Proposal 8***: Suggest to delete FG33-7. |
| [11] | CMCC | As the DCI based HARQ-ACK feedback enabling/disabling, it is supported for both ACK/NACK based HARQ-ACK feedback and NACK-only HARQ-ACK feedback. In addition, considering ACK/NACK based HARQ-ACK feedback and NACK-only based HARQ-ACK feedback are two separate FGs, both FG 33-2 and FG 33-4 should be the prerequisite feature groups of FG 33-7.**Proposal 10. Update the FG 33-7 as the following:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33-7 | Supporting group-common DCI indicating the enabling/disabling ~~[ACK/NACK based]~~ HARQ-ACK feedback | 1. Supports ~~the function of~~ group-common DCI indicating the enabling/disabling ~~[ACK/NACK based]~~ HARQ-ACK feedback | 33-2, 33-4 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |

 |
| [12] | Xiaomi | In the updated RAN1 UE features list, FG 33-7 is captured for supporting group-common DCI indicating the enabling/disabling [ACK/NACK based] HARQ-ACK feedback.[1] However, FG 33-2b is already specified to support DCI-based enabling/disabling ACK/NACK-based feedback for dynamic scheduling for multicast, which fully covers the current FG 33-7.**Proposal 9: FG 33-2b is sufficient and remove FG 33-7 in the MBS UE feature list.** |
| [15] | Qualcomm | We suggest to delete FG33-7 since it can be replaced by FG33-2c for ACK/NACK-based and FG33-4-1 for NACK-only-based, respectively. |

## **Discussion**

**[FL1] High priority question 9-1:**

* **Companies are encouraged to provide views on whether to remove FG 33-7.**
	+ Keep: OPPO, Intel, CMCC
	+ Remove: NTT DOCOMO, Spreadtrum Communications, Xiaomi, Qualcomm

|  |  |
| --- | --- |
| Company | Comment |
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|  |  |
|  |  |

**[FL1] High priority question 9-2:**

* **Companies are encouraged to provide views on whether NACK-only based feedback should also be included in FG 33-7.**
	+ Include in FG 33-7: Intel, CMCC
	+ Separate FG: OPPO

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | We prefer Separate FG |
|  |  |
|  |  |

**[FL1] Medium priority question 9-3:**

* **Companies are encouraged to provide views on whether the type of FG 33-7 should be per UE or per FSPC**
	+ Per UE: OPPO, Nokia, NSB, CMCC
	+ Per FSPC: MediaTek,

|  |  |
| --- | --- |
| Company | Comment |
|  |  |
|  |  |
|  |  |

**Low priority question 9-4:**

* **Companies are encouraged to provide views on whether/how to revise the prerequisite feature groups for FG 33-7**

|  |  |
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| Company | Comment |
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|  |  |

**Low priority question 9-5:**

* **Companies are encouraged to provide views on whether/how to revise any other contents in FG 33-7 which do not have capability signaling impacts**

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| --- | --- |
| Company | Comment |
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|  |  |

# **33-9: Supporting unicast PDCCH to release SPS group-common PDSCH**

In [1], FG 33-9 is captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 33. NR\_MBS | 33-9 | Supporting unicast PDCCH to release SPS group-common PDSCH | Supports unicast PDCCH scrambled with CS-RNTI to release SPS group-common PDSCH | 33-5-1 | Yes |  |  | Per UE | No | No |  |  | Optional with capability signalling |

Following feedbacks are provided in contributions for the RAN1#108-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [15] | Qualcomm | We suggest the changes for FG 33-9 as:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-9 | Supporting unicast PDCCH to release SPS group-common PDSCH | Supports unicast PDCCH scrambled with CS-RNTI to release SPS group-common PDSCH | 33-5-1 | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |

 |

## **Discussion**

**[FL1] Medium priority question 10-1:**

* **Companies are encouraged to provide views on whether the type of FG 33-9 should be per UE or per FSPC**
	+ Per FSPC: MediaTek, Qualcomm

|  |  |
| --- | --- |
| Company | Comment |
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|  |  |
|  |  |

**Low priority question 10-2:**

* **Companies are encouraged to provide views on whether/how to revise the prerequisite feature groups for FG 33-9.**

|  |  |
| --- | --- |
| Company | Comment |
|  |  |
|  |  |
|  |  |

**Low priority question 10-3:**

* **Companies are encouraged to provide views on whether/how to revise any other contents in FG 33-9 which do not have capability signaling impacts**

|  |  |
| --- | --- |
| Company | Comment |
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|  |  |
|  |  |

# **Other FGs**

This section discusses other FGs which are not included in [1].

Following feedbacks are provided in contributions for the RAN1#108-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [15] | Qualcomm |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 33. NR\_MBS | 33-8-1 | PUCCH resource configuration for ACK/NACK-based multicast feedback for dynamically scheduled multicast | 1. Support of a PUCCH-Config for multicast ACK/NACK-based HARQ-ACK feedback, separate from that of unicast configurations | 33-2a | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-8-2 | Up to 2 PUCCH resources configuration for ACK/NACK-based multicast feedback for dynamically scheduled multicast | 1. Support of a PUCCH-ConfigurationList for multicast ACK/NACK-based HARQ-ACK feedback, separate from that of unicast configurations | 33-2a, 33-6-1a | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-8-3 | PUCCH resource configuration for NACK-only-based multicast feedback for dynamically scheduled multicast | 1. Support of a PUCCH-Config for multicast NACK-only-based HARQ-ACK feedback, separate from that of multicast ACK/NACK-based configurations if configured  | 33-4 | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-8-4 | Up to 2 PUCCH resources configuration for NACK-only-based multicast feedback for dynamically scheduled multicast | 1. Support of a seperate PUCCH-ConfigurationList for multicast NACK-only-based HARQ-ACK feedback, separate from that of multicast ACK/NACK-based configurations if configured | 33-4, 33-6-1b | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |
| 33. NR\_MBS | 33-8-5 | PUCCH resource configuration for ACK/NACK-based multicast feedback for SPS GC-PDSCH | 1. Support of a SPS-PUCCH-AN-List for multicast ACK/NACK-based HARQ-ACK feedback of all SPS configuration(s), separate from that of SPS unicast configurations | 33-5-1a | Yes |  |  | Per FSPC | N/A | N/A |  |  | Optional with capability signalling |

 |

## **Discussion**

**[FL1] High priority question 11-1:**

* **Companies are encouraged to provide views on whether to introduce new FGs for** **PUCCH resource configuration as follows:**
	+ **FG for support of a PUCCH-Config for multicast ACK/NACK-based HARQ-ACK feedback, separate from that of unicast configurations.**
	+ **FG for support of a PUCCH-ConfigurationList for multicast ACK/NACK-based HARQ-ACK feedback, separate from that of unicast configurations.**
	+ **FG for support of a PUCCH-Config for multicast NACK-only-based HARQ-ACK feedback, separate from that of multicast ACK/NACK-based configurations if configured.**
	+ **FG for support of a seperate PUCCH-ConfigurationList for multicast NACK-only-based HARQ-ACK feedback, separate from that of multicast ACK/NACK-based configurations if configured.**
	+ **FG for support of a SPS-PUCCH-AN-List for multicast ACK/NACK-based HARQ-ACK feedback of all SPS configuration(s), separate from that of SPS unicast configurations.**

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | SupportConsidering feedback is optional feature, the PUCCH resource configuration for multicast should be treated as separate FGs. |
|  |  |
|  |  |

# **Conclusions**

TBD

# **References**

[1] R1-2200780 Updated RAN1 UE features list for Rel-17 NR after RAN1 #107bis-e Moderators (AT&T, NTT DOCOMO, INC.)

[2] R1-2200951 Rel-17 UE features for NR MBS Huawei, HiSilicon

[3] R1-2201128 Discussion on UE features for MBS vivo

[4] R1-2201178 Discussion on Rel-17 UE features for NR MBS ZTE

[5] R1-2201260 Discussion on UE features for NR MBS OPPO

[6] R1-2201419 On UE features for NR MBS Nokia, Nokia Shanghai Bell

[7] R1-2201511 Discussion on Rel-17 UE features for NR MBS NTT DOCOMO, INC.

[8] R1-2201722 UE Features for NR MBS Intel Corporation

[9] R1-2201800 Views on Rel-17 MBS UE Features Apple

[10] R1-2201818 UE features for R17 NR MBS Spreadtrum Communications

[11] R1-2201888 Discussion on UE features for NR MBS CMCC

[12] R1-2201934 Discussion on UE features for NR MBS Xiaomi

[13] R1-2202047 UE features for NR MBS Samsung

[14] R1-2202082 Views on UE features for NR MBS MediaTek Inc.

[15] R1-2202176 UE features for MBS Qualcomm Incorporated

[16] R1-2202395 views on NR MBS UE features Ericsson