3GPP TSG RAN WG1 #108-e R1-220XXXX

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

**Agenda item:** 8.12

**Source:** CMCC

**Title:** Agreements for NR MBS up to RAN1#108

**Document for:** Discussion/decision

# 1. Agreements in #102 e-meetings

**RAN1#102-e**

Agreements:

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

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

Agreements:

For RRC\_CONNECTED UEs, at least support group-common PDCCH with CRC scrambled by a common RNTI to schedule a group-common PDSCH, where the scrambling of the group-common PDSCH is based on the same common RNTI.

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

Agreements:

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

Agreements:

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

Agreements:

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

Agreements:

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

# 2. Agreements in #103 e-meetings

**RAN1#103-e**

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

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

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

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

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

**Working assumption:**

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

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

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

Agreements: Support SPS group-common PDSCH for MBS for RRC\_CONNECTED UEs

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Agreements:

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

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

Agreements:

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

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

Agreements:

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

* FFS PUCCH format

Agreements:

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

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

Agreements:

For slot-level repetition for group-common PDSCH of RRC\_CONNECTED UEs, for indicating the repetition number, further down-select among:

* Opt 1: by DCI
* Opt 2: by RRC
* Opt 3: by RRC+DCI
* FFS: Opt 4: by MAC-CE
* FFS: Opt 5: by RRC+MAC-CE
* FFS details for each option.
* FFS further enhancements for configuration of slot-level repetition

Agreements:

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

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

Agreements:

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

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

Agreements:

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

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

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

Agreements:For RRC\_IDLE/RRC\_INACTIVE UEs, support group-common PDCCH with CRC scrambled by a common RNTI to schedule a group-common PDSCH, where the scrambling of the group-common PDSCH is based on the same common RNTI.

* FFS details

Agreements:

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

**Agreements:** For RRC\_IDLE/RRC\_INACTIVE UEs, define/configure common frequency resource(s) for group-common PDCCH/PDSCH.

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

**Agreements:** From physical layer perspective, for broadcast reception, the same group-common PDCCH and the corresponding scheduled group-common PDSCH can be received by both RRC\_IDLE/RRC\_INACTIVE UEs and RRC\_CONNECTED UEs.

* FFS details.

 Agreements**:** For RRC\_IDLE/RRC\_INACTIVE UEs, CSS is supported for group-common PDCCH.

* FFS: reuse current CSS type, define a new CSS type, etc.
* FFS other details.

 Agreements: For RRC\_IDLE/RRC\_INACTIVE UEs, a CORESET can be configured within the common frequency resource for group-common PDCCH/PDSCH. CORESET0 is used by default if the common frequency resource for group-common PDCCH/PDSCH is the initial BWP and the CORESET is not configured.

* FFS: configuration details of the CORESET for group-common PDCCH/PDSCH

# 3. Agreements in #104 e-meetings

**RAN1#104-e**

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

Agreement:

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

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

Agreement:

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

Agreement:

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

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

Agreement:

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

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

Working Assumption:

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

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

Agreement:

For RRC\_CONNECTED UEs, more than one SPS group-common PDSCH configuration for MBS can be configured per UE subject to UE capability

* The total number of SPS configurations supported by a UE currently defined for unicast is not increased due to additionally supporting MBS.
* FFS: How to allocate the total SPS configurations between MBS and unicast.

Agreement:

For RRC\_CONNECTED UEs, support HARQ-ACK feedback for SPS group-common PDSCH for MBS

* FFS: The retransmission scheme(s)
* FFS: The HARQ-ACK details for SPS PDSCH and activation/deactivation, which can be discussed in AI 8.12.2

Agreement:

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

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

Agreement:

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

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

Working assumption:

For activation/deactivation of SPS group-common PDSCH for MBS in RRC\_CONNECTED state,

* At least group-common PDCCH is supported
  + FFS: Whether and how to address the missed activation and deactivation
* FFS: Whether UE-specific PDCCH is supported for activation/deactivation

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

Agreement:

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

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

Agreement:

For slot-level repetition for group-common PDSCH for RRC\_CONNECTED UEs receiving multicast,

* (Config A) UE can be optionally configured with *pdsch-AggregationFactor*.
* (Config B) UE can be optionally configured with TDRA table with *repetitionNumber* as part of the TDRA table.
* If UE is configured with Config B, UE does not expect to be configured with Config A for the same group-common PDSCH.

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

Agreement:

For RRC\_IDLE/RRC\_INACTIVE UEs, one common frequency resource for group-common PDCCH/PDSCH can be defined/configured.

* FFS: whether to define/configure more than one common frequency resources

Agreement:

For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, the UE may assume that group-common PDCCH/PDSCH is QCL’d with SSB.

* It is up to UE implementation whether UE monitors monitoring occasions corresponding to all SSB indexes or monitoring occasions corresponding to a subset of all SSB indexes.
* FFS: association rules between SSB indexes and UE monitoring occasions.
* FFS: group-common PDCCH/PDSCH is QCl’d with TRS if configured

Agreement:

For broadcast reception, the same group-common PDCCH and the corresponding scheduled group-common PDSCH can be received by both RRC\_IDLE/RRC\_INACTIVE UEs and RRC\_CONNECTED UEs when UE-specific active BWP of RRC\_CONNECTED UE contains the common frequency resource of RRC\_IDLE/INACTIVE UEs and the SCS and CP are the same.

* FFS: the case when UE-specific active BWP of RRC\_CONNECTED UE does not contain the common frequency resource of RRC\_IDLE/INACTIVE UEs.

Agreement:

For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, further study the following cases of a configured/defined specific common frequency resource (CFR) for group-common PDCCH/PDSCH, and identify which case(s) will be supported:

* [Case E] the case where a CFR is defined based on a configured BWP.
  + In particular, study the following:
    - whether a configured BWP for MBS is needed or not.
    - whether BWP switching is needed or not.
  + In this study, the configured BWP has the following properties:
    - The configured BWP is different than the initial BWP where the frequency resources of this initial BWP are configured smaller than the full carrier bandwidth.
    - The CFR has the frequency resources identical to the configured BWP.
    - The configured BWP needs to fully contain the initial BWP in frequency domain and has the same SCS and CP as the initial BWP.
  + Note: The configured BWP is not larger than the carrier bandwidth
* the case where the initial BWP fully contains the CFR in the frequency domain.
  + In this study the following sub-cases are considered:
    - [Case B] A CFR with smaller size than the initial BWP, where the initial BWP has the same frequency resources as CORESET0. In this case the CFR has the frequency resources confined within the initial BWP and have the same SCS and CP as the initial BWP.
    - [Case D] A CFR with smaller size than the initial BWP, where the initial BWP has the frequency resources configured by SIB1. In this case the CFR has the frequency resources confined within the initial BWP and have the same SCS and CP as the initial BWP.
  + In particular, study the following:
    - Whether the considered two options with a CFR with smaller size than the initial BWP are needed or not for MBS.
* the case where the initial BWP has same size as the CFR in the frequency domain.
  + In this study the following two sub-cases are considered:
    - [Case A] A CFR with the same size as the initial BWP, where the initial BWP has the same frequency resources as CORESET0. In this case the CFR has the same frequency resources and same SCS and CP as the initial BWP.
    - [Case C] A CFR with same size as the initial BWP, where the initial BWP has the frequency resources configured by SIB1. In this case the CFR has the same frequency resources and same SCS and CP as the initial BWP.
  + In particular, study the following:
    - Whether the considered two options with a CFR with the same size as the initial BWP are needed or not for MBS.

# 4. Agreements in #104b e-meetings

**RAN1#104b-e**

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

Agreement:

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

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

Agreement:

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

Agreement:

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

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

Agreement:

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

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

Agreement:

One CFR is supported per dedicated unicast BWP for multicast of RRC-CONNECTED UEs.

* FFS: Whether more than one CFR is supported per dedicated unicast BWP
* FFS: Whether multicast can be supported or not in a dedicated unicast BWP when no CFR is configured for that BWP

Agreement:

The retransmission scheme for a given SPS group-common PDSCH can be either PTM scheme 1 or PTP.

* FFS: Whether PTM scheme 1 retransmission and PTP retransmission can be used simultaneously for different UEs in the same MBS group

Agreement:

Define G-CS-RNTI at least for SPS group-common PDSCH and activation/deactivation of SPS group-common PDSCH, different from CS-RNTI for unicast SPS PDSCH.

* G-CS-RNTI is used for PTM scheme 1 based dynamic retransmission of SPS group-common PDSCH
* FFS: Whether CS-RNTI can be used for PTP retransmission of SPS group-common PDSCH.
* FFS: Number of G-CS-RNTI.

Conclusion:

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

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

Agreement:

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

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

Agreement:

Include the following in the LS to RAN2:

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

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

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

Agreement:

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

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

Agreement:

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

Conclusion:

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

Agreement:

For RRC\_CONNECTED UE supporting MBS, support up to 8 configured SPS configurations in a BWP of a serving cell for unicast and MBS in total.

* It is up to gNB implementation to configure the SPS configuration indexes for unicast and MBS, respectively.

Agreement:

Confirm the working assumption:

For activation/deactivation of SPS group-common PDSCH for MBS in RRC\_CONNECTED state,

* At least group-common PDCCH is supported
  + FFS: Whether and how to address the missed activation and deactivation
* FFS: Whether UE-specific PDCCH is supported for activation/deactivation

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

Agreement:

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

Agreement:

Two priority indexes are introduced for multicast, with

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

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

# 5. Agreements in #105 e-meetings

**RAN1#105-e**

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

Agreement:

For CSS of group-common PDCCH of PTM scheme 1 for multicast in RRC\_CONNECTED state, Alt 2 is supported:

* Alt 2: support a Type-x CSS
  + The monitoring priority of Type-x CSS is determined based on the search space set indexes of the Type-x CSS set and USS sets, regardless of which DCI format of group-common PDCCH is configured in the Type-x CSS.
* FFS: Whether the Type-x CSS is a Type-3 CSS

Agreement:

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

Agreement:

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

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

Working assumption:

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

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

Agreement:

For multicast of RRC\_CONNECTED UEs, further study

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

Agreement:

Confirm the working assumption:

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

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

Agreement:

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

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

Agreement:

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

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

Working assumption:

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

Agreement:

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

* FFS for SPS activation/deactivation.

Agreement:

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

Agreement:

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

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

Agreement:

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

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

**Conclusion:**

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

Agreement:

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

Agreement:

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

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

Agreement:

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

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

assumption:

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

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

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

Agreement:

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

Agreement:

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

* FFS details of FDRA.

Agreement:

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

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

Agreement:

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

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

Agreement:

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

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

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

**Conclusion:**

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

Agreement:

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

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

Agreement:

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

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

# 6. Agreements in #106 e-meetings

**RAN1#106-e**

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

Agreement:

Confirm the working assumption with the following update:

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

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

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

Agreement:

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

Agreement:

Confirm the following working assumption:

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

Agreement:

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

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

Agreement:

For LBRM and TBS determination for GC-PDSCH:

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

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

Agreement:

If a SPS-config for MBS is configured in CFR, one G-CS-RNTI is associated with the SPS-config.

* FFS: Multiple G-CS-RNTIs associated with one SPS-config

Agreement:

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

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

Conclusion:

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

Agreement:

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

* equals the higher layer parameter *dataScramblingIdentityPDSCH* if it is configured in *PDSCH-Config* in a CFR used for GC-PDSCH and the RNTI equals the G-RNTI or G-CS-RNTI; otherwise.
* corresponds to the RNTI associated with the GC-PDSCH transmission (i.e., the G-RNTI used by the scheduling GC-PDCCH, or the G-CS-RNTI used by the SPS GC-PDSCH activation PDCCH)

Agreement:

For initializing sequence generator for DMRS of GC-PDCCH with the second DCI format received in Type-x CSS,

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

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

Agreement:

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

Agreement:

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

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

Agreement:

The priority index is,

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

Agreement:

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

Working assumption:

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

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

Agreement

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

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

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

Agreement:

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

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

Conclusion:

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

Agreement:

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

Agreement:

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

Agreement:

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

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

Agreement

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

Agreement

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

Agreement:

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

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

Conclusion:

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

Agreement:

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

Agreement:

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

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

# 7. Agreements in RANP#93 e-meetings

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

Agreement:

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

Agreement (Updated proposal from RAN1#106e):

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

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

# 8. Agreements in #106b e-meetings

**RAN1#106b-e**

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

Agreement:

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

Agreement:

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

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

Agreement:

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

Agreement:

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

Agreement:

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

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

Agreement:

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

Agreement:

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

Agreement:

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

* equals the higher layer parameter *dataScramblingIdentityPDSCH* if it is configured in *PDSCH-Config* in a CFR used for GC-PDSCH and the RNTI equals the G-RNTI or G-CS-RNTI; otherwise.
* corresponds to the RNTI associated with the GC-PDSCH transmission (i.e., the G-RNTI used by the scheduling GC-PDCCH, or the G-CS-RNTI used by the SPS GC-PDSCH activation PDCCH)

Agreement:

For initializing sequence generator for DMRS of GC-PDSCH,

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

Agreement:

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

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

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

Agreement:

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

Agreement:

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

* + Alt2: Always low priority, i.e., the priority index is not included in the DCI format.

Agreement:

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

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

Agreement:

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

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

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

Agreement:

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

Agreement:

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

Agreement:

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

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

Agreement:

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

Agreement:

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

* equals the higher layer parameter *dataScramblingIdentityPDSCH* if it is configured in a CFR used for GC-PDSCH for MCCH/MTCH and the RNTI equals the G-RNTI or MCCH-RNTI; otherwise.
* corresponds to the RNTI associated with the GC-PDSCH transmission.

Agreement:

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

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

Agreement:

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

* equals the higher-layer parameters *scramblingID0* if it is configured in the *DMRS-DownlinkConfig*IE in a CFR used for GC-PDSCH for MCCH/MTCH;  otherwise.

Working assumption:

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

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

Agreement:

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

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

Agreement:

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

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

# 8. Agreements in #107 e-meetings

**RAN1#107-e**

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

Agreement:

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

Agreement:

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

* given by

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

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

- otherwise by

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

Agreement:

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

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

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

Agreement:

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

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

Conclusion:

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

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

Agreement:

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

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

Conclusion:

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

Agreement:

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

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

Conclusion:

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

Agreement:

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

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

Agreement:

For multicast in RRC\_CONNECTED state,

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

Agreement:

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

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

Agreement:

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

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

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

Agreement:

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

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

Agreement:

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

Agreement:

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

Agreement:

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

Agreement:

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

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

Agreement:

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

Agreement:

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

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

Agreement:

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

Agreement:

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

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

Agreement:

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

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

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

Agreement:

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

Working assumption:

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

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

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

Final LS is endorsed in R1-2112646

Agreement:

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

Conclusion:

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

Agreement:

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

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

Working assumption:

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

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

* Note: for Case A and Case C, the above parameters (Point A, *offsetToCarrier* and *locationAndBandwidth*) can be derived from the configurations in MIB and SIB1, respectively.

Agreement:

For RRC\_IDLE/INACTIVE UEs, for slot-level repetition for MTCH, support:

* (Config A) UE can be configured with *pdsch-AggregationFactor* per G-RNTI, applied to DCI format 1\_0 with the G-RNTI.
* (Config B) UE can be configured with TDRA table with *repetitionNumber* as part of the TDRA table in *PDSCH-Config-Broadcast*
* If UE is configured with Config B, UE does not expect to be configured with Config A for the same GC-PDSCH.

Agreement:

The following agreements for RRC\_CONECTED UEs also apply for broadcast reception with UEs in RRC\_IDLE/ RRC\_INACTIVE states, with the following updates:

Agreement:

For LBRM and TBS determination for GC-PDSCH:

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

Agreement:

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

Agreement:

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

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

For LBRM and TBS determination for GC-PDSCH for broadcast reception:

* the maximum number of layers is 1
* the maximum modulation order can be determined from *mcs-Table* in *PDSCH-Config* for broadcast.
* If *mcs-Table* in *PDSCH-Config* is not configured in CFR for broadcast, Table 5.1.3.1-1 in TS38.214 is used.

Agreement:

Confirm the following working assumption with the following note:

* Note: Confirming this WA does not have impact on the down-selection decision for CFR cases

Working assumption

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

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

Conclusion:

RAN1 cannot get consensus on the support of Case D and/or Case E.

Conclusion:

Is up to RAN2 decision:

* the configuration of the MTCH scheduling window parameters: monitoring periodicity and the starting of the periodicity:
* whether the MTCH scheduling window is associated to one or multiple or all G-RNTIs

Send an LS to RAN2 to inform about RAN1 conclusion

R1-2112850 LS on MTCH scheduling window

# 9. Agreements in #107b e-meetings

**RAN1#107b-e**

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

**Agreement**

DCI format 4\_2 doesn’t include the following fields:

* + Scell dormancy indication
  + BWP indicator

DCI format 4\_2 includes the following field (configurable):

* + MCS/NDI/RV for TB2
    - Support of this field is subject to UE capability

**Agreement**

DCI format 4\_2 includes ‘ZP CSI-RS trigger’ field.

**Agreement**

For DCI size alignment of DCI format 4\_2, the size of DCI format 4\_2 is configured by RRC signaling for RRC\_CONNECTED UEs (similar as the configuration for the size alignment among DCI format 2\_0/2\_1/2\_4/2\_5/2\_6).

**Conclusion**

For multicast of RRC\_CONNECTED UEs, the value range of *sps-ConfigIndex* in *SPS-Config-Multicast* is {0-7}, and *sps-ConfigIndex* in *sps-Config* and *SPS-Config-Multicast* cannot be configured with the same value.

The TP below for Clause 10.1 in TS 38.213v17.0.0 is endorsed.

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

**10.1 UE procedure for determining physical downlink control channel assignment**

**<**Unchanged text is omitted>

A UE does not expect to detect, in a same PDCCH monitoring occasion, a DCI format with CRC scrambled by a SI-RNTI, RA-RNTI, MsgB-RNTI, TC-RNTI, P-RNTI, C-RNTI, CS-RNTI, ~~or~~ MCS-RNTI, MCCH-RNTI, G-RNTI, or G-CS-RNTI and a DCI format with CRC scrambled by a SL-RNTI or a SL-CS-RNTI for scheduling respective PDSCH reception and PSSCH transmission on a same serving cell.

**<**Unchanged text is omitted>

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

The TP below for Clause 5.1.2.2 in TS 38.214v17.0.0 is endorsed.

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

**5.1.2.2 Resource allocation in frequency domain**

**<**Unchanged text is omitted>

Two downlink resource allocation schemes, type 0 and type 1, are supported. The UE shall assume that when the scheduling grant is received with DCI format 1\_0, DCI format 4\_0 or DCI format 4\_1, then downlink resource allocation type 1 is used.

If the scheduling DCI is configured to indicate the downlink resource allocation type as part of the '*Frequency domain resource assignment'* field by setting a higher layer parameter *resourceAllocation* in *PDSCH-Config* to 'dynamicSwitch', for DCI format 1\_1 or setting a higher layer parameter *resourceAllocationDCI-1-2* in *PDSCH-Config* to 'dynamicSwitch' for DCI format 1\_2 or setting a higher layer parameter *resourceAllocation* in *PDSCH-Config-Multicast* to 'dynamicSwitch' for DCI format 4\_2, the UE shall use downlink resource allocation type 0 or type 1 as defined by this DCI field. Otherwise the UE shall use the downlink frequency resource allocation type as defined by the higher layer parameter *resourceAllocation* in *PDSCH-Config* for DCI format 1\_1 or by the higher layer parameter *resourceAllocationDCI-1-2* for DCI format 1\_2 or by the higher layer parameter *resourceAllocation* in *PDSCH-Config-Multicast* for DCI format 4\_2.

**<**Unchanged text is omitted>

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

The TP below for Clause 5.1.2.3 in TS 38.214v17.0.0 is endorsed.

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

**<**Unchanged text is omitted>

The PRB bundling procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 1\_2, by applying the parameters of *prb-BundlingTypeDCI-1-2* instead of *prb-BundlingType* as well as *vrb-ToPRB-InterleaverDCI-1-2* instead of *vrb-ToPRB-Interleaver*. The PRB bundling procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 4\_2, by applying the parameters of *prb-BundlingType* given by *PDSCH-Config-Multicast* as well as *vrb-ToPRB-Interleaver* given by *PDSCH-Config-Multicast*.

A UE may assume that precoding granularity is  consecutive resource blocks in the frequency domain.  can be equal to one of the values among {2, 4, wideband}.

If  is determined as "wideband", the UE is not expected to be scheduled with non-contiguous PRBs and the UE may assume that the same precoding is applied to the allocated resource associated with a same TCI state or a same QCL assumption.

**<**Unchanged text is omitted>

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

**Agreement**

For DMRS of GC-PDSCH,

* + For GC-PDSCH scheduled by a DCI format 4\_0/4\_1, the UE assumes *dmrs-AdditionalPosition* = ‘pos2’, similar as that of DCI format 1\_0.
  + For GC-PDSCH scheduled by a DCI format 4\_2, the UE assumes *dmrs-AdditionalPosition* in *DMRS-Config* if configured in *PDSCH-Config-Multicast*, similar as that of DCI format 1\_1.
  + Adopt the following TP for Clause 5.1.6.2 in TS 38.214:

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

**5.1.6.2 DM-RS reception procedure**

**<**Unchanged text is omitted>

The DM-RS reception procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 1\_2, by applying the parameters of *dmrs-DownlinkForPDSCH-MappingTypeA-DCI-1-2* and *dmrs-DownlinkForPDSCH-MappingTypeB-DCI-1-2* instead of *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB*.

The DM-RS reception procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 4\_2, by applying the parameters of *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB* in *PDSCH-Config-Multicast* instead of *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB in PDSCH-Config*.

When receiving PDSCH scheduled by DCI format 1\_0, 4\_0, 4\_1 or receiving PDSCH before dedicated higher layer configuration of any of the parameters *dmrs-AdditionalPosition*, *maxLength* and *dmrs-Type,* the UE shall assume that the PDSCH is not present in any symbol carrying DM-RS except for PDSCH with allocation duration of 2 symbols with PDSCH mapping type B (described in clause 7.4.1.1.2 of [4, TS 38.211]), and a single symbol front-loaded DM-RS of configuration type 1 on DM-RS port 1000 is transmitted, and that all the remaining orthogonal antenna ports are not associated with transmission of PDSCH to another UE and in addition

- For PDSCH with mapping type A and type B, the UE shall assume *dmrs-AdditionalPosition*='pos2' and up to two additional single-symbol DM-RS present in a slot according to the PDSCH duration indicated in the DCI as defined in Clause 7.4.1.1 of [4, TS 38.211], and

- For PDSCH with allocation duration of 2 symbols with mapping type B, the UE shall assume that the PDSCH is present in the symbol carrying DM-RS.

When receiving PDSCH scheduled by DCI format 1\_1 by PDCCH with CRC scrambled by C-RNTI, MCS-C-RNTI, or CS-RNTI or DCI format 4\_2 by PDCCH with CRC scrambled by G-RNTI or G-CS-RNTI,

- the UE may be configured with the higher layer parameter *dmrs-Type*, and the configured DM-RS configuration type is used for receiving PDSCH in as defined in Clause 7.4.1.1 of [4, TS 38.211].

- the UE may be configured with the maximum number of front-loaded DM-RS symbols for PDSCH by higher layer parameter *maxLength* given by *DMRS-DownlinkConfig.*

- if *maxLength* is set to 'len1', single-symbol DM-RS can be scheduled for the UE by DCI, and the UE can be configured with a number of additional DM-RS for PDSCH by higher layer parameter *dmrs-AdditionalPosition,* which can be set to 'pos0', 'pos1', 'pos2' or 'pos3'.

- if *maxLength* is set to 'len2', both single-symbol DM-RS and double symbol DM-RS can be scheduled for the UE by DCI, and the UE can be configured with a number of additional DM-RS for PDSCH by higher layer parameter *dmrs-AdditionalPosition,* which can be set to 'pos0' or 'pos1'.

- and the UE shall assume to receive additional DM-RS as specified in Table 7.4.1.1.2-3 and Table 7.4.1.1.2-4 as described in Clause 7.4.1.1.2 of [4, TS 38.211].

**<**Unchanged text is omitted>

When receiving PDSCH scheduled by DCI format 1\_0, 4\_0, 4\_1, the UE shall assume the number of DM-RS CDM groups without data is 1 which corresponds to CDM group 0 for the case of PDSCH with allocation duration of 2 symbols, and the UE shall assume that the number of DM-RS CDM groups without data is 2 which corresponds to CDM group {0,1} for all other cases.

**<**Unchanged text is omitted>

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

**Agreement**

For PDSCH scheduled by a DCI format 4\_1/4\_2, the UE assumes *phaseTrackingRS* in *dmrs-DownlinkForPDSCH-MappingTypeA* or *dmrs-DownlinkForPDSCH-MappingTypeB* configured in *PDSCH-Config-Multicast*.

* + Adopt the following TP for Clause 5.1.6.3 in TS 38.214:

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

**5.1.6.3 PT-RS reception procedure**

**<**Unchanged text is omitted>

The procedures on PT-RS reception described in this clause apply to a UE receiving PDSCH scheduled by DCI format 1\_2 configured with the higher layer parameter *phaseTrackingRS* in *dmrs-DownlinkForPDSCH-MappingTypeA-DCI-1-2* or *dmrs-DownlinkForPDSCH-MappingTypeB-DCI-1-2* and to a UE receiving PDSCH scheduled by DCI format 1\_0 or DCI format 1\_1 configured with the higher layer parameter *phaseTrackingRS* in *dmrs-DownlinkForPDSCH-MappingTypeA* or *dmrs-DownlinkForPDSCH-MappingTypeB*. The procedures on PT-RS reception described in this clause apply to a UE receiving PDSCH scheduled by DCI format 4\_1 or DCI format 4\_2 configured with the higher layer parameter *phaseTrackingRS* in *dmrs-DownlinkForPDSCH-MappingTypeA* or *dmrs-DownlinkForPDSCH-MappingTypeB* in *PDSCH-Config-Multicast*.

**<**Unchanged text is omitted>

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

The TP below for Clause 5.1 in TS 38.214v17.0.0 is endorsed.

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

**5.1 UE procedure for receiving the physical downlink shared channel**

**<**Unchanged text is omitted>

A UE shall upon detection of a PDCCH with a configured DCI format 1\_0, 1\_1, 4\_0, 4\_1, 4\_2 or 1\_2 decode the corresponding PDSCHs as indicated by that DCI. For any HARQ process ID(s) in a given scheduled cell, the UE is not expected to receive a PDSCH that overlaps in time with another PDSCH. The UE is not expected to receive another PDSCH for a given HARQ process until after the end of the expected transmission of HARQ-ACK for that HARQ process, where the timing is given by Clause 9.2.3 of [6]. Except for the case when a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *coresetPoolIndex* in *ControlResourceSet* and PDCCHs that schedule two PDSCHs are associated to different *ControlResourceSets* having different values of *coresetPoolIndex,* in a given scheduled cell, the UE is not expected to receive a first PDSCH and a second PDSCH, starting later than the first PDSCH, with its corresponding HARQ-ACK assigned to be transmitted on a resource ending before the start of a different resource for the HARQ-ACK assigned to be transmitted for the first PDSCH, where the two resources are in different slots for the associated HARQ-ACK transmissions, each slot is composed of symbols [4] or a number of symbols indicated by *subslotLengthForPUCCH* if provided, and the HARQ-ACK for the two PDSCHs are associated with the HARQ-ACK codebook of the same priority. Except for the case when a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *coresetPoolIndex* in *ControlResourceSet* and PDCCHs that schedule two PDSCHs are associated to different *ControlResourceSets* having different values of *coresetPoolIndex,* in a given scheduled cell, the UE is not expected to receive a first PDSCH, and a second PDSCH, starting later than the first PDSCH, with its corresponding HARQ-ACK assigned to be transmitted on a resource ending before the start of a different resource for the HARQ-ACK assigned to be transmitted for the first PDSCH if the HARQ-ACK for the two PDSCHs are associated with HARQ-ACK codebooks of different priorities. For any two HARQ process IDs in a given scheduled cell, if the UE is scheduled to start receiving a first PDSCH starting in symbol *j* by a PDCCH ending in symbol *i*, the UE is not expected to be scheduled to receive a PDSCH starting earlier than the end of the first PDSCH with a PDCCH that ends later than symbol *i*. In a given scheduled cell, for any PDSCH corresponding to SI-RNTI, the UE is not expected to decode a re-transmission of an earlier PDSCH with a starting symbol less than *N* symbols after the last symbol of that PDSCH, where the value of *N* depends on the PDSCH subcarrier spacing configuration *m,* with *N*=13 for *m*=0, *N*=13 for *m*=1, *N*=20 for *m*=2, and *N*=24 for *m*=3.

**<**Unchanged text is omitted>

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

The TP below for Clause 5.1.3.2 in TS 38.214v17.0.0 is endorsed.

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

**5.1.3.2 Transport block size determination**

**<**Unchanged text is omitted>

In case the higher layer parameter *maxNrofCodeWordsScheduledByDCI* indicates that two codeword transmission is enabled, then one of the two transport blocks is disabled by DCI format 1\_1 if *IMCS* = 26 and if *rvid* = 1 for the corresponding transport block. If both transport blocks are enabled, transport block 1 and 2 are mapped to codeword 0 and 1 respectively. If only one transport block is enabled, then the enabled transport block is always mapped to the first codeword.

For the PDSCH assigned by a PDCCH with DCI format 1\_0, format 1\_1, format 4\_0, format 4\_1, format 4\_2 or format 1\_2 with CRC scrambled by C-RNTI, MCS-C-RNTI, TC-RNTI, CS-RNTI, G-RNTI, G-CS-RNTI or SI-RNTI, if Table 5.1.3.1-2 is used and *,* or a table other than Table 5.1.3.1-2 is usedand *,* the UE shall, except if the transport block is disabled in DCI format 1\_1, first determine the TBS as specified below:

**<**Unchanged text is omitted>

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

The TP below for Clause 7.3.1.6 in TS 38.211v17.0.0 is endorsed.

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

**7.3.1.6 Mapping from virtual to physical resource blocks**

**<**Unchanged text is omitted>

- for PDSCH transmissions scheduled with DCI format 1\_0 in any common search space in bandwidth part with starting position , other than Type0-PDCCH common search space in CORESET 0 ~~and common search space associated with G-RNTI or G-CS-RNTI~~, the set of virtual resource blocks , where is the size of CORESET 0 if CORESET 0 is configured for the cell and the size of initial downlink bandwidth part if CORESET 0 is not configured for the cell, are divided into virtual resource-block bundles in increasing order of the virtual resource-block number and virtual bundle number and the set of physical resource blocks are divided into physical resource-block bundles in increasing order of the physical resource-block number and physical bundle number, where , is the bundle size, and is the lowest-numbered physical resource block in the control resource set where the corresponding DCI was received.

**<**Unchanged text is omitted>

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

The TP below for Clause 5.1.3.1 in TS 38.214v17.0.0 is endorsed.

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

**<**Unchanged text is omitted>

elseif the higher layer parameter *mcs-Table* given by *PDSCH-Config-Multicast* is set to 'qam256', and the PDSCH is scheduled by a PDCCH with DCI format 4\_1 or 4\_2 with CRC scrambled by G-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the higher layer parameter *mcs-Table* given by *PDSCH-Config-Multicast* is set to 'qam64LowSE', and the PDSCH is scheduled by a PDCCH with DCI format 4\_1 or 4\_2 with CRC scrambled by G-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

**<**Unchanged text is omitted>

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

**Agreement**

For RRC\_CONNECTED UEs receiving broadcast MCCH/MTCH, the Type0B-PDCCH CSS set configured by *searchSpace-Broadcast* in *pdcch-Config-MCCH/pdcch-Config-MTCH* follows the same prioritization rule for search space set overbooking procedure as CSS set(s) configured by *searchSpace-Multicast*.

**Agreement**

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

**Agreement**

For multicast RRC\_CONNECTED UEs, *rateMatchPatternToAddModList*, *rateMatchPatternGroup1* and *rateMatchPatternGroup2* can be configured in *PDSCH-Config-Multicast* for GC-PDSCH rate matching, subject to UE capability. For PDSCH resource mapping with RB symbol level granularity,

* + The procedure for PDSCH scheduled by PDCCH with DCI format 4\_1is similar as that of DCI format 1\_0 and the procedure for PDSCH scheduled by PDCCH with DCI format 4\_2is similar as that of DCI format 1\_1, by applying the parameters of *rateMatchPatternToAddModList*, *rateMatchPatternGroup1* and *rateMatchPatternGroup2* configured in *PDSCH-Config-Multicast*.
  + *rateMatchPatternToAddModList*, *rateMatchPatternGroup1* and *rateMatchPatternGroup2* configured in *PDSCH-Config* for unicast do not apply for GC-PDSCHs.
  + *rateMatchPatternToAddModList*, *rateMatchPatternGroup1* and *rateMatchPatternGroup2* configured in *PDSCH-Config-Multicast* for multicast do not apply for unicast PDSCHs.

**Agreement**

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

**Agreement**

Regarding the size of DCI format 4\_2 for multicast of RRC\_CONNECTED UE,

* + the size is configured per CFR for all G-RNTIs (included in cfr-Config-Multicast).
  + the value range of the size is {[1]..140} (the same as for DCI format 2\_6)

**Agreement**

Regarding the size of DCI format 4\_2 for multicast of RRC\_CONNECTED UE,

* + the value range of the size is {20..140}

The TP below for Clause 5.1.4.1 in TS 38.214v17.0.0 is endorsed.

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

**5.1.4.1 PDSCH resource mapping with RB symbol level granularity**

**<**Unchanged text is omitted>

The procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 1\_2, by applying the parameters of *rateMatchPatternGroup1DCI-1-2*, *rateMatchPatternGroup2DCI-1-2* instead of *rateMatchPatternGroup1* and *rateMatchPatternGroup2*.

The procedures for PDSCH scheduled by PDCCH with DCI format 1\_0 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 4\_1, and the procedures for PDSCH scheduled by DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 4\_2 by applying the parameters of *rateMatchPatternToAddModList, rateMatchPatternGroup1* and *rateMatchPatternGroup2* configured in *PDSCH-Config-Multicast*.

**<**Unchanged text is omitted>

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

The TP below for Clause 5.1.4.2 in TS 38.214v17.0.0 is endorsed.

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

**5.1.4.2 PDSCH resource mapping with RE level granularity**

The procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 1\_2, by applying the parameters of *aperiodicZP-CSI-RS-ResourceSetsToAddModListDCI-1-2* instead of *aperiodic-ZP-CSI-RS-ResourceSetsToAddModList*. The procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 4\_2, by applying the parameters of *aperiodicZP-CSI-RS-ResourceSetsToAddModList in PDSCH-Config-Multicast* instead of *aperiodic-ZP-CSI-RS-ResourceSetsToAddModList in PDSCH-Config*.

**<**Unchanged text is omitted>

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

**Agreement**

From RAN1 perspective, it is feasible for UE in RRC\_CONNECTED state to receive MBS broadcast on an activated SCell as long as UE has capability of supporting MBS broadcast on SCell. From RAN1 perspective, if a UE is to receive MBS broadcast on SCell,

* + The capability of supporting MBS broadcast on SCell is separate capability from the one of CA for unicast.
  + The UE is not required to monitor DCI formats associated with SI-RNTI, P-RNTI, RA-RNTI in SCell.
  + Overbooking for SCell is not supported.
  + MBS broadcast reception on SCell can be supported only for RRC\_CONNECTED UEs only with self-scheduling.
  + Type0-PDCCH CSS set is only configured on the primary cell of the MCG.
  + Configuring the search space on SCell for PDCCH monitoring of MBS DCI formats is via unicast RRC signaling.
  + The UE capability is expected to be defined by RAN2.
    - E.g. the total number of component carriers for receiving broadcast on SCell may be subject to UE capability
  + The UE is not required to receive broadcast on PCell and SCell simultaneously

**Agreement**

From RAN1 perspective, it is feasible for UE in RRC\_CONNECTED state to receive MBS broadcast on non-serving cell, which is up to UE implementation and transparent to the network.

* + It is assumed in RAN1 that UE receiving MBS broadcast on non-serving cell does not have any impact to operation on serving cell(s), e.g., does not require UE to obtain the related configuration from the serving cell, does not require the network to guarantee the scheduling doesn’t exceed UE’s capability on serving cell, etc.
  + RAN1 assumes that receiving MBS broadcast on non-serving cell could be on the same or on a different band, but on a different carrier frequency than a UE’s serving cell
  + No RAN1 spec impact and no optimization is pursued in Rel-17 for MBS broadcast reception on non-serving cell.
  + The UE capability(ies), if any, is(are) expected to be defined by RAN2.

R1-2200785 DRAFT LS reply to MBS broadcast reception on SCell and non-serving cell Moderator (Huawei)

Final LS to RAN2 is endorsed in R1-2200798.

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

**Agreement**

When PUCCH carrying multicast HARQ-ACK only overlaps with PUSCH with the same priority, support UL-DAI indicating the number of HARQ-ACK bits for multicast as defined in Rel-16 for unicast HARQ-ACK.

* + FFS it is applied to a single G-RNTI or applied to all configured G-RNTIs.

**Agreement**

Support multiplexing unicast and multicast HARQ-ACK onto the same PUSCH with the same priority for the following cases:

* + If the unicast and multicast HARQ-ACK codebooks are both Type-1
    - Option1-1: the 1-bit UL DAI with value “1” indicates multiplexing unicast and multicast HARQ-ACK codebooks onto the same PUSCH.
    - Option1-2: two bits UL DAI separately indicate whether multiplexing unicast and/or multicast HARQ-ACK codebooks onto the same PUSCH
      * FFS whether it is applied to a single G-RNTI or applied to all configured G-RNTIs.
  + If both unicast and multicast HARQ-ACK codebooks are Type-2, down-select from:
    - Option2-1: the 2-bit UL DAI is applicable to both HARQ-ACK codebooks.
    - Option2-2: 2-bit UL DAI(s) are included in DCI for multicast, in addition to the 2-bit UL DAI for unicast.
      * FFS whether a single UL DAI field is applied to all G-RNTIs, or separate UL DAI fields are applied for each configured G-RNTI.
  + FFS the unicast and multicast HARQ-ACK codebooks are different Types.

The TP below for TS38.213v17.0.0 section 18 is endorsed.

|  |
| --- |
| **<**Unchanged text is omitted>  If a UE is provided *pucch-Config-Multicast1* or *pucch-Config-Multicast2* for PUCCH transmissions with a priority value, the UE transmits a PUCCH with the priority value according to *pucch-Config-Multicast1* or *pucch-Config-Multicast2* for each G-RNTI or G-CS-RNTI that the UE provides associated HARQ-ACK information according to the first HARQ-ACK reporting mode or second HARQ-ACK reporting mode.  **<**Unchanged text is omitted> |

The TP below for TS38.213v17.0.0 section 18 is endorsed.

|  |
| --- |
| **<**Unchanged text is omitted>  A UE monitors PDCCH for scheduling PDSCH receptions or for activation/release of SPS PDSCH receptions for a corresponding SPS PDSCH configuration as described in clause 10.1. A UE can be configured by *harq-Feedback-Option-Multicast* for a G-RNTI or by *sps-HARQ-Feedback-Option-Multicast* for a G-CS-RNTI to provide HARQ-ACK information for a transport block reception associated with the G-RNTI or with the G-CS-RNTI, respectively, according to the first HARQ-ACK reporting mode or according to the second HARQ-ACK reporting mode. The second HARQ-ACK reporting mode is not applicable for DCI formats having associated HARQ-ACK information without scheduling a PDSCH reception. For the first HARQ-ACK reporting mode, the UE generates HARQ-ACK information with ACK value when a UE correctly decodes a transport block or detects a DCI format indicating an SPS PDSCH release; otherwise, the UE generates HARQ-ACK information with NACK value, as described in clauses 9 and 9.1 through 9.3. For the second HARQ-ACK reporting mode, the UE does not transmit a PUCCH that would include only HARQ-ACK information with ACK values.  **<**Unchanged text is omitted> |

The TP below for TS38.213v17.0.0 section 18 is endorsed.

|  |
| --- |
| 18 Multicast Broadcast Services  < Unchanged parts are omitted >  A UE determines a PUCCH resource for a PUCCH transmission with HARQ-ACK information as described in clauses 9.2 and 9.2.1 through 9.2.5. If the UE multiplexes HARQ-ACK information associated with unicast DCI formats and HARQ-ACK information associated with multicast DCI formats in a same PUCCH, the last DCI format that the UE uses to determine the PUCCH resource, as described in clause 9.2.3, is a last unicast DCI format.  A UE is not required to multiplex in a PUCCH multicast HARQ-ACK and unicast UCI of the same priority if the UE is provided *subslotLengthForPUCCH* for the PUCCH with the unicast UCI. |

**Agreement**

When HARQ-ACK for unicast SPS PDSCHs and multicast SPS PDSCHs with ACK/NACK based feedback are multiplexed on the same PUCCH for the same priority case, the PUCCH carrying the multiplexed HARQ-ACK is determined from the SPS-PUCCH-AN-List configured for unicast.

**Agreement**

When HARQ-ACK for unicast SPS PDSCHs and multicast dynamic grant PDSCHs with ACK/NACK based feedback are multiplexed on the same PUCCH for the same priority case, down-select from:

* + Option 1: the PUCCH carrying the multiplexed HARQ-ACK is determined from the SPS-PUCCH-AN-List configured for unicast.
  + Option 2: the PUCCH carrying the multiplexed HARQ-ACK is determined from PUCCH-Config/PUCCH-ConfigurationList configured for multicast.

**Agreement**

For the separate *PUCCH-Config/ PUCCH-ConfigurationList* configured to UE for NACK-only based feedback,

* + 1 PUCCH resource set in each *PUCCH-Config*.
  + up to 32 PUCCH resources in PUCCH resource set
  + Note: the separate *PUCCH-Config/PUCCH-ConfigurationList* applies to all configured G-RNTIs configured with NACK-only based feedback.

**Agreement**

Support *pdsch-AggregationFactor* configured in *PDSCH-Config-Multicast* for DCI formats 4\_0/4\_1, similar as that of DCI format 4\_2. The TP below for TS38.214v17.0.0 section 5.1.2.1 is endorsed:

|  |
| --- |
| 5.1.2.1 Resource allocation in time domain  \*\*\* Unchanged text is omitted \*\*\*  When receiving PDSCH scheduled by DCI format 4\_0/4\_1/4\_2 in PDCCH with CRC scrambled by G-RNTI or G-CS-RNTI with NDI=1, if the UE is configured with *pdsch-AggregationFactor* in the *pdsch-Config-Multicast* associated withthe corresponding G-RNTI or in the associated *SPS-Config-Multicast* activated by the DCI format 4\_0/4\_1/4\_2 with CRC scrambled by G-CS-RNTI, the same symbol allocation is applied across the *pdsch-AggregationFactor* consecutive slots. When receiving PDSCH scheduled by DCI format 4\_0/4\_1/4\_2 for multicast reception in PDCCH with CRC scrambled by G-CS-RNTI with NDI = 0, or PDSCH without corresponding PDCCH transmission using associated [*SPS-Config-Multicast*] and activated by the DCI format 4\_0/4\_1/4\_2 in PDCCH with CRC scrambled by G-CS-RNTI, the same symbol allocation is applied across the *pdsch-AggregationFactor*, in associated *SPS-Config-Multicast* if configured, or 1 otherwise, consecutive slots. When receiving PDSCH scheduled by DCI format 4\_0 in PDCCH with CRC scrambled by G-RNTI for MTCH, if the UE is configured with *pdsch-AggregationFactor* in the *pdsch-Config-Broadcast*, the same symbol allocation is applied across the *pdsch-AggregationFactor* consecutive slots.  When receiving PDSCH scheduled by DCI in PDCCH with CRC scrambled by G-CS-RNTI for multicast reception or G-RNTI, if the DCI field 'Time domain resource assignment' indicates an entry which contains *repetitionNumber* in *PDSCH-TimeDomainResourceAllocation* in the *PDSCH-Config-Multicast* or *PDSCH-Config-Broadcast*,the same SLIV is applied for all PDSCH transmission occasions across the *repetitionNumber* consecutive slots. When receiving PDSCH scheduled without corresponding PDCCH transmission using associated *SPS-Config-Multicast* and activated by DCI in PDCCH with CRC scrambled by G-CS-RNTI for multicast reception, if the DCI field 'Time domain resource assignment' of the activating DCI indicates an entry which contains *repetitionNumber* in *PDSCH-TimeDomainResourceAllocation* in the *PDSCH-Config-Multicast*,the same SLIV is applied for all PDSCH transmission occasions across the *repetitionNumber* consecutive slots.  \*\*\* Unchanged text is omitted \*\*\* |

**Agreement**

For multicast SPS PDSCH re-transmission, the *pdsch-AggregationFactor* in *pdsch-Config-Multicast* is applied as the repetition number. The TP below for TS38.214v17.0.0 section 5.1.2.1 is endorsed:

|  |
| --- |
| **for TS 38.214 section 5.1.2.1**  **<**Unchanged text is omitted>  When receiving PDSCH scheduled by DCI format 4\_2 in PDCCH with CRC scrambled by G-RNTI or G-CS-RNTI with NDI=1, if the UE is configured with *pdsch-AggregationFactor* in the *pdsch-Config-Multicast* associated withthe corresponding G-RNTI or G-CS-RNTI, the same symbol allocation is applied across the *pdsch-AggregationFactor* consecutive slots. When receiving PDSCH scheduled by DCI format 4\_2 for multicast reception in PDCCH with CRC scrambled by G-CS-RNTI with NDI = 0, or PDSCH without corresponding PDCCH transmission using associated *SPS-Config-Multicast* and activated by the DCI format 4\_2 in PDCCH with CRC scrambled by G-CS-RNTI, the same symbol allocation is applied across the *pdsch-AggregationFactor*, in associated *SPS-Config-Multicast* if configured, or 1 otherwise, consecutive slots. When receiving PDSCH scheduled by DCI format 4\_0 in PDCCH with CRC scrambled by G-RNTI for MTCH, if the UE is configured with *pdsch-AggregationFactor* in the *pdsch-Config-Broadcast*, the same symbol allocation is applied across the *pdsch-AggregationFactor* consecutive slots.  **<**Unchanged text is omitted> |

**Agreement**

When UE is configured with unicast SPS and multicast SPS with ACK/NACK based feedback for multiplexing on the same PUCCH for the same priority case, the HARQ-ACK codebook is constructed as for multiple SPS PDSCHs regardless of unicast SPS PDSCH or multicast SPS PDSCH.

**Agreement**

When HARQ-ACK for multicast dynamic grant PDSCHs and multicast SPS PDSCHs with ACK/NACK based feedback are multiplexed on the same PUCCH for the same priority case, the PUCCH carrying the multiplexed HARQ-ACK is determined from PUCCH-Config/PUCCH-ConfigurationList configured for multicast.

**Agreement**

Extending the fallback operation for Type-1 HARQ-ACK codebook to multicast PDSCH receptions.

* FFS how to handle the fallback operation for the case of multiple G-RNTIs/G-CS-RNTIs configured
* FFS how to handle the fallback operation for the case that PTP retransmission is used for PTM initial transmission.

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

**Agreement**

For RRC\_IDLE/INACTIVE UEs, a UE is not required to support reception of FDMed MCCH PDSCH and MTCH PDSCH in PCell.

**Agreement**

For RRC\_IDLE/INACTIVE UEs, a UE is not required to support reception of FDMed multiple MTCH PDSCHs in PCell.

**Agreement**

For RRC\_IDLE/INACTIVE UEs, a UE is not required to support reception of FDMed MCCH/MTCH PDSCH and SIB1 or Paging PDSCH in PCell.

* + FFS: PBCH and other SIBs

**Conclusion**

Additional HARQ process(es) is(are) not introduced for Rel-17 MBS broadcast reception on serving cell.

* + Note: The UE is not expected to support hardware for more HARQ processes for receiving broadcast in Rel-17 in addition to the maximum number of HARQ processes supported for receiving unicast in Rel-16, i.e. the HARQ process resources are shared between broadcast, unicast and multicast

The TP below for Section 5.1.2.1 of TS 38.214v17.0.0 is endorsed.

|  |
| --- |
| 5.1.2.1 Resource allocation in time domain  < Unchanged parts are omitted >  When receiving PDSCH scheduled by DCI format 4\_2 in PDCCH with CRC scrambled by G-RNTI or G-CS-RNTI with NDI=1, if the UE is configured with *pdsch-AggregationFactor* in the *pdsch-Config-Multicast* associated withthe corresponding G-RNTI or in the associated *SPS-Config-Multicast* activated by the DCI format 4\_2 with CRC scrambled by G-CS-RNTI, the same symbol allocation is applied across the *pdsch-AggregationFactor* consecutive slots. When receiving PDSCH scheduled by DCI format 4\_2 for multicast reception in PDCCH with CRC scrambled by G-CS-RNTI with NDI = 0, or PDSCH without corresponding PDCCH transmission using associated [*SPS-Config-Multicast*] and activated by the DCI format 4\_2 in PDCCH with CRC scrambled by G-CS-RNTI, the same symbol allocation is applied across the *pdsch-AggregationFactor*, in associated *SPS-Config-Multicast* if configured, or 1 otherwise, consecutive slots. When receiving PDSCH scheduled by DCI format 4\_0 in PDCCH with CRC scrambled by G-RNTI for MTCH, if the UE is configured with *pdsch-AggregationFactor* in the *pdsch-Config-MTCH*, the same symbol allocation is applied across the *pdsch-AggregationFactor* consecutive slots. |

The TP below for Section 5.1.2.3 of TS 38.214v17.0.0 is endorsed.

|  |
| --- |
| ----------------------------------- **Start of Text proposal to 5.1.2.3 of 38.214** ------------------------------------------------  <Unchanged text omitted>  If a UE is scheduled a PDSCH with DCI format 1\_0 or DCI format 4\_0, the UE shall assume that  is equal to 2 PRBs.  <Unchanged text omitted>  ----------------------------------- **End of Text proposal to 5.1.2.3 of 38.214** ------------------------------------------------ |

The TP below for Section 5.1.3.1 of TS 38.214v17.0.0 is endorsed.

|  |
| --- |
| 5.1.3.1 Modulation order and target code rate determination  < Unchanged parts are omitted >  elseif the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to ‘qam256’, and the PDSCH is scheduled by a PDCCH with DCI format 1\_1 with CRC scrambled by C-RNTI  - the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate ® used in the physical downlink shared channel.  Elseif the higher layer parameter *mcs-Table* given by *PDSCH-Config-Multicast* is set to ‘qam256’, and the PDSCH is scheduled by a PDCCH with DCI format 4\_1 or 4\_2 with CRC scrambled by G-RNTI  - the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate ® used in the physical downlink shared channel.  Elseif the higher layer parameter *mcs-Table* given by *PDSCH-Config-MCCH and PDSCH-Config-MTCH* is set to ‘qam256’, and the PDSCH is scheduled by a PDCCH with DCI format 4\_0 with CRC scrambled by MCCH-RNTI or G-RNTI for MTCH  - the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate ® used in the physical downlink shared channel. |

The TP below for Section 5.1.6.2 of TS 38.214v17.0.0 is endorsed.

|  |
| --- |
| ----------------------------------- **Start of Text proposal to 5.1.6.2 of 38.214** ------------------------------------------------  <Unchanged text omitted>  When receiving PDSCH scheduled by DCI format 1\_0 or DCI format 4\_0 or receiving PDSCH before dedicated higher layer configuration of any of the parameters *dmrs-AdditionalPosition*, *maxLength* and *dmrs-Type,* the UE shall assume that the PDSCH is not present in any symbol carrying DM-RS except for PDSCH with allocation duration of 2 symbols with PDSCH mapping type B (described in clause 7.4.1.1.2 of [4, TS 38.211]), and a single symbol front-loaded DM-RS of configuration type 1 on DM-RS port 1000 is transmitted, and that all the remaining orthogonal antenna ports are not associated with transmission of PDSCH to another UE and in addition  <Unchanged text omitted>  When receiving PDSCH scheduled by DCI format 1\_0 or DCI format 4\_0, the UE shall assume the number of DM-RS CDM groups without data is 1 which corresponds to CDM group 0 for the case of PDSCH with allocation duration of 2 symbols, and the UE shall assume that the number of DM-RS CDM groups without data is 2 which corresponds to CDM group {0,1} for all other cases.  <Unchanged text omitted>  ----------------------------------- **End of Text proposal to 5.1.6.2 of 38.214** ------------------------------------------------ |

The TP below for Section 5.4.2.1 of TS 38.212v17.0.0 is endorsed.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **5.4.2.1 Bit selection**  ---------------------------- Other parts are omitted. ----------------------------  **Table 5.4.2.1-1: Value of**   |  |  | | --- | --- | | Maximum number of PRBs across all configured DL BWPs and UL BWPs of a carrier for DL-SCH and UL-SCH, respectively,  or  Maximum number of PRBs across all CFRs of a carrier for DL-SCH with PDSCH scheduled by DCI format 4\_0/4\_1/4\_2 |  | | Less than 33 | 32 | | 33 to 66 | 66 | | 67 to 107 | 107 | | 108 to 135 | 135 | | 136 to 162 | 162 | | 163 to 217 | 217 | | Larger than 217 | 273 |   ---------------------------- Other parts are omitted. ---------------------------- |

The TP below for Section 5.4.2.1 of TS 38.212v17.0.0 is endorsed.

|  |
| --- |
| 7.3.1.5.1 Format 4\_0 DCI format 4\_0 is used for the scheduling of PDSCH for broadcast in DL cell.  The following information is transmitted by means of the DCI format 4\_0 with CRC scrambled by MCCH-RNTI or G-RNTI for MTCH configured by *MBS-SessionInfo*:  - Frequency domain resource assignment – bits where equals to  - the size of CORESET 0 if CORESET 0 is configured for the cell; and  - the size of initial DL bandwidth part if CORESET 0 is not configured for the cell.  <Unchanged text omitted> |

**Agreement**

The *dataScramblingIdentityPDSCH-Broadcast, and scramblingID0-Broadcast* can be separately configured for MCCH-RNTI and for each MTCH G-RNTI.

**Agreement**

For broadcast RRC\_IDLE/INACTIVE UEs, *rateMatchPatternToAddModList* can be configured in *PDSCH-Config-MCCH* or *PDSCH-Config-MTCH* for GC-PDSCH rate matching.

* + Whether UE can receive the GC-PDSCH with rate matching based on the *rateMatchPatternToAddModList* is subject to UE capability.
  + Rel-15/16 UE capability of the supported maximum number of RE mapping patterns per symbol and per slot are kept unchanged to support rate matching for unicast/multicast/broadcast. The RateMatchPattern configured for MBS broadcast is counted into the ones that are configured per serving-cell.

**Agreement**

For RRC\_IDLE/INACTIVE UEs, a UE is not required to support reception of FDMed MCCH/MTCH PDSCH and SIB PDSCH in PCell.

**Agreement**

New data indicator is not indicated in DCI format 4\_0 for MCCH

**Agreement**

HARQ process ID is not indicated in DCI format 4\_0 for both MCCH and MTCH.

**Agreement**

New data indicator is not indicated in DCI format 4\_0 for MTCH

The TP below for Section 10 of TS 38.213v17.0.0 is endorsed.

|  |
| --- |
| **10.1 UE procedure for determining physical downlink control channel assignment**  A set of PDCCH candidates for a UE to monitor is defined in terms of PDCCH search space sets. A search space set can be a CSS set or a USS set. A UE monitors PDCCH candidates in one or more of the following search spaces sets  - a Type0-PDCCH CSS set configured by *pdcch-ConfigSIB1* in *MIB* or by *searchSpaceSIB1* in *PDCCH-ConfigCommon* or by *searchSpaceZero* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a SI-RNTI, or by *searchSpaceZero* in *PDCCH-ConfigCommon* when neither *pdcch-Config-MCCH nor pdcch-Config-MTCH* is not provided, for a DCI format with CRC scrambled by a MCCH-RNTI or a G-RNTI for MTCH, on the primary cell of the MCG  ---------------------------- Other parts are omitted. ---------------------------- |

**Agreement**

* + If the active DL BWP and the common MBS frequency resource for broadcast have same SCS and same CP length and the active DL BWP includes all RBs of the common MBS frequency resource configured for broadcast and if a UE is provided searchSpace for Type0B-PDCCH CSS set, the UE monitors PDCCH for Type0B-PDCCH CSS set on the DL BWP.
    - Note: It is up to the editor how to capture the above.
  + The TP below for section 10.1 of TS 38.213v17.0.0 is endorsed

|  |
| --- |
| ***----------------------------------------------------Text proposal starts------------------------------------***  10.1 UE procedure for determining physical downlink control channel assignment  < Unchanged parts are omitted >  For a DL BWP, if a UE is not provided *searchSpaceSIB1* for Type0-PDCCH CSS set by *PDCCH-ConfigCommon*, the UE does not monitor PDCCH candidates for a Type0-PDCCH CSS set on the DL BWP. The Type0-PDCCH CSS set is defined by the CCE aggregation levels and the number of PDCCH candidates per CCE aggregation level given in Table 10.1-1. If the active DL BWP and the initial DL BWP have same SCS and same CP length and the active DL BWP includes all RBs of the CORESET with index 0, or the active DL BWP is the initial DL BWP, or the active DL BWP includes all RBs of the common MBS frequency resource configured for broadcast, the CORESET configured for Type0-PDCCH CSS set has CORESET index 0 and the Type0-PDCCH CSS set has search space set index 0.  < Unchanged parts are omitted >  ***----------------------------------------------------Text proposal ends-------------------------------------*** |

The TP below for Section 7.3.1.5 of TS 38.211v17.0.0 is endorsed.

|  |
| --- |
| **TP-2.11-1 for TS38.211**  **7.3.1.5 Mapping to virtual resource blocks**  The UE shall, for each of the antenna ports used for transmission of the physical channel, assume the block of complex-valued symbols C:\Users\10240317\AppData\Local\Temp\ksohtml7920\wps1.jpg conform to the downlink power allocation specified in [6, TS 38.214] and are mapped in sequence starting with C:\Users\10240317\AppData\Local\Temp\ksohtml7920\wps2.jpg to resource elements C:\Users\10240317\AppData\Local\Temp\ksohtml7920\wps3.jpg in the virtual resource blocks assigned for transmission which meet all of the following criteria:  - they are in the virtual resource blocks assigned for transmission;  - the corresponding physical resource blocks are declared as available for PDSCH according to clause 5.1.4 of [6, TS 38.214];  - the corresponding resource elements in the corresponding physical resource blocks are  - not used for transmission of the associated DM-RS or DM-RS intended for other co-scheduled UEs as described in clause 7.4.1.1.2;  - not used for non-zero-power CSI-RS according to clause 7.4.1.5 if the corresponding physical resource blocks are for a PDSCH scheduled by a PDCCH with the CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI, G-RNTI for multicast, G-CS-RNTI, ~~MCCH-RNTI,~~ or a PDSCH with SPS, except if the non-zero-power CSI-RS is a CSI-RS configured by the higher-layer parameter *CSI-RS-Resource-Mobility* in the *MeasObjectNR* IE or except if the non-zero-power CSI-RS is an aperiodic non-zero-power CSI-RS resource;  - not used for PT-RS according to clause 7.4.1.2;  - not declared as 'not available for PDSCH according to clause 5.1.4 of [6, TS 38.214].  ---------------------------- Other parts are omitted. ---------------------------- |

# 9. Agreements in #108 e-meetings

**RAN1#107b-e**

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

**Agreement**

In the reply LS on MBS SPS to RAN2, capture the following for Q1:

* RAN1 confirms that RAN2’s understanding is correct.
* RAN1 thinks that the maximum number of G-CS-RNTI configured for UE should be subject to UE capability.

**Agreement**

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

* From RAN1 perspective, retransmission scheme (i.e. via PTM or PTP) can be changed per TB per transmission.
  + UE is not expected to receive PTM retransmission after PTP retransmission for the same multicast TB
  + There is no consensus in RAN1 to support PTM retransmission and PTP retransmission simultaneously for different UEs in the same MBS group
* A single CS-RNTI is used for PTP retransmissions of all G-CS-RNTIs.

**Agreement**

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

Reply LS to R1-2200888 on MBS SPS is endorsed in R1-2202591.

**Agreement**

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

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

**Agreement**

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

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

**Agreement**

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

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

**Conclusion**

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

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

**Agreement**

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

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

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

10.1 UE procedure for determining physical downlink control channel assignment

**<**Unchanged text is omitted>

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

**<**Unchanged text is omitted>

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

“Initial TP 2-6-1” in section 7 of R1-2202641 is endorsed for Clause 7.3.1.5.2 in TS 38.212.

“Initial TP 2-6-2” in section 7 of R1-2202641 is endorsed for Clause 7.3.1.5.3 in TS 38.212.

“Initial TP 2-6-3” in section 7 of R1-2202641 is endorsed for Clause 10.2 in TS 38.213.

**Agreement**

Regarding rate matching of GC-PDSCH reception, the UE shall assume that both of indicated resources in clauses 5.1.4.1, 5.1.4.2 and the PRBs containing SS/PBCH block transmission resources are not available for the PDSCH scheduled with G-RNTI for multicast.

* + Adopt the following TP for Clause 5.1.4 of TS38.214

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

5.1.4 PDSCH resource mapping

**<**Unchanged text is omitted>

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

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

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

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

**<**Unchanged text is omitted>

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

**Agreement**

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

**Agreement**

Adopt the following TP for Clause 7.3.1.5.3 in TS 38.212:

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

7.3.1.5.3 Format 4\_2

**<**Unchanged text is omitted>

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

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

**<**Unchanged text is omitted>

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

**Agreement**

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

* *zp-CSI-RS-ResourceToAddModList, zp-CSI-RS-ResourceToReleaseList*

**Agreement**

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

* the REs indicated by *p-ZP-CSI-RS-ResourceSet* configured in *PDSCH-Config-Multicast* are declared as not available for GC-PDSCH.
* *p-ZP-CSI-RS-ResourceSet* configured in *PDSCH-Config* for unicast do not apply for GC-PDSCHs.
* *p-ZP-CSI-RS-ResourceSet* in *PDSCH-Config-Multicast* for multicast do not apply for unicast PDSCHs.
* The total number of *p-ZP-CSI-RS-ResourceSet* that a UE can be configured with is the same as for unicast in Rel-16

Also include this agreement in an LS to RAN2.

**Agreement**

For multicast RRC\_CONNECTED UEs, *sp-ZP-CSI-RS-ResourceSetsToAddModList* can be configured in *PDSCH-Config-Multicast* for GC-PDSCH rate matching, subject to UE capability. For PDSCH resource mapping with RE symbol level granularity,

* the REs indicated by *sp-ZP-CSI-RS-ResourceSetsToAddModList* configured in *PDSCH-Config-Multicast* are declared as not available for GC-PDSCH when their activation delivered by unicast PDSCH is applied.
* *sp-ZP-CSI-RS-ResourceSetsToAddModList* configured in *PDSCH-Config* for unicast do not apply for GC-PDSCHs.
* *sp-ZP-CSI-RS-ResourceSetsToAddModList* in *PDSCH-Config-Multicast* for multicast do not apply for unicast PDSCHs.
* The total number of semi-persistent *ZP-CSI-RS-ResourceSet* that a UE can be configured with is the same as for unicast in Rel-16

Also include this agreement in an LS to RAN2.

**Agreement**

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

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

**Agreement**

Adopt the following TP for Clause 10.1 in TS 38.213:

* note: further clarification may be needed for the case of receiving broadcast, and MCCH-RNTI

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

10.1 UE procedure for determining physical downlink control channel assignment

**<**Unchanged text is omitted>

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

**<**Unchanged text is omitted>

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

**Agreement**

Send the LS reply with the following answer to Q1 from the incoming LS (R1-2202727):

* From RAN1 perspective, UE receiving SIBx directly from SCell via BCCH is not feasible since it is legacy procedure that UE is not required to monitor DCI formats associated with SI-RNTI, P-RNTI, RA-RNTI in SCell. Such procedure is expected to be unchanged because of the impact to RAN1 specifications and UE implementation.

**Agreement**

Send the LS reply with the following answer to Q2 from the incoming LS (R1-2202727):

* From RAN1 perspective, UE can receive MCCH directly from SCell and there is no need to provide MCCH to UE with dedicated signalling. There is no dependency between SIBx reception method for SCell (i.e. directly reading from SCell vs. dedicated RRC signalling) and MCCH provision method (i.e. dedicated signalling vs. directly reading from SCell).

R1-2202821 DRAFT LS reply on MBS broadcast reception on SCell Moderator (Huawei)

Final LS is endorsed in R1-2202822.

**Agreement**

Update the previous agreement for *p-ZP-CSI-RS-ResourceSet* as below:

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

* the REs indicated by *p-ZP-CSI-RS-ResourceSet* configured in *PDSCH-Config-Multicast* are declared as not available for GC-PDSCH.
* *p-ZP-CSI-RS-ResourceSet* configured in *PDSCH-Config* for unicast do not apply for GC-PDSCHs.
* *p-ZP-CSI-RS-ResourceSet* in *PDSCH-Config-Multicast* for multicast do not apply for unicast PDSCHs.
* The total number of periodic ZP-CSI-RS-Resources *~~p-ZP-CSI-RS-ResourceSet~~* that a UE can be configured with is the same as for unicast in Rel-16
  + If *p-ZP-CSI-RS-ResourceSet* is configured in both *PDSCH-Config* and PDSCH-Config-Multicast, it is subject to UE capability whether the *p-ZP-CSI-RS-ResourceSet* configured in *PDSCH-Config-Multicast* can be different from the *p-ZP-CSI-RS-ResourceSet* configured in *PDSCH-Config*.

Also include this agreement in an LS to RAN2.

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

**Conclusion**

No TP is needed to reflect the RAN1 agreement of the FDMed Type-1 HARQ-ACK codebook for more than one configured G-RNTI,

* Note: it means the following RAN1 agreement is updated as follows, to align with further agreements made in RAN1:

|  |
| --- |
| ***Agreement***  *For the Type-1 codebook construction for FDM-ed unicast and multicast via Opt 4 (from the previous agreement), when UE is configured with multiple G-RNTIs and UE is configured with fdmed-Reception-Multicast, the sub-codebook for multicast consists of the HARQ-ACK bits for all configured G-RNTIs.* |

**Agreement**

For supporting more than one NACK-only feedback in the same PUCCH transmission, define RRC configuration to configure between Alt1 and Alt4 (from previous agreements):

* Alt1: Support UE multiplexing the HARQ-ACK bits by transforming NACK-only into ACK/NACK HARQ bits.
  + FFS: how to determine PUCCH resource
* Alt4: Define combination of NACK-only which corresponds to a specific sequence or a PUCCH transmission.
  + define up to 15 orthogonal PUCCH resources to select from according to combinations of up to 4 TBs with NACK-only feedback,
    - FFS: The PUCCH slot for the transmission is based on the K1 in the “last DCI” scheduling multicast.
    - FFS: The PUCCH resource for the transmission is from PUCCH-config configured for NACK-only based feedback according to the mapping between number of TBs with PUCCH resource ID.
      * FFS mapping details.
      * How to determine the number of TBs is discussed separately, e.g., Type-1-like and/or Type-2-like codebook.
    - FFS: whether this applies to a single G-RNTI or multiple G-RNTIs
  + Alt4 is not supported for more than 4 TBs
* FFS: whether RRC configuration between Alt1 and Alt4 is per G-RNTI or per CFR
* FFS: UE capability

**Agreement**

When HARQ-ACK for unicast SPS PDSCHs and multicast dynamic grant PDSCHs with ACK/NACK based feedback are multiplexed on the same PUCCH for the same priority case, the following option 1 (from the previous agreement) is adopted:

* Option 1: the PUCCH carrying the multiplexed HARQ-ACK is determined from the *SPS-PUCCH-AN-List* configured for unicast.
* Option 2: the PUCCH carrying the multiplexed HARQ-ACK is determined from *PUCCH-Config/PUCCH-ConfigurationList* configured for multicast.

**Agreement**

When NACK-only based HARQ-ACK feedback is used for multicast SPS PDSCH without PDCCH scheduling, the UE determines a priority index from the HARQ-ACK codebook index in the configuration for SPS multicast, using the same method with the one for ACK/NACK based feedback.

**Agreement**

When UE is configured with unicast SPS and multicast SPS with NACK-only based feedback for multiplexing on the same PUCCH for the same priority case, NACK only based HARQ-ACK is transformed to ACK/NACK based HARQ-ACK.

* For NACK only based HARQ-ACK transformed to ACK/NACK based HARQ-ACK, the HARQ-ACK codebook is constructed as for multiple SPS PDSCHs regardless of unicast SPS PDSCH or multicast SPS PDSCH and the PUCCH carrying the multiplexed HARQ-ACK is determined from the SPS-PUCCH-AN-List configured for unicast, as agreed for ACK/NACK based feedback.

**Agreement**

Regarding RRC configuring Alt1 or Alt4 (from the previous agreement) for multiplexing more than one NACK-only in the same PUCCH transmission, the configuration is per CFR.

**Agreement**

If Type-1 codebook is configured for both multicast and unicast, at least for single cell case for both unicast and multicast:

* If the UE is configured to construct the HARQ-ACK codebooks for unicast and multicast jointly, a single UL DAI bit applies for unicast and multicast
* Otherwise, 1 additional bit UL DAI is included for multicast in DCI format 0\_1/0\_2, in addition to the UL DAI for unicast. The 1-bit UL DAI for multicast is applied to all configured G-RNTIs.
  + FFS: additional restrictions

**Agreement**

When PUCCH transmission for the NACK-only based feedback for one G-RNTI collides with PUCCH transmission for ACK/NACK feedback for another G-RNTI with the same priority, support UE multiplexing the NACK-only based feedback with the ACK/NACK feedback onto the same PUCCH by transforming NACK-only into the ACK/NACK based HARQ-ACK bit.

* Note: When the TB configured with NACK-only feedback is correctly decoded, the ACK will be transmitted and multiplexed with others.

**Agreement**

For multiplexing NACK-only feedback for the first G-RNTI with ACK/NACK based feedback for the second G-RNTI or for unicast, down-select from:

* Alt1: the converted NACK-only bits are concatenated to the ACK/NACK feedback.
* Alt2: the codebook construction/concatenation is the same as when the feedback mode is ‘ACK/NACK’ for both G-RNTIs.

**Agreement**

When UE is configured with enhanced Type-2 codebook for unicast and when the UE is scheduled to multiplex enhanced Type-2 HARQ-ACK for unicast with Type-1 or Type-2 HARQ-ACK codebook for multicast in the same PUCCH slot,

* UE generates separate sub-codebooks for unicast and multicast respectively and appends the multicast HARQ-ACK sub-codebook to the unicast HARQ-ACK sub-codebook.

**Agreement**

* For the following two cases, the fallback operation for the Type-1 HARQ-ACK codebook for multicast is applied to G-RNTI/G-CS-RNTI configured with HARQ-ACK enabled only,
  + a SPS PDSCH release indicated by DCI format 4\_1 with counter DAI field value of 1,
  + a PDSCH reception scheduled by DCI format 4\_1 with counter DAI field value of 1 on the PCell,
  + SPS PDSCH reception(s) associated with G-CS-RNTIs.
* Note: If the UE receives two SPS PDSCH releases for two respective G-CS-RNTIs with DAI=1, or two PDSCHs by DCI 4\_1 with DAI=1 for two respective G-RNTIs on the PCell, there is no fallback.

**Agreement**

For Type-1 codebook generation,

* if all configured G-RNTIs are with HARQ-ACK disabled by RRC signalling, UE does not report any HARQ-ACK information in the PUCCH slot;
* For other cases, FFS between the 3 alternatives below:
  + Alt1: if at least one configured G-RNTI is with HARQ-ACK enabled, UE will report NACK for the G-RNTI with HARQ-ACK disabled regardless of decoding results of corresponding PDSCH.
  + Alt2: if at least one configured G-RNTI is with HARQ-ACK enabled, UE reports actual HARQ-ACK result for all G-RNTIs.
  + Alt3: UE is not expected to be configured with some G-RNTI with HARQ-ACK disabled by RRC signalling and some other G-RNTI with HARQ-ACK enabled by RRC signalling for all configured G-RNTI
  + Other alternatives are not precluded

Text Proposal 4.2.2-1 (for TS 38.213 clause 9.2.3) in section 12 of R1-2202579 is endorsed.

Text Proposal 4.2.2-2 (for TS 38.213 clause 9.1.2.1) in section 12 of R1-2202579 is endorsed.

Text Proposal 5.1.1 (for TS 38.213 clause 18) in section 12 of R1-2202579 is endorsed.

**Agreement**

If Type-2 codebook is configured for unicast and multicast, the following option2-2 (from the previous agreement) is adopted:

* Option2-2: 2-bit UL DAI(s) are included in DCI for multicast, in addition to the 2-bit UL DAI for unicast.
  + The 2-bit UL DAI for multicast is applied for all configured G-RNTIs.
    - FFS: how to count the total number of HARQ-ACK bits for all configured G-RNTIs.

Alt1-1: UL-DAI indicates the sum of DL-DAIs

Alt1-2: DL-DAIs have the same value.

Alt1-3: largest DL DAI value among the configured G-RNTIs.

Other alternatives are not precluded

**Agreement**

When Type-1 codebook is configured for unicast and Type-2 codebook is configured for multicast, or when Type-2 codebook is configured for unicast and Type-1 codebook is configured for multicast, the UL-DAI for multicast is included in DCI format 0\_1/0\_2, in addition to the UL-DAI field for unicast.

* The UL-DAI for multicast is 1-bit for Type-1 codebook
  + The 1-bit UL-DAI for multicast is applied to all configured G-RNTIs.
* The UL-DAI for multicast is 2-bit for Type-2 codebook applied for all configured G-RNTIs.
  + FFS: how to count the total number of HARQ-ACK bits for all configured G-RNTIs.
    - * Alt1-1: UL-DAI indicates the sum of DL-DAIs
      * Alt1-2: DL-DAIs have the same value.
      * Alt1-3: largest DL DAI value among the configured G-RNTIs.
      * Other alternatives are not precluded
* FFS: details of the UL DAI field

**Agreement**

For NACK-only feedback for PUCCH format 0 or format 1, only 1 cyclic shift is used.

* The sequence cyclic shift for NACK-only is .
* For PF1 NACK-only, set .
* Note: the *initialCyclicShift* is configured for PUCCH-format0 and PUCCH-format1 as legacy.

**Agreement**

For multiplexing NACK-only with HARQ-ACK feedback/CSI for unicast for the same priority or PUSCH transmission for the same priority or ACK/NACK based HARQ-ACK feedback for multicast with another G-RNTI for the same priority, the multiplexing does not depend on the decoding result.

* Note: when multiplexing the NACK-only is transformed into ACK/NACK as agreed.

**Agreement**

For Type-2 codebook generation, UE reports HARQ-ACK bits only for TBs with enabled HARQ-ACK by RRC or DCI.

**Agreement**

For multiplexing NACK-only feedback for the first G-RNTI with ACK/NACK based feedback for the second G-RNTI or for unicast, the following Alt2 (from the previous agreement) is adopted:

* Alt1: the converted NACK-only bits are concatenated to the ACK/NACK feedback.
* Alt2: the codebook construction/concatenation is the same as when the feedback mode is ‘ACK/NACK’ for both G-RNTIs.

**Agreement**

If a UE supports ACK/NACK based feedback for dynamic multicast scheduling and for multicast SPS, and if the UE is configured with ACK/NACK based feedback for multicast dynamic scheduling and is configured with disabled HARQ feedback for multicast SPS scheduling, for Type-1 codebook generation,

* FFS between the 4 alternatives below:
  + Alt1: UE will report NACK for the G-CS-RNTI with HARQ-ACK disabled regardless of decoding results of corresponding PDSCH.
  + Alt2: UE will report ACK/NACK for the G-CS-RNTI with HARQ-ACK disabled regardless of decoding results of corresponding PDSCH.
  + Alt3: UE is not expected to be configured with G-RNTI with HARQ-ACK enabled by RRC signalling and G-CS-RNTI with HARQ-ACK enabled by RRC signalling.
  + Alt4: UE does not report any HARQ-ACK information for G-CS-RNTI with HARQ-ACK feedback disabled by RRC.
  + Other alternatives are not precluded.

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

**Agreement**

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

* RAN1 confirm RAN2’s understanding that only a single frequency resource in CFR (indicated by *locationAndBandwidth-Broadcast*) is configured for MCCH/MTCH reception of MBS broadcast and it is common for MCCH and all MTCHs.

R1-2202610 DRAFT LS reply about the MBS issues Moderator (Huawei)

Final reply LS to R1-2200882 is endorsed in R1-2202611

**Agreement**

*RateMatchPatternLTE-CRS* can be configured in PDSCH-Config-MCCH or PDSCH-Config-MTCH for RRC\_IDLE/RRC\_INACTIVE UEs*.*

**Agreement**

For broadcast reception, if the frequency resources of the CFR for broadcast is larger than CORESET0, a CORESET larger than CORESET0 can be configured in the CFR when no CORESET is configured by c*ommonControlResourceSet.*

TP-2.3-1 (for Section 5.1.2.1 of TS38.214) in section 6 of R1-2202549 is endorsed.

TP-2.4-2 (for Section 10.1 of TS 38.213) in section 6 of R1-2202549 is endorsed.

TP-2.4-4 (for Section 18 of TS 38.213) in section 6 of R1-2202549 is endorsed.

**Agreement**

For RRC\_IDLE/INACTIVE UEs, a UE is required to support reception of FDMed MCCH PDSCH and PBCH in PCell.

**Agreement**

For RRC\_IDLE/INACTIVE UEs, a UE is not required to support reception of FDMed MTCH PDSCH and PBCH in PCell.

TP-2.4-3 (for Section 18 of TS 38.213) in section 6 of R1-2202550 is endorsed.