**3GPP TSG RAN WG1 #109-e** **R1-22xxxxx**

**e-Meeting, May 9th – 20th, 2022**

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| *CR-Form-v12.2* | | | | | | | | |
| **DRAFT CHANGE REQUEST** | | | | | | | | |
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|  | **38.213** | **CR** |  | **rev** |  | **Current version:** | **17.1.0** |  |
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| *For* [***HELP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

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| ***Title:*** | Corrections on the introduction of multicast-broadcast services in NR | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Samsung | | | | | | | | | |
| ***Source to TSG:*** |  | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_MBS-Core | | | | |  | ***Date:*** | | | 2022-05-24 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | F |  | | | | | ***Release:*** | | | Rel-17 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | 1. Undefined value for power control adjustment component for a PUCCH transmission providing multicast HARQ-ACK according to the “NACK-only”/second mode using PUCCH format 1 in clause 7.2.1. 2. Undefined CLPC adjustement state for PUCCH transmissions that provide only multiplest HARQ-ACK information from a UE operating with two CLPC adjustment states in clause 7.2.1. 3. Undefined *pdsch-AggregationFactor* for PTM SPS PDSCH retransmissions for the Type-1 HARQ-CB generation in clause 9.1.2. 4. Undefined report of HARQ-ACK associated with DCI formats with CRCs scrambled by G-CS-RNTIs for Type-2 HARQ-ACK CB in clause 9.1.3.1. 5. Undefined applicability of a DAI value for multicast HARQ-ACK in a DCI format 0\_1/0\_2 for the generation of Type-2 HARQ-ACK codebooks associated with G-RNTIs in clause 9.1.3.2. 6. Undefined PUCCH resource determination based on whether or not a multicast DCI format is associated with enabled HARQ-ACK information in clause 9.2.3. 7. Missing DCI formats with G-RNTI or G-CS-RNTI for determining the maximum number of scheduled PDSCHs or PUSCHs when a UE is or is not configured to operate with NR-DC in clause 10.1. 8. Align RRC parameter names with those in TS 38.331 in clause 10.1. 9. Undefined mapping and ordering of HARQ-ACK values according to the “NACK-only”/second mode to PUCCH resources in clause 18. 10. Unclear meaning of “other UCI” multiplexed with “NACK-only” HARQ-ACK in clause 18. 11. Undefined PUCCH resource for multiplexing multicast “NACK-only” HARQ-ACK with only CSI reports in clause 18. 12. Incorrect description for reporting “NACK-only” HARQ-ACK when a UE is provided *moreThanOneNackOnly-Mode* and the number of HARQ-ACK bits is more than four in clause 18. 13. Undefined PUCCH resource determination when a UE multiplexes in a PUCCH only multicast HARQ-ACK according to the first and second HARQ-ACK reporting modes in clause 18. 14. Undefined PUCCH resource determination when a UE is configured to report HARQ-ACK according to the second reporting mode and provides HARQ-ACK according to the first reporting mode in clause 18. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | 1. Capture that the power control adjustment component has value zero for a PUCCH transmission providing multicast HARQ-ACK according to the “NACK-only”/second mode using PUCCH format 1 in clause 7.2.1. 2. Capture that if the UE operates with two CLPC adjustment states, the UE uses the first CLPC adjustment state for PUCCH transmissions that provide only multiplest HARQ-ACK information in clause 7.2.1. 3. Capture that for PTM based SPS PDSCH retransmission, the repetition number is determined by *pdsch-AggregationFactor* in SPS-Config-Multicast for the Type-1 HARQ-CB generation in clause 9.1.2. 4. Capture report of HARQ-ACK associated with DCI formats with CRCs scrambled by G-CS-RNTIs for Type-2 HARQ-ACK CB in clause 9.1.3.1. 5. Capture the applicability of a DAI value for multicast HARQ-ACK in a DCI format 0\_1/0\_2 to generation of Type-2 HARQ-ACK codebooks associated with G-RNTIs in clause 9.1.3.2. 6. Capure that a UE does not use the PRI field of a multicast DCI format associated with enabled HARQ-ACK information in determining a PUCCH resource in clause 9.2.3. 7. Include DCI formats with G-RNTI or G-CS-RNTI for determining the maximum number of scheduled PDSCHs or PUSCHs when a UE is or is not configured to operate with NR-DC in clause 10.1. 8. Align RRC parameter names with those in TS 38.331 in clause 10.1. 9. Capture the mapping and ordering of HARQ-ACK values according to the “NACK-only”/second mode to PUCCH resources in clause 18. 10. Clarify “other UCI” multiplexed with “NACK-only” HARQ-ACK in clause 18. 11. Capture the PUCCH resource used for multiplexing multicast “NACK-only” HARQ-ACK with only CSI reports in clause 18. 12. Revise to correct description for reporting “NACK-only” HARQ-ACK when a UE is provided *moreThanOneNackOnly-Mode* and the number of HARQ-ACK bits is more than four in clause 18. 13. Capture PUCCH resource determination when a UE multiplexes in a PUCCH only multicast HARQ-ACK according to the first and second HARQ-ACK reporting modes in clause 18. 14. Capture PUCCH resource determination when a UE is configured to report HARQ-ACK according to the second reporting mode and provides HARQ-ACK according to the first reporting mode in clause 18. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Incomplete support for MBS in NR. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 7.2.1, 9.1.2, 9.1.3.1, 9.1.3.2, 9.2.3, 10.1, 18 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  |  | Other core specifications | | | | TS 38.331 | | |
| ***affected:*** | |  |  | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  |  | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

\*\*\* Unchanged text is omitted \*\*\*

### 7.2.1 UE behaviour

\*\*\* Unchanged text is omitted \*\*\*

- is a PUCCH transmission power adjustment component on active UL BWP of carrier of primary cell

- For a PUCCH transmission using PUCCH format 0 or PUCCH format 1, where

- is a number of PUCCH format 0 symbols or PUCCH format 1 symbols for the PUCCH transmission as described in clause 9.2.

- for PUCCH format 0

- for PUCCH format 1

- For PUCCH format 0,

- For PUCCH format 1

- if the PUCCH transmission provides multicast HARQ-ACK information according to the second HARQ-ACK reporting mode as described in clause 18,

- otherwise, , where is a number of UCI bits in PUCCH transmission occasion

- For a PUCCH transmission using PUCCH format 2 or PUCCH format 3 or PUCCH format 4 and for a number of UCI bits smaller than or equal to 11, , where

-

- is a number of HARQ-ACK information bits that the UE determines as described in clause 9.1.2.1 or 16.5.1.1 for Type-1 HARQ-ACK codebook and as described in clause 9.1.3.1 or 9.1.3.3 or 16.5.2.1 for Type-2 HARQ-ACK codebook.is the same as as described in clause 9.1.4 for Type-3 HARQ-ACK codebook. If the UE is not provided any of *pdsch-HARQ-ACK-Codebook*, *pdsch-HARQ-ACK-Codebook-r16*, or *pdsch-HARQ-ACK-OneShotFeedback*, if the UE includes a HARQ-ACK information bit in the PUCCH transmission; otherwise,

- is a number of SR information bits that the UE determines as described in clause 9.2.5.1

- is a number of CSI information bits that the UE determines as described in clause 9.2.5.2

- is a number of resource elements determined as , where is a number of subcarriers per resource block excluding subcarriers used for DM-RS transmission, and is a number of symbols excluding symbols used for DM-RS transmission, as defined in clause 9.2.5.2, for PUCCH transmission occasion on active UL BWP of carrier of primary cell

- For a PUCCH transmission using PUCCH format 2 or PUCCH format 3 or PUCCH format 4 and for a number of UCI bits larger than 11, , where

-

-

- is a number of HARQ-ACK information bits that the UE determines as described in clause 9.1.2.1 or 16.5.1.1 for Type-1 HARQ-ACK codebook and as described in clause 9.1.3.1 or 9.1.3.3 or 16.5.2.1 for Type-2 HARQ-ACK codebook, or as described in clause 9.1.4 for Type-3 HARQ-ACK codebook. If the UE is not provided any of *pdsch-HARQ-ACK-Codebook*, *pdsch-HARQ-ACK-Codebook-r16*, or *pdsch-HARQ-ACK-OneShotFeedback*, if the UE includes a HARQ-ACK information bit in the PUCCH transmission; otherwise,

- is a number of SR information bits that the UE determines as described in clause 9.2.5.1

- is a number of CSI information bits that the UE determines as described in clause 9.2.5.2

- is a number of CRC bits that the UE determines as described in clause 9.2

- is a number of resource elements that the UE determines as , where is a number of subcarriers per resource block excluding subcarriers used for DM-RS transmission, and is a number of symbols excluding symbols used for DM-RS transmission, as defined in clause 9.2.5.2, for PUCCH transmission occasion on active UL BWP of carrier of primary cell.

- For the PUCCH power control adjustment state for active UL BWP of carrier of primary cell and PUCCH transmission occasion

- is a TPC command value included in a DCI format associated with the PUCCH transmission for active UL BWP of carrier of the primary cell that the UE detects for PUCCH transmission occasion , or is jointly coded with other TPC commands in a DCI format 2\_2 with CRC scrambled by TPC-PUCCH-RNTI [5, TS 38.212], as described in clause 11.3

- if the UE is provided *twoPUCCH-PC-AdjustmentStates* and *PUCCH-SpatialRelationInfo*, or more than one sets of power control parameters for operation in FR1, if the UE is not provided *twoPUCCH-PC-AdjustmentStates* or *PUCCH-SpatialRelationInfo* and more than one sets of power control parameters, and if the PUCCH transmission provides only multicast HARQ-ACK information

- If the UE obtains a TPC command value from a DCI format associated with the PUCCH transmission and if the UE is provided *PUCCH-SpatialRelationInfo*, the UE obtains a mapping, by an index provided by *p0-PUCCH-Id*, between a set of *pucch-SpatialRelationInfoId* values and a set of values for *closedLoopIndex* that provide the value(s). If the UE receives an activation command indicating a value of *pucch-SpatialRelationInfoId*, the UE determines the value *closedLoopIndex* that provides the value of through the link to a corresponding *p0-PUCCH-Id* index

- If the UE obtains a TPC command from a DCI format 2\_2 with CRC scrambled by a TPC-PUCCH-RNTI, the value is provided by the closed loop indicator field in DCI format 2\_2

\*\*\* Unchanged text is omitted \*\*\*

### 9.1.2 Type-1 HARQ-ACK codebook determination

This clause applies if the UE is configured with *pdsch-HARQ-ACK-Codebook = semi-static*. In clauses 9.1.2, 9.1.2.1, and 9.1.2.2, if the UE is configured with *pdsch-HARQ-ACK-Codebook = semi-static* for only one of unicast or multicast HARQ-ACK codebook, the Type-1 HARQ-ACK codebook is generated considering only one of respective unicast or multicast configurations for PDSCH receptions or for PDCCH monitoring for detection of DCI formats.

If a UE is provided *HARQ-feedbackEnabling-disablingperHARQprocess* indicating disabled HARQ-ACK information for a HARQ process associated with a transport block in PDSCH reception occasion on serving cell , the UE reports a NACK value for a HARQ-ACK information bit corresponding to the transport block in a Type-1 HARQ-ACK codebook and does not consider the transport block as received in the determination of in clause 9.1.2.1. If the UE is also provided *PDSCH-CodeBlockGroupTransmission*, the UE reports NACK values for HARQ-ACK information bits corresponding to CBGs of the transport block in the Type-1 HARQ-ACK codebook and does not consider the CBGs as received in the determination of in clause 9.1.2.1. If the UE is also provided *HARQ-feedbackEnablingforSPSactive*, the UE considers a HARQ process associated with a transport block in a first SPS PDSCH reception, after an activation of SPS PDSCH receptions, to have enabled HARQ-ACK information and the UE provides a HARQ-ACK information bit according to a decoding outcome for the transport block in the first SPS PDSCH reception.

If a UE reports HARQ-ACK information associated with a G-RNTI or a G-CS-RNTI with disabled HARQ-ACK information, as described in clause 18, a value of the HARQ-ACK information is a UE implementation choice.

A UE reports HARQ-ACK information for a corresponding PDSCH reception or SPS PDSCH release or TCI state update only in a HARQ-ACK codebook that the UE transmits in a slot indicated by a value of a PDSCH-to-HARQ\_feedback timing indicator field in a corresponding DCI format or provided by *dl-DataToUL-ACK* or *dl-DataToUL-ACK-r16* or *dl-DataToUL-ACK-ForDCI-Format1-2* if the PDSCH-to-HARQ\_feedback timing indicator field is not present in the DCI format as described in clause 9.2.3. The UE reports NACK value(s) for HARQ-ACK information bit(s) in a HARQ-ACK codebook that the UE transmits in a slot not indicated by a value of a PDSCH-to-HARQ\_feedback timing indicator field in a corresponding DCI format.

If a UE is not provided *pdsch-HARQ-ACK-OneShotFeedback*, the UE does not expect to receive a PDSCH scheduled by a DCI format that the UE detects in any PDCCH monitoring occasion and includes a PDSCH-to-HARQ\_feedback timing indicator field providing an inapplicable value from *dl-DataToUL-ACK-r16*.

If the UE is provided *pdsch-AggregationFactor-r16* in *SPS-Config*, or *pdsch-AggregationFactor* in *SPS-Config-Multicast*, or *pdsch-AggregationFactor* in *PDSCH-Config* and no entry in *pdsch-TimeDomainAllocationList* and *pdsch-TimeDomainAllocationListDCI-1-2* includes *repetitionNumber* in *PDSCH-TimeDomainResourceAllocation-r16*, is a maximum value of *pdsch-AggregationFactor-r16* in *SPS-Config*, or *pdsch-AggregationFactor* in *SPS-Config-Multicast*, or *pdsch-AggregationFactor* in *PDSCH-Config*; otherwise . The UE reports HARQ-ACK information for a PDSCH reception

- from DL slot to DL slot , if is provided by *pdsch-AggregationFactor* or *pdsch-AggregationFactor-r16* [6, TS 38.214], or

- from DL slot to DL slot , if the time domain resource assignment field in the DCI format scheduling the PDSCH reception indicates an entry containing *repetitionNumber,* or

- in DL slot , otherwise

only in a HARQ-ACK codebook that the UE includes in a PUCCH or PUSCH transmission in slot , where is

- an UL slot overlapping with the end of the PDSCH reception in DL slot if the UE is provided *subslotLengthForPUCCH* for the HARQ-ACK codebook

- the last UL slot for PUCCH transmission overlapping with DL slot if the UE is not provided *subslotLengthForPUCCH* for the HARQ-ACK codebook

and is a number of slots indicated by the PDSCH-to-HARQ\_feedback timing indicator field in a corresponding DCI format, or provided by *dl-DataToUL-ACK* or *dl-DataToUL-ACK-r16* or *dl-DataToUL-ACK-ForDCI-Format1-2* if the PDSCH-to-HARQ\_feedback timing indicator field is not present in the DCI format. If the UE reports HARQ-ACK information for the PDSCH reception in a slot other than slot , the UE sets a value for each corresponding HARQ-ACK information bit to NACK.

\*\*\* Unchanged text is omitted \*\*\*

while

Set – SPS PDSCH configuration index: lower indexes correspond to lower RRC indexes of corresponding SPS configurations

while

Set – slot index

while

if {

a UE is configured to receive SPS PDSCHs from slot to slot for SPS PDSCH configuration on serving cell , excluding SPS PDSCHs that are not required to be received in any slot among overlapping SPS PDSCHs, if any according to [6, TS 38.214], or based on a UE capability for a number of PDSCH receptions in a slot according to [6, TS 38.214], or due to overlapping with a set of symbols indicated as uplink by *tdd-UL-DL-ConfigurationCommon* or by *tdd-UL-DL-ConfigurationDedicated* where is provided by *pdsch-AggregationFactor-r16* in *sps-Config* or, if *pdsch-AggregationFactor-r16* is not included in *sps-Config*, by *pdsch-AggregationFactor* in *pdsch-config*, or by *pdsch-AggregationFactor* in *sps-Config-Multicast* and

HARQ-ACK information for the SPS PDSCH is associated with the PUCCH

}

= HARQ-ACK information bit for this SPS PDSCH reception

;

end if

;

end while

;

end while

;

end while

\*\*\* Unchanged text is omitted \*\*\*

#### 9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel

If a UE is configured to monitor PDCCH for multicast DCI formats with CRC scrambled by one or more G-RNTIs or G-CS-RNTIs that the UE generates a Type-2 HARQ-ACK codebook, the UE separately applies the procedures in this clause per G-RNTI or per G-CS-RNTI and determines the Type-2 HARQ-ACK codebook by concatenating the Type-2 HARQ-ACK codebook for unicast DCI formats, followed by the HARQ-ACK codebooks for the multicast DCI formats in ascending order of the corresponding G-RNTI values, followed by the HARQ-ACK codebooks for the multicast DCI formats in ascending order of the corresponding G-CS-RNTI values.

\*\*\* Unchanged text is omitted \*\*\*

#### 9.1.3.2 Type-2 HARQ-ACK codebook in physical uplink shared channel

In this clause, a DAI field is either the one corresponding to unicast HARQ-ACK information and associated PDSCH receptions or DCI formats, or is the one corresponding to multicast HARQ-ACK information and associated PDSCH receptions or DCI formats, as described in [5, TS 38.212].

If a UE would multiplex HARQ-ACK information in a PUSCH transmission that is not scheduled by a DCI format or is scheduled by a DCI format that does not include a DAI field, then

- if the UE has not received any PDCCH within the monitoring occasions for DCI formats scheduling PDSCH receptions, or providing a DCI format having associated HARQ-ACK information without scheduling a PDSCH reception, on any serving cell and the UE does not have HARQ-ACK information in response to a SPS PDSCH reception to multiplex in the PUSCH, as described in clause 9.1.3.1, the UE does not multiplex HARQ-ACK information in the PUSCH transmission;

- else, the UE generates the HARQ-ACK codebook as described in clause 9.1.3.1, except that *harq-ACK-SpatialBundlingPUCCH* is replaced by *harq-ACK-SpatialBundlingPUSCH*.

If a UE multiplexes HARQ-ACK information in a PUSCH transmission that is scheduled by a DCI format that includes a DAI field, the UE generates the HARQ-ACK codebook as described in clause 9.1.3.1, with the following modifications:

- For the pseudo-code for the HARQ-ACK codebook generation in clause 9.1.3.1, after the completion of the and loops, the UE sets where is the value of the DAI field according to Table 9.1.3-2

*-* if the UE multiplexes HARQ-ACK information associated with more than one G-RNTIs, is applicable to each of the more than one G-RNTIs.

- For the case of first and second HARQ-ACK sub-codebooks, the DCI format includes a first DAI field corresponding to the first HARQ-ACK sub-codebook and a second DAI field corresponding to the second HARQ-ACK sub-codebook

*- harq-ACK-SpatialBundlingPUCCH* is replaced by *harq-ACK-SpatialBundlingPUSCH*.

If a UE is not provided *PDSCH-CodeBlockGroupTransmission* and the UE is scheduled for a PUSCH transmission by DCI format that includes a DAI field with value and the UE has not received any PDCCH within the monitoring occasions for a DCI format scheduling PDSCH receptions or having associated HARQ-ACK information without scheduling PDSCH receptions on any serving cell , and the UE does not have HARQ-ACK information in response to a SPS PDSCH reception to multiplex in the PUSCH as described in clause 9.1.3.1, the UE does not multiplex HARQ-ACK information in the PUSCH transmission.

If a UE is provided *PDSCH-CodeBlockGroupTransmission* and the UE is scheduled for a PUSCH transmission by DCI format that includes a DAI field with first value or with second value and the UE has not received any PDCCH within the monitoring occasions for a DCI format scheduling PDSCH reception or having associated HARQ-ACK information without scheduling PDSCH reception on any serving cell , and the UE does not have HARQ-ACK information in response to a SPS PDSCH reception to multiplex in the PUSCH, as described in clause 9.1.3.1, the UE does not multiplex HARQ-ACK information for the first sub-codebook or for the second sub-codebook, respectively, in the PUSCH transmission.

Table 9.1.3-2: Value of DAI

|  |  |  |
| --- | --- | --- |
| DAI MSB, LSB |  | Number of {serving cell, PDCCH monitoring occasion}-pair(s) in which PDSCH transmission(s) associated with PDCCH or PDCCH indicating SPS PDSCH release or providing TCI state update or DCI format 1\_1 indicating SCell dormancy is present, denoted as and |
| 0,0 | 1 |  |
| 0,1 | 2 |  |
| 1,0 | 3 |  |
| 1,1 | 4 |  |

\*\*\* Unchanged text is omitted \*\*\*

### 9.2.3 UE procedure for reporting HARQ-ACK

In this clause, for the purpose of determining a PUCCH resource for a PUCCH transmission in a slot using a PUCCH resource indicator field in a DCI format that schedules a PDSCH reception, and for the purpose of determining the slot for the PUCCH transmission

- a UE is assumed to generate HARQ-ACK information regardless of whether or not the PDSCH reception provides a transport block for a HARQ process with disabled HARQ-ACK information as indicated by *HARQ-feedbackEnabling-disablingperHARQprocess*, if provided

- a UE is assumed to not generate HARQ-ACK information associated with a G-RNTI or a G-CS-RNTI with disabled HARQ-ACK information as described in clause 18

The UE determines a number of HARQ-ACK information bits as described in clauses 9.1 through 9.1.5 and a corresponding set of PUCCH resources as described in clause 9.2.1.

A UE does not expect to transmit more than one PUCCH with HARQ-ACK information in a slot per priority index, if the UE is not provided *ackNackFeedbackMode = separate*.

\*\*\* Unchanged text is omitted \*\*\*

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

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

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

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

- *searchSpaceZero* in *PDCCH-ConfigCommon* when *searchSpaceMCCH* and *searchSpaceMTCH* are not provided, for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI

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

- a Type0B-PDCCH CSS set configured by *searchSpaceMCCH* and *searchSpaceMCCH* for a DCI format with CRC scrambled by a MCCH-RNTI or a G-RNTI, on the primary cell of the MCG

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

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

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

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

- a Type3-PDCCH CSS set configured by

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

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

- *searchSpaceMCCH*and *searchSpaceMTCH* on a secondary cell for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI, and

- a USS set configured by

- *SearchSpace* in *PDCCH-Config* with *searchSpaceType* = *ue-Specific* for DCI formats with CRC scrambled by C-RNTI, MCS-C-RNTI, SP-CSI-RNTI, CS-RNTI(s), SL-RNTI, SL-CS-RNTI, or SL Semi-Persistent Scheduling V-RNTI, or

- *sdt-CG-SearchSpace* for DCI formats with CRC scrambled by C-RNTI or CS-RNTI as described in clause 19.1.

In the following, DCI formats with CRC scrambled by C-RNTI or CS-RNTI or MCS-C-RNTI are also referred to as unicast DCI formats, DCI formats with CRC scrambled by G-RNTI or G-CS-RNTI are also referred to as multicast DCI formats, and DCI formats with CRC scrambled by MCCH-RNTI or G-RNTI for MTCH scheduling PDSCH receptions are also referred to as broadcast DCI formats.

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 for a UE 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 an MBS frequency resource provided by *cfr-Config-MCCH-MTCH* as described in clause 18, the CORESET configured for Type0-PDCCH CSS set has CORESET index 0 and the Type0-PDCCH CSS set has search space set index 0.

If the active DL BWP and an MBS frequency resource provided by *cfr-Config-MCCH-MTCH* for a UE have same SCS and same CP length and the active DL BWP includes all RBs of the MBS frequency resource, and if the UE is provided *searchSpaceMCCH* or *searchSpaceMTCH* for Type0B-PDCCH CSS set on the primary cell or for Type3-PDCCH CSS set on a secondary cell, the UE monitors PDCCH for detection of broadcast DCI formats, as described in clause 18, on the active DL BWP.

\*\*\* Unchanged text is omitted \*\*\*

A UE does not expect to be configured CSS sets, except for CSS sets provided by *searchSpaceMCCH*, *searchSpaceMTCH* or by *SearchSpace* in *PDCCH-ConfigMulticast* for DCI formats with CRC scrambled by G-RNTI or G-CS-RNTI, that result to corresponding total, or per scheduled cell, numbers of monitored PDCCH candidates and non-overlapped CCEs per slot, per group of slots for a corresponding combination , or per span that exceed the corresponding maximum numbers per slot, or per group of slots for a corresponding combination , or per span, respectively.

For same cell scheduling or for cross-carrier scheduling, a UE does not expect a number of PDCCH candidates, and a number of corresponding non-overlapped CCEs per slot, or per group of slots for a corresponding combination , or per span, on a secondary cell to be larger than the corresponding numbers that the UE is capable of monitoring on the secondary cell per slot, or per group of slots for a corresponding combination , or per span, respectively. If a UE is provided *monitoringCapabilityConfig* = *r16monitoringcapability* for the primary cell, except the first span of each slot, the UE does not expect a number of PDCCH candidates and a number of corresponding non-overlapped CCEs per span on the primary cell to be larger than the corresponding numbers that the UE is capable of monitoring on the primary cell per span.

\*\*\* Unchanged text is omitted \*\*\*

For all search space sets that a UE monitors PDCCH on the primary cell within a slot , or within a group of slots for a corresponding combination , or within a span in slot , denote by a set of CSS sets, except for CSS sets provided by *searchSpaceMCCH*, *searchSpaceMTCH* or by *SearchSpace* in *PDCCH-ConfigMulticast* for DCI formats with CRC scrambled by G-RNTI or G-CS-RNTI, with cardinality of and by a set of USS sets and CSS sets provided by *searchSpaceMCCH*, *searchSpaceMTCH* or by *SearchSpace* in *PDCCH-ConfigMulticast* for DCI formats with CRC scrambled by G-RNTI or G-CS-RNTI with cardinality of for scheduling on the primary cell. The location of search space sets , , in is according to an ascending order of the search space set index.

Denote by , , the number of counted PDCCH candidates for monitoring for CSS set and by , , the number of counted PDCCH candidates for monitoring for search space set . If a UE indicates *three-BDforSSsetLinking* and is provided for search space set , by *searchSpaceLinking*, a search space set with , set if and are CSS sets or set if and are USS sets.

\*\*\* Unchanged text is omitted \*\*\*

For a scheduled cell and at any time, if a UE is provided a C-RNTI, the UE expects to have received at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, MCS-C-RNTI, G-RNTI for multicast, or G-CS-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.

If a UE is not provided *monitoringCapabilityConfig* = *r16monitoringcapability* for any serving cell, and

- is not configured for NR-DC operation and indicates through *pdcch-BlindDetectionCA* a capability to monitor PDCCH candidates for downlink cells and the UE is configured with downlink cells or uplink cells, or

- is configured with NR-DC operation and for a cell group with downlink cells or uplink cells

the UE expects to have respectively received at most PDCCHs for

- DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI, or a G-RNTI, or a G-CS-RNTI scheduling PDSCH receptions for which the UE has not received any corresponding PDSCH symbol over all downlink cells

- DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI scheduling PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol over all uplink cells

If a UE is provided *monitoringCapabilityConfig* = *r16monitoringcapability* for all serving cells*,* and

- is not configured for NR-DC operation and indicates through *pdcch-MonitoringCA* a capability to monitor PDCCH candidates for downlink cells and the UE is configured with downlink cells or uplink cells, or

- is configured with NR-DC operation and for a cell group with downlink cells or uplink cells

the UE expects to have respectively received at most PDCCHs for

- DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI, or a G-RNTI, or a G-CS-RNTI scheduling PDSCH receptions for which the UE has not received any corresponding PDSCH symbol over all downlink cells

- DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI scheduling PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol over all uplink cells.

If a UE is provided *monitoringCapabilityConfig* = *r16monitoringcapability* for at least one serving cell and is not provided *monitoringCapabilityConfig* = *r16monitoringcapability* for at least one serving cell,and

- is not configured for NR-DC operation, and indicates a capability to monitor PDCCH candidates for downlink cells and downlink cells, and the UE is configured with downlink cells or uplink cells, or

- is configured with NR-DC operation and for a cell group with downlink cells or uplink cells

the UE expects to have respectively received

- at most PDCCHs for DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI, or a G-RNTI, or a G-CS-RNTI scheduling PDSCH receptions for which the UE has not received any corresponding PDSCH symbol over all serving cells that are not provided *monitoringCapabilityConfig* = *r16monitoringcapability*

- at most PDCCHs for DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI scheduling PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol over all serving cells that are not provided *monitoringCapabilityConfig* = *r16monitoringcapability*

- at most PDCCHs for DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI, or a G-RNTI, or a G-CS-RNTI scheduling PDSCH receptions for which the UE has not received any corresponding PDSCH symbol over all serving cells that are provided *monitoringCapabilityConfig* = *r16monitoringcapability*

- at most PDCCHs for DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI scheduling PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol over all serving cells that are provided *monitoringCapabilityConfig* = *r16monitoringcapability*

If a UE is provided serving cells with SCS configuration for the active DL BWP, is not configured for NR-DC operation and indicates through *pdcch-MonitoringCA* a capability to monitor PDCCH candidates for downlink cells and the UE is configured with downlink cells or uplink cells, the UE expects to have respectively received at most PDCCHs for

- DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI, or a G-RNTI, or a G-CS-RNTI scheduling PDSCH receptions for which the UE has not received any corresponding PDSCH symbol over all downlink cells

- DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI scheduling PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol over all uplink cells.

If a UE is provided *monitoringCapabilityConfig* = *r17monitoringcapability* for at least one serving cell, is provided *monitoringCapabilityConfig* = *r15monitoringcapability* for at least one serving cell, is not provided *monitoringCapabilityConfig* = *r16monitoringcapability* for any serving cell, is not configured for NR-DC operation, indicates a capability to monitor PDCCH candidates for downlink cells and downlink cells, and UE is configured with downlink cell or uplink cells, the UE expects to have respectively received

- at most PDCCHs for DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI, or a G-RNTI, or a G-CS-RNTI scheduling PDSCH receptions for which the UE has not received any corresponding PDSCH symbol over all serving cells that are provided *monitoringCapabilityConfig* = *r15monitoringcapability*

- at most PDCCHs for DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI scheduling PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol over all serving cells that are provided *monitoringCapabilityConfig* = *r15monitoringcapability*

- at most PDCCHs for DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI, or a G-RNTI, or a G-CS-RNTI scheduling PDSCH receptions for which the UE has not received any corresponding PDSCH symbol over all serving cells with *monitoringCapabilityConfig* = *r17monitoringcapability*

- at most PDCCHs for DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI scheduling PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol over all serving cells with *monitoringCapabilityConfig* = *r17monitoringcapability*

If a UE is provided *monitoringCapabilityConfig* = *r17monitoringcapability* for at least one serving cell, is provided *monitoringCapabilityConfig* = *r16monitoringcapability* for at least one serving cell, is not provided *monitoringCapabilityConfig* = *r15monitoringcapability* for any serving cell, is not configured for NR-DC operation, indicates a capability to monitor PDCCH candidates for downlink cells and downlink cells, and the UE is configured with downlink cells or uplink cells

the UE expects to have respectively received

- at most PDCCHs for DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI, or a G-RNTI, or a G-CS-RNTI scheduling PDSCH receptions for which the UE has not received any corresponding PDSCH symbol over all serving cells that are provided *monitoringCapabilityConfig* = *r16monitoringcapability*

- at most PDCCHs for DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI scheduling PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol over all serving cells that are provided *monitoringCapabilityConfig* = *r16monitoringcapability*

- at most PDCCHs for DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI, or a G-RNTI, or a G-CS-RNTI scheduling PDSCH receptions for which the UE has not received any corresponding PDSCH symbol over all serving cells with *monitoringCapabilityConfig* = *r17monitoringcapability*

- at most PDCCHs for DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI scheduling PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol over all serving cells with *monitoringCapabilityConfig* = *r17monitoringcapability*

If a UE is provided *monitoringCapabilityConfig* = *r17monitoringcapability* for at least one serving cell, is provided *monitoringCapabilityConfig* = *r16monitoringcapability* for at least one serving cell, and *monitoringCapabilityConfig* = *r15monitoringcapability* for at least one serving cell, is not configured for NR-DC operation, indicates a capability to monitor PDCCH candidates for downlink cells, , and downlink cells, and is configured with downlink cells or uplink cells

the UE expects to have respectively received

- at most PDCCHs for DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI, or a G-RNTI, or a G-CS-RNTI scheduling PDSCH receptions for which the UE has not received any corresponding PDSCH symbol over all serving cells that are provided *monitoringCapabilityConfig* = *r15monitoringcapability*

- at most PDCCHs for DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI scheduling PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol over all serving cells that are provided *monitoringCapabilityConfig* = *r15monitoringcapability*

- at most PDCCHs for DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI, or a G-RNTI, or a G-CS-RNTI scheduling PDSCH receptions for which the UE has not received any corresponding PDSCH symbol over all serving cells that are provided *monitoringCapabilityConfig* = *r16monitoringcapability*

- at most PDCCHs for DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI scheduling PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol over all serving cells that are provided *monitoringCapabilityConfig* = *r16monitoringcapability*

- at most PDCCHs for DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI, or a G-RNTI, or a G-CS-RNTI scheduling PDSCH receptions for which the UE has not received any corresponding PDSCH symbol over all serving cells with *monitoringCapabilityConfig* = *r17monitoringcapability*

- at most PDCCHs for DCI formats with CRC scrambled by a C-RNTI, or a CS-RNTI, or a MCS-C-RNTI scheduling PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol over all serving cells with *monitoringCapabilityConfig* = *r17monitoringcapability*

If a UE

- is configured to monitor a first PDCCH candidate for a DCI format 0\_0 and a DCI format 1\_0 from a CSS set and a second PDCCH candidate for a DCI format 0\_0 and a DCI format 1\_0 from a USS set, where the CSS set and the USS set do not include *searchSpaceLinking*, in a CORESET with index zero on an active DL BWP, and

- the DCI formats 0\_0/1\_0 associated with the first PDCCH candidate and the DCI formats 0\_0/1\_0 associated with the second PDCCH candidate have same size, and

- the UE receives the first PDCCH candidate and the second PDCCH candidate over a same set of CCEs, and

- the first PDCCH candidate and the second PDCCH candidate have identical scrambling, and

- the DCI formats 0\_0/1\_0 for the first PDCCH candidate and the DCI formats 0\_0/1\_0 for the second PDCCH candidate have CRC scrambled by either C-RNTI, or MCS-C-RNTI, or CS-RNTI

the UE decodes only the DCI formats 0\_0/1\_0 associated with the first PDCCH candidate.

\*\*\* Unchanged text is omitted \*\*\*

# 18 Multicast Broadcast Services

This clause is applicable only for PDCCH receptions, PDSCH receptions, and PUCCH transmissions for MBS on a serving cell. DCI formats with CRC scrambled by G-RNTI or G-CS-RNTI scheduling PDSCH receptions are referred to as multicast DCI formats and the PDSCH receptions are referred to as multicast PDSCH receptions. DCI formats with CRC scrambled by MCCH-RNTI or G-RNTI for MTCH scheduling PDSCH receptions are referred to as broadcast DCI formats and the PDSCH receptions are referred to as broadcast PDSCH receptions. HARQ-ACK information associated with multicast DCI formats or multicast PDSCH receptions is referred to as multicast HARQ-ACK information.

A UE can be provided one or more G-RNTIs per serving cell for scrambling the CRC of multicast DCI formats for scheduling PDSCH receptions. The UE can be provided one or more G-CS-RNTI per serving cell for scrambling the CRC of multicast DCI formats providing activation/release for SPS PDSCH receptions.

A UE can be configured by *cfr-Config-MCCH-MTCH* an MBS frequency resource for PDCCH and PDSCH receptions providing MCCH and MTCH [12, TS 38.331]; otherwise, the MBS frequency resource is same as for the CORESET with index 0 that is associated with the Type0-PDCCH CSS set for PDCCH and PDSCH receptions providing MCCH and MTCH. A UE monitors PDCCH for scheduling PDSCH receptions for MCCH or MTCH as described in clause 10.1.

In clauses referring to a higher layer parameter value provided by *PDCCH-ConfigCommon* or *PDSCH-ConfigCommon*, when applicable a corresponding higher layer parameter value for MCCH/MTCH PDCCH receptions or PDSCH receptions, respectively, is provided as described in [12, TS 38.331].

A UE is not required to simultaneously receive PDSCHs for MCCH or MTCH on two serving cells. A UE is not required to simultaneously receive on a serving cell

- PDSCHs for MCCH and MTCH, or

- more than one MTCH PDSCHs, or

- PDSCH for MTCH and PBCH, or

- PDSCH for MCCH or MTCH and PDSCH scheduled by a DCI format 1\_0 with CRC scrambled by SI-RNTI or by P-RNTI

A UE in the RRC\_CONNECTED state is not required to simultaneously receive on a serving cell

- PDSCHs for MCCH or MTCH and multicast PDSCH, or

- more than one multicast PDSCHs, or

- multicast PDSCH and PBCH, or

- PDSCH for MCCH or MTCH or multicast PDSCH and PDSCH scheduled by a DCI format 1\_0 with CRC scrambled by RA-RNTI

A UE can be configured, per DL BWP by *cfr-Config-Multicast*, an MBS frequency resource within the DL BWP for PDCCH and PDSCH receptions [4, TS 38.211]. If *cfr-Config-Multicast* does not include *locationAndBandwidth-Multicast*, the MBS frequency resource is the active DL BWP. The UE is not required to simultaneously receive PDSCHs on two serving cells. In clauses referring to a higher layer parameter value provided by *PDCCH-Config* or *PDSCH-Config* or *SPS-Config* for a DL BWP, when applicable a corresponding higher layer parameter value for multicast PDCCH, PDSCH, or SPS PDSCH receptions is provided as described in [12, TS 38.331].

In clauses referring to a higher layer parameter value provided by a first or second *PUCCH-Config*, when applicable a corresponding higher layer parameter value for PUCCH transmissions associated with multicast PDCCH or PDSCH receptions is provided as described in [12, TS 38.331]. In clauses referring to a higher layer parameter value provided by *SPS-PUCCH-AN* or *SPS-PUCCH-AN-List*, when applicable a corresponding higher layer parameter value for PUCCH transmissions associated with multicast SPS PDSCH receptions is provided as described in [12, TS 38.331]. In clauses referring to a higher layer parameter value provided by *pdsch-HARQ-ACK-Codebook* or *pdsch-HARQ-ACK-CodebookList*, when applicable a corresponding higher layer parameter value for HARQ-ACK codebooks associated with multicast HARQ-ACK information is provided as described in [12, TS 38.331].

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 UE determines a priority for a PUCCH transmission with multicast HARQ-ACK information according to any HARQ-ACK reporting mode as described in clause 9 for a PUCCH transmission with unicast HARQ-ACK information.

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. The second HARQ-ACK reporting mode is not applicable for the first SPS PDSCH reception after activation of SPS PDSCH receptions for a SPS configuration, or for DCI formats having associated HARQ-ACK information without scheduling a PDSCH reception.

For the second HARQ-ACK reporting mode, when a number of HARQ-ACK information bits is one, a UE transmits a PUCCH only when the HARQ-ACK information bit has NACK value. For a PUCCH resource associated with PUCCH format 0, the UE transmits the PUCCH as described in [4, TS 38.211] by obtaining as described for HARQ-ACK information in clause 9.2.3 and by setting . For a PUCCH resource associated with PUCCH format 1, the UE transmits the PUCCH as described in [4, TS 38.211] by setting .

For the second HARQ-ACK reporting mode and a UE configured with only one G-RNTI, the UE can be indicated by *moreThanOneNackOnlyMode* to provide the HARQ-ACK information bits in a PUCCH either according to the first HARQ-ACK reporting mode or by selecting a resource from a set of resources for the PUCCH transmission based on the values of the HARQ-ACK information bits as described in Table 18-1. The UE generates HARQ-ACK information bits for the second HARQ-ACK reporting mode according to a Type-2 HARQ-ACK codebook as described in clause 9.1.3.1.

Table 18-1: Mapping of values of HARQ-ACK information bits to PUCCH resources for the second HARQ-ACK reporting mode

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Value of HARQ-ACK information bits | | | | PUCCH resource |
| {0} | {0,0} | {0,0,0} | {0,0,0,0} | 1st PUCCH resource from *resourceList* |
|  | {1,0} | {1,0,0} | {1,0,0,0} | 2nd PUCCH resource from *resourceList* |
|  | {0,1} | {0,1,0} | {0,1,0,0} | 3rd PUCCH resource from *resourceList* |
|  |  | {1,1,0} | {1,1,0,0} | 4th PUCCH resource from *resourceList* |
|  |  | {0,0,1} | {0,0,1,0} | 5th PUCCH resource from *resourceList* |
|  |  | {1,0,1} | {1,0,1,0} | 6th PUCCH resource from *resourceList* |
|  |  | {0,1,1} | {0,1,1,0} | 7th PUCCH resource from *resourceList* |
|  |  |  | {1,1,1,0} | 8th PUCCH resource from *resourceList* |
|  |  |  | {0,0,0,1} | 9th PUCCH resource from *resourceList* |
|  |  |  | {1,0,0,1} | 10th PUCCH resource from *resourceList* |
|  |  |  | {0,1,0,1} | 11th PUCCH resource from *resourceList* |
|  |  |  | {1,1,0,1} | 12th PUCCH resource from *resourceList* |
|  |  |  | {0,0,1,1} | 13th PUCCH resource from *resourceList* |
|  |  |  | {1,0,1,1} | 14th PUCCH resource from *resourceList* |
|  |  |  | {0,1,1,1} | 15th PUCCH resource from *resourceList* |

If a UE is provided *pucch-ConfigurationListMulticast1* or *pucch-ConfigurationListMulticast2* for PUCCH transmissions with a priority value, the UE transmits a PUCCH with the priority value according to *pucch-ConfigurationListMulticast1* or *pucch-ConfigurationListMulticast2* 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 the second HARQ-ACK reporting mode, respectively. For HARQ-ACK information associated only with the second HARQ-ACK reporting mode, when the UE is provided *moreThanOneNackOnlyMode* and the UE provides the HARQ-ACK information according to the first HARQ-ACK reporting mode and in response to at least one DCI format detection, the UE determines a PUCCH resource from *pucch-ConfigurationListMulticast1*, if provided; otherwise, the UE determines a PUCCH resource from *pucch-Config/pucch-ConfigurationList*.

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

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

A UE can be configured per G-RNTI or per G-CS-RNTI, by *harq-FeedbackEnablerMulticast* with value set to 'enabled', to provide HARQ-ACK information for PDSCH receptions. When the UE is not provided *harq-FeedbackEnablerMulticast* for a G-RNTI or G-CS-RNTI, or when the UE is provided *harq-FeedbackEnablerMulticast* with value set to 'disabled', the UE does not provide HARQ-ACK information for respective PDSCH receptions. If a UE is provided *harq-FeedbackEnablerMulticast* with value set to 'dci-enabler' for a G-RNTI or a G-CS-RNTI, the UE determines whether or not to provide the HARQ-ACK information for PDSCH receptions based on an indication by the multicast DCI format associated with the G-RNTI or the G-CS-RNTI [4, TS 38.212].

If a UE would multiplex multicast HARQ-ACK information according to the second HARQ-ACK reporting mode with multicast HARQ-ACK information according to the first HARQ-ACK reporting mode, or unicast HARQ-ACK information, or CSI reports in a first PUCCH or in a PUSCH, as described in clauses 9 and 9.2.5, the UE provides the HARQ-ACK information according to the first HARQ-ACK reporting mode. For resolving an overlapping among a second PUCCH with HARQ-ACK information according to the second HARQ-ACK reporting mode and other PUCCHs or PUSCHs prior to multiplexing the HARQ-ACK information in a PUCCH or PUSCH, the UE considers that the UE would transmit the second PUCCH when all values of the HARQ-ACK information are 'ACK'.

If a UE is provided multiple G-RNTIs or G-CS-RNTIs, a configuration for a HARQ-ACK codebook type applies to all G-RNTIs or G-CS-RNTIs.

If a UE is provided *pdsch-HARQ-ACK-Codebook-Multicast = semi-static*, the UE generates a Type-1 HARQ-ACK codebook as described in clauses 9.1.2, 9.1.2.1, and 9.1.2.2.

If a UE is provided *pdsch-HARQ-ACK-Codebook-Multicast = dynamic*, the UE generates a Type-2 HARQ-ACK codebook as described in clause 9.1.3.1.

If, for unicast and multicast HARQ-ACK information of same priority value, a UE

- is provided

- either *pdsch-HARQ-ACK-Codebook = dynamic* or *pdsch-HARQ-ACK-Codebook-r16* and *pdsch-HARQ-ACK-Codebook-Multicast = semi-static*,

- or *pdsch-HARQ-ACK-Codebook = semi-static* and *pdsch-HARQ-ACK-Codebook-Multicast = dynamic*, and

- would multiplex the unicast and multicast HARQ-ACK information in a same PUCCH or PUSCH

the UE

- appends the HARQ-ACK codebooks for the multicast HARQ-ACK information to the HARQ-ACK codebooks for the unicast HARQ-ACK information

- if , the UE determines for obtaining a power of a PUCCH transmission with the HARQ-ACK information, as described in clause 7.2.1, as a sum of the value from clause 9.1.2.1 or clause 9.1.3.3 and the value from clause 9.1.3.1.

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 a UE multiplexes in a PUCCH HARQ-ACK information of same priority associated with unicast DCI formats and 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.

If the UE multiplexes in a PUCCH only multicast HARQ-ACK information of same priority that is according to both the first and second HARQ-ACK reporting modes, the last DCI format that the UE uses to determine the PUCCH resource, as described in clause 9.2.3, is a last DCI format associated with multicast HARQ-ACK information that is according to the first HARQ-ACK reporting mode.

If a UE multiplexes in a PUCCH first HARQ-ACK information associated with multicast SPS PDSCH receptions and second HARQ-ACK information associated with multicast DCI formats and having same priority value as the first HARQ-ACK information, and both the first and second HARQ-ACK information are according to the first HARQ-ACK reporting mode, the UE determines the PUCCH resource based on the last multicast DCI format, as described in clause 9.2.3.

If a UE multiplexes in a PUCCH first HARQ-ACK information associated with unicast SPS PDSCH receptions and second HARQ-ACK information associated with multicast DCI formats and having same priority value as the first HARQ-ACK information in a same PUCCH, the UE determines the PUCCH resource from *SPS-PUCCH-AN-List* for unicast SPS PDSCH receptions as described in clause 9.2.1.

If a UE multiplexes in a PUCCH first HARQ-ACK information associated with unicast SPS PDSCH receptions and second HARQ-ACK information associated with multicast SPS PDSCH receptions and having same priority value as the first HARQ-ACK information in a same PUCCH, the UE determines the PUCCH resource from *SPS-PUCCH-AN-List* for unicast SPS PDSCH receptions as described in clause 9.2.1.

If a UE multiplexes in a PUCCH only multicast HARQ-ACK information according to second HARQ-ACK reporting modes and CSI reports, the UE determines a PUCCH resource as described in clause 9.2.5.2 for multiplexing CSI reports with HARQ-ACK information that is in response to PDSCH receptions without corresponding PDCCHs.

A UE is not required to multiplex in a PUCCH multicast HARQ-ACK information of a priority and unicast UCI of the priority if the UE is provided *subslotLengthForPUCCH* for PUCCH transmissions with unicast UCI of the priority.