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

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

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| *CR-Form-v12.0* |
| **DRAFT CHANGE REQUEST** |
|  |
|  | **38.213** | **CR** |  | **rev** |  | **Current version:** | **17.0.0** |  |
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| *For* [***HE******LP***](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:*** | 2022-03-07 |
|  |  |  |  |  |
| ***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 canbe 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-12 (Release 12)**Rel-13 (Release 13)Rel-14 (Release 14)Rel-15 (Release 15)Rel-16 (Release 16)* |
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| ***Reason for change:*** | Corrections/additions on multicast-broadcast services (MBS) in NR. |
|  |  |
| ***Summary of change:*** | 1. Capture “fallback” conditions for Type-1 HARQ-ACK codebook generation for multicast HARQ-ACK information in clause 9.1.2.
2. Include multicast SPS PDSCHs in the determination of the HARQ-ACK codebooks for SPS PDSCHs in clause 9.1.2.
3. Capture broadcast PDSCH receptions on a SCell in clause 10.1.
4. Capture condition for a UE to monitor PDCCH for a Type0B-PDCCH CSS set on an active DL BWP in clause 10.1.
5. Include *searchSpace-Broadcast* in the procedure for determining search space sets for PDCCH monitoring on the primary cell in clause 10.1.
6. Capture applicability of *RateMatchPattern* in *PDSCH-Config-Multicast* for PDCCH/PDSCH receptions in clause 10.1.
7. Capture types of FDMed receptions that a UE in RRC\_IDLE or RRC\_INACTIVE is not required to support in clause 18.
8. Capture that a UE is not required to simultaneously receive broadcast/multicast PDSCHs on the PCell and on a SCell in clause 18.
9. Capture PUCCH resource determination aspects for cases when some HARQ-ACK information is for multicast SPS PDSCHs in clause 18.
10. Include SPS GC-PDSCH activation/deactivation by DCI formats 4\_1/4\_2 in clause 10.2.
11. Add G-RNTI for multicast and G-CS-RNTI in the RNTIs that a UE expects to have received at most 16 PDCCHs scheduling PDSCHs for which the UE has not received any symbol for a scheduled cell at any time in clause 10.1.
12. Include G-CS-RNTI for SPS PDSCH activation/release in clause 10.2.
13. Capture Type-1 HARQ-ACK codebook multiplexing in a PUSCH when the multicast HARQ-ACK CB, or both the multicast and unicast HARQ-ACK CBs, is Type-1 in clause 9.1.2.2.
14. Correct determination of PDSCH-to-HARQ\_feedback timing indicator field values for multicast DCI formats in clauses 9.1.2.1 and 9.2.3.
15. Capture that for Type-2 HARQ-ACK CB generation, a UE does not include HARQ-ACK that the UE is indicated to not provide in clause 9.1.3.
16. Add statement that the second HARQ-ACK report mode does not apply to the first SPS PDSCH reception after activation in clause 18.
17. Capture the case that the unicast HARQ-ACK codebook is the Rel-16 Type-2 HARQ-ACK codebook in clause 18.
18. Capture PUCCH transmission aspects when a UE is configured the second HARQ-ACK report mode and there is 1 bit in clause 18.
19. Capture HARQ-ACK reporting aspects when a UE is configured the second HARQ-ACK report mode and the number of bits is more than 1 in clause 18.
20. Capture HARQ-ACK multiplexing for the second HARQ-ACK report mode with other UCI in a PUCCH or in a PUSCH in clause 18.
21. Other miscellaneous corrections/alignments in clauses 10.1 and 18.
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| ***Consequences if not approved:*** | Incomplete support for MBS in NR. |
|  |  |
| ***Clauses affected:*** | 9.1.2, 9.1.2.1, 9.1.2.2, 9.1.3, 9.2.3, 10.1, 10.2, 18 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS 38.211, TS 38.212, TS 38.214 |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

\*\*\* 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.

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 *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 *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.

If a UE reports HARQ-ACK information in a PUCCH only for

- a SPS PDSCH release indicated by DCI format 1\_0 or by DCI format 4\_1 with counter DAI field value of 1, or

- a PDSCH reception scheduled by DCI format 1\_0 or by DCI format 4\_1 with counter DAI field value of 1 on the PCell, or

- SPS PDSCH receptions associated with a CS-RNTI or with G-CS-RNTIs

within the occasions for candidate PDSCH receptions as determined in clause 9.1.2.1, the UE determines a HARQ-ACK codebook only for the SPS PDSCH release, or only for the PDSCH reception, or only for SPS PDSCH receptions according to corresponding occasions on respective serving cells, where the value of counter DAI in DCI format 1\_0 or in DCI format 4\_1 is according to Table 9.1.3-1 and HARQ-ACK information bits in response to more than one SPS PDSCH receptions that the UE is configured to receive are ordered according to the following pseudo-code; otherwise, the procedures in clause 9.1.2.1 and clause 9.1.2.2 for a HARQ-ACK codebook determination apply.

In the following pseudo-code, SPS PDSCH receptions associated with a SPS PDSCH configuration are activated by a DCI format with CRC scrambled by a CS-RNTI or by a DCI format with CRC scrambled by a G-CS-RNTI.

Set to the number of serving cells configured to the UE

Set to the number of SPS PDSCH configurations configured to the UE for serving cell

Set to the number of DL slots for SPS PDSCH receptions on serving cell with HARQ-ACK information multiplexed on the PUCCH

Set – HARQ-ACK information bit index

Set – serving cell index: lower indexes correspond to lower RRC indexes of corresponding cell

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*, 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

#### 9.1.2.1 Type-1 HARQ-ACK codebook in physical uplink control channel

For a serving cell , an active DL BWP, and an active UL BWP, as described in clause 12, the UE determines a set of occasions for candidate PDSCH receptions for which the UE can transmit corresponding HARQ-ACK information in a PUCCH in slot . If serving cell is deactivated, the UE uses as the active DL BWP for determining the set of occasions for candidate PDSCH receptions a DL BWP provided by *firstActiveDownlinkBWP-Id*. The determination is based:

a) on a set of slot timing values associated with the active UL BWP

- If the UE is configured to monitor PDCCH for DCI format 1\_0 and is not configured to monitor PDCCH for either DCI format 1\_1 or DCI format 1\_2 for serving cell , is provided by the slot timing values {1, 2, 3, 4, 5, 6, 7, 8} for SCS configuration of PUCCH transmission , {7, 8, 12, 16, 20, 24, 28, 32} for , and {13, 16, 24, 32, 40, 48, 56, 64} for .

- If the UE is configured to monitor PDCCH for DCI format 1\_1 and is not configured to monitor PDCCH for DCI format 1\_2 for serving cell , is provided by *dl-DataToUL-ACK*

- If the UE is configured to monitor PDCCH for DCI format 1\_2 and is not configured to monitor PDCCH for DCI format 1\_1 for serving cell , is provided by *dl-DataToUL-ACK-DCI-1-2*

- If the UE is configured to monitor PDCCH for DCI format 1\_1 and DCI format 1\_2 for serving cell , is provided by the union of *dl-DataToUL-ACK* and *dl-DataToUL-ACK-DCI-1-2*

- If the UE is configured to monitor PDCCH for multicast DCI formats for serving cell

- if the UE is not provided *type1-Codebook-Generation-Mode =* 'mode1', is additionally provided by the union of *dl-DataToUL-ACK from pucch-ConfigurationListMulticast1 or pucch-ConfigurationListMulticast2* and *dl-DataToUL-ACK-ForDCI Format4\_1*

- if the UE is not provided *dl-DataToUL-ACK-ForDCI Format4\_1*, is provided by union of *dl-DataToUL-ACK from pucch-ConfigurationListMulticast1 or pucch-ConfigurationListMulticast2* and the slot timing values {1, 2, 3, 4, 5, 6, 7, 8}

- if the UE is provided *type1-Codebook-Generation-Mode =* 'mode1', the UE

- determines a first set as , where is a set of slot timing values for the multicast DCI formats, a second set as , and a third set as

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

#### 9.1.2.2 Type-1 HARQ-ACK codebook in physical uplink shared channel

If a UE is not provided *pdsch-HARQ-ACK-Codebook = ‘semi-static’* for unicast or multicast HARQ-ACK information, the UE does not multiplex the unicast or multicast HARQ-ACK information in the PUSCH transmission, respectively.

If a UE is provided *pdsch-HARQ-ACK-Codebook = ‘semi-static’* for unicast and/or multicast HARQ-ACK information, and 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 PDSCH or SPS PDSCH release or TCI state update that the UE multiplexes corresponding HARQ-ACK information in the PUSCH, based on a value of a respective PDSCH-to-HARQ\_feedback timing indicator field in a DCI format scheduling the PDSCH reception or the SPS PDSCH release or the TCI state update, or on the value of *dl-DataToUL-ACK* or *dl-DataToUL-ACK-r16* if the PDSCH-to-HARQ\_feedback timing indicator field is not present in DCI format 1\_1 or on the value of *dl-DataToUL-ACK-ForDCI-Format1-2* if the PDSCH-to-HARQ\_feedback timing indicator field is not present in DCI format 1\_2 and the UE is provided *pdsch-HARQ-ACK-Codebook = ‘semi-static’* for unicast HARQ-ACK information, or on the value of *dl-DataToUL-ACK* if the PDSCH-to-HARQ\_feedback timing indicator field is not present in DCI format 4\_1 or DCI format 4\_2 and the UE is provided *pdsch-HARQ-ACK-Codebook = ‘semi-static’* for multicast HARQ-ACK information, in any of the occasions for candidate PDSCH receptions by a DCI format or SPS PDSCH on any serving cell , as described in clause 9.1.2.1, the UE does not multiplex HARQ-ACK information in the PUSCH transmission

- else the UE generates the HARQ-ACK codebook as described in clause 9.1.2.1, except that *harq-ACK-SpatialBundlingPUCCH* is replaced by *harq-ACK-SpatialBundlingPUSCH*, unless the UE receives only a SPS PDSCH release, or only a SPS PDSCH reception, or only a TCI state update, or only a PDSCH that is scheduled by DCI format 1\_0 with a counter DAI field value of 1 if the UE is provided *pdsch-HARQ-ACK-Codebook = ‘semi-static’* for unicast HARQ-ACK information, or is scheduled by DCI format 4\_1 with a counter DAI field value of 1 if the UE is provided *pdsch-HARQ-ACK-Codebook = ‘semi-static’* for multicast HARQ-ACK information, on the PCell in the occasions for candidate PDSCH receptions in which case the UE generates HARQ-ACK information only for the SPS PDSCH release or only for the PDSCH reception or only for the TCI state update as described in clause 9.1.2

A UE sets to NACK value in the HARQ-ACK codebook any HARQ-ACK information corresponding to PDSCH reception or SPS PDSCH release or TCI state update that the UE detects in a PDCCH monitoring occasion that starts after a PDCCH monitoring occasion where the UE detects a DCI format scheduling the PUSCH transmission.

A UE does not expect to detect a DCI format switching a DL BWP within symbols prior to a first symbol of a PUSCH transmission where the UE multiplexes HARQ-ACK information, where is defined in [6, TS 38.214].

If a UE multiplexes HARQ-ACK information in a PUSCH transmission that is scheduled by DCI format that includes a DAI field, and

- is not provided *fdmed-Reception-Multicast* and is provided *pdsch-HARQ-ACK-Codebook = ‘semi-static’* for both unicast and multicast HARQ-ACK information, or

- is provided *pdsch-HARQ-ACK-Codebook = ‘semi-static’* only for one of unicast and multicast HARQ-ACK information

the UE generates the HARQ-ACK codebook as described in clause 9.1.2.1 when a value of the DAI field is except that *harq-ACK-SpatialBundlingPUCCH* is replaced by *harq-ACK-SpatialBundlingPUSCH*. The UE does not generate a HARQ-ACK codebook for multiplexing in the PUSCH transmission when unless the UE receives only a SPS PDSCH release, or only SPS PDSCH(s), or only a TCI state update, or only a PDSCH that is scheduled by a DCI format 1\_0 if the UE is provided *pdsch-HARQ-ACK-Codebook = ‘semi-static’* for unicast HARQ-ACK information, or scheduled by a DCI format 4\_1 if the UE is provided *pdsch-HARQ-ACK-Codebook = ‘semi-static’* for multicast HARQ-ACK information, with a counter DAI field value of 1 on the PCell in the occasions for candidate PDSCH receptions in which case the UE generates HARQ-ACK information only for the SPS PDSCH release or only for the TCI state update or only for the PDSCH reception as described in clause 9.1.2.

 if the PUSCH is scheduled by a DCI format that includes a DAI field and the DAI field is set to ‘0’; otherwise, .

If a UE is provided *fdmed-Reception-Multicast* and is provided *pdsch-HARQ-ACK-Codebook = ‘semi-static’* for both unicast and multicast HARQ-ACK information, the UE generates the HARQ-ACK codebook as described in clause 9.1.2.1, except that *harq-ACK-SpatialBundlingPUCCH* is replaced by *harq-ACK-SpatialBundlingPUSCH*

- for the first set of serving cells if a value of the DAI field associated with unicast HARQ-ACK information is [5, TS 38.212]

- for the second set of serving cells if a value of the DAI field associated with multicast HARQ-ACK information is [5, TS 38.212]

The UE does not generate unicast or multicast HARQ-ACK information for multiplexing in the PUSCH transmission when or , respectively, unless the UE receives respectively

- only a unicast or a multicast SPS PDSCH release, or

- only unicast or multicast SPS PDSCH(s), or

- only a TCI state update or a PDSCH that is scheduled by a DCI format 1\_0 with a counter DAI field value of 1 on the PCell, or a PDSCH that is scheduled by a DCI format 4\_1 with a counter DAI field value of 1 on the PCell

in the occasions for candidate PDSCH receptions in which case the UE generates only the corresponding unicast or multicast HARQ-ACK information.

 if the corresponding value of the DAI field is set to '0'; otherwise, . if the corresponding value of the DAI field is set to '0'; otherwise, [5, TS 38.212].

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

### 9.1.3 Type-2 HARQ-ACK codebook determination

This clause applies if the UE is configured with *pdsch-HARQ-ACK-Codebook = dynamic* or with *pdsch-HARQ-ACK-Codebook-r16*. Unless stated otherwise, a PDSCH-to-HARQ\_feedback timing indicator field provides an applicable value.

A UE does not expect to multiplex in a Type-2 HARQ-ACK codebook HARQ-ACK information that is in response to a detection of a DCI format that does not include a counter DAI field.

If a UE is provided *HARQ-feedbackEnabling-disablingperHARQprocess* indicating disabled HARQ-ACK information for a HARQ process associated with a transport block for PDCCH monitoring occasion or for SPS PDSCH receptions on serving cell , the UE does not multiplex a HARQ-ACK information bit corresponding to the transport block in a Type-2 HARQ-ACK codebook and does not consider the transport block as received in the determination of or of in clause 9.1.3.1. If the UE is also provided *PDSCH-CodeBlockGroupTransmission*, the UE does not multiplex HARQ-ACK information bits corresponding to CBGs of the transport block in the Type-2 HARQ-ACK codebook and does not consider the CBGs as received in the determination of in clause 9.1.3.1. 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 is indicated to not provide multicast HARQ-ACK information, as described in clause 18, associated with PDCCH monitoring occasion or for SPS PDSCH receptions on serving cell , the UE does not multiplex corresponding HARQ-ACK information bits in a Type-2 HARQ-ACK codebook and does not consider any transport blocks as received in the determination of or of in clause 9.1.3.1.

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

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

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

If a UE is not provided *PDSCH-CodeBlockGroupTransmission* for any serving cells, or for PDSCH receptions scheduled by a DCI format that does not support CBG-based PDSCH receptions, or for SPS PDSCH reception, or for a DCI format having associated HARQ-ACK information without scheduling PDSCH reception, and if , the UE determines a number of HARQ-ACK information bits for obtaining a transmission power for a PUCCH, as described in clause 7.2.1, as

where

- is a number of serving cells where the UE is configured to receive unicast PDSCHs

- is a number of serving cells where the UE is configured to receive multicast PDSCHs for a G-RNTI or a G-CS-RNTI

- is a total number of G-RNTIs or G-CS-RNTIs configured to the UE

- is the number of PDCCH monitoring occasions for unicast DCI formats

- is the number of PDCCH monitoring occasions for multicast DCI formats with CRC scrambled by G-RNTI or G-CS-RNTI

- where the number of bits for the counter DAI field in unicast DCI formats

- where the number of bits for the counter DAI field in multicast DCI formats with CRC scrambled by G-RNTI or G-CS-RNTI

- if , is the value of the counter DAI in the last DCI format scheduling PDSCH reception or having associated HARQ-ACK information without scheduling PDSCH reception, that the UE detects within the PDCCH monitoring occasions.

- if , is the value of the counter DAI in the last multicast DCI format with G-RNTI , or G-CS-RNTI , scheduling PDSCH reception or having associated HARQ-ACK information without scheduling a PDSCH reception, that the UE detects within the PDCCH monitoring occasions

- if or if

- if the UE does not detect any DCI format that includes a total DAI field in a last PDCCH monitoring occasion within the or PDCCH monitoring occasions where the UE detects at least one DCI format scheduling PDSCH reception, or having associated HARQ-ACK information without scheduling PDSCH reception, for any serving cell , or , respectively, is the value of the counter DAI in a last DCI format the UE detects in the last PDCCH monitoring occasion

- if the UE detects at least one DCI format that includes a total DAI field in a last PDCCH monitoring occasion within the or , for G-RNTI or G-CS-RNTI , PDCCH monitoring occasions where the UE detects at least one DCI format scheduling PDSCH reception, or having associated HARQ-ACK information without scheduling PDSCH reception, for any serving cell , or , respectively, is the value of the total DAI in the at least one DCI format that includes a total DAI field

- or if the UE does not detect any DCI format scheduling PDSCH reception, or having associated HARQ-ACK information without scheduling PDSCH reception, for any serving cell in any of the or PDCCH monitoring occasions, respectively.

- or , for G-RNTI or G-CS-RNTI , is the total number of DCI formats scheduling PDSCH receptions, or having associated HARQ-ACK information without scheduling a PDSCH reception, that the UE detects within the or PDCCH monitoring occasions, respectively, for serving cell . or if the UE does not detect any DCI format scheduling PDSCH reception, or having associated HARQ-ACK information without scheduling PDSCH reception, for serving cell in any of the or , respectively, PDCCH monitoring occasions.

- if the value of *maxNrofCodeWordsScheduledByDCI* is 2 for any serving cell and *harq-ACK-SpatialBundlingPUCCH* is not provided; otherwise, .

- if the value of *maxNrofCodeWordsScheduledByDCI* is 2 for any serving cell and *harq-ACK-SpatialBundlingPUCCH* is not provided for G-RNTI or G-CS-RNTI ; otherwise, .

- or , for G-RNTI or G-CS-RNTI , is the number of transport blocks the UE receives in a PDSCH scheduled by a DCI format that the UE detects in PDCCH monitoring occasion for serving cell if *harq-ACK-SpatialBundlingPUCCH* is not provided, or the number of PDSCH scheduled by a DCI format that the UE detects in PDCCH monitoring occasion for serving cell if *harq-ACK-SpatialBundlingPUCCH* is provided, or the number of DCI formats that the UE detects and have associated a HARQ-ACK information without scheduling PDSCH reception in PDCCH monitoring occasion for serving cell .

- or , for G-RNTI or G-CS-RNTI , is the number of SPS PDSCH receptions by the UE on serving cell for which the UE transmits corresponding HARQ-ACK information in the same PUCCH as for HARQ-ACK information corresponding to PDSCH receptions within the or PDCCH monitoring occasions, respectively.

\*\*\* 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. 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*.

For DCI format 1\_0, the PDSCH-to-HARQ\_feedback timing indicator field values map to {1, 2, 3, 4, 5, 6, 7, 8} for SCS configuration of PUCCH transmission , to {7, 8, 12, 16, 20, 24, 28, 32} for , and to {13, 16, 24, 32, 40, 48, 56, 64} for . For a unicast DCI format, other than DCI format 1\_0 or requesting Type-3 HARQ-ACK codebook report without scheduling a PDSCH reception as described in clause 9.1.4, the PDSCH-to-HARQ\_feedback timing indicator field values, if present, map to values for a set of number of slots provided by *dl-DataToUL-ACK*, *dl-DataToUL-ACK-r16*, or *dl-DataToUL-ACKForDCIFormat1\_2*, or *dl-DataToUL-ACK-r17* as defined in Table 9.2.3-1. If the DCI format indicates a cell for the PUCCH transmission, as described in clause 9.A, the PDSCH-to-HARQ\_feedback timing indicator field value maps to slots of the active UL BWP of the cell; otherwise, the PDSCH-to-HARQ\_feedback timing indicator field value maps to slots of the active UL BWP of the PCell. For DCI format 4\_1, the PDSCH-to-HARQ\_feedback timing indicator field values are provided by *dl-DataToUL-ACK-MulticastDciFormat4\_1* or, if *dl-DataToUL-ACK-MulticastDciFormat4\_1* is not provided, by {1, 2, 3, 4, 5, 6, 7, 8}. For DCI format 4\_2, the PDSCH-to-HARQ\_feedback timing indicator field values are provided by *dl-DataToUL-ACK* from *pucch-ConfigurationListMulticast1* or *pucch-ConfigurationListMulticast2.*

\*\*\* 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 *pdcch-Config-MCCH* and *pdcch-Config-MTCH* are not provided, for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI, on the primary cell of the MCG

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

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

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

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

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

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

- a Type3-PDCCH CSS set configured by

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

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

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

- 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 *searchSpace* for Type0B-PDCCH CSS set or for Type3-PDCCH CSS set on a secondary cell, the UE monitors PDCCH for Type0B-PDCCH CSS set or for Type3-PDCCH CSS set on the active DL BWP.

For a DL BWP, if a UE is not provided *searchSpaceOtherSystemInformation* for Type0A-PDCCH CSS set, the UE does not monitor PDCCH for Type0A-PDCCH CSS set on the DL BWP. The CCE aggregation levels and the number of PDCCH candidates per CCE aggregation level for Type0A-PDCCH CSS set are given in Table 10.1-1.

For a DL BWP, if a UE is not provided *ra-SearchSpace* for Type1-PDCCH CSS set, the UE does not monitor PDCCH for Type1-PDCCH CSS set on the DL BWP. If the UE has not been provided a Type3-PDCCH CSS set or a USS set and the UE has received a C-RNTI and has been provided a Type1-PDCCH CSS set, the UE monitors PDCCH candidates for DCI format 0\_0 and DCI format 1\_0 with CRC scrambled by the C-RNTI in the Type1-PDCCH CSS set. If the UE has not been provided *sdt-SearchSpace* for Type1A-PDCCH CSS set, the UE monitors PDCCH candidates for DCI format 0\_0 and DCI format 1\_0 with CRC scrambled by the C-RNTI in the Type1-PDCCH CSS set as described in clause 19.2.

If a UE is not provided *pagingSearchSpace* for Type2-PDCCH CSS set, the UE does not monitor PDCCH for Type2-PDCCH CSS set on the DL BWP. The CCE aggregation levels and the number of PDCCH candidates per CCE aggregation level for Type2-PDCCH CSS set are given in Table 10.1-1.

If a UE is not provided *peiSearchSpace* for Type2A-PDCCH CSS set, the UE does not monitor PDCCH for Type2A-PDCCH CSS set on the DL BWP. The CCE aggregation levels and the maximum number of PDCCH candidates per CCE aggregation level for Type2A-PDCCH CSS set are given in Table 10.1-1.

If a UE is provided a zero value for *searchSpaceID* in *PDCCH-ConfigCommon* for a Type0/0A/2-PDCCH CSS set, or is not provided *searchSpaceBroadcast*, the UE determines monitoring occasions for PDCCH candidates of the Type0/0A/2-PDCCH CSS set as described in clause 13, and the UE is provided a C-RNTI, the UE monitors PDCCH candidates only at monitoring occasions associated with a SS/PBCH block, where the SS/PBCH block is determined by the most recent of

- a MAC CE activation command indicating a TCI state of the active BWP that includes a CORESET with index 0, as described in [6, TS 38.214], where the TCI-state includes a CSI-RS which is quasi-co-located with the SS/PBCH block, or

- a random access procedure that is not initiated by a PDCCH order that triggers a contention-free random access procedure

If a UE monitors PDCCH candidates for DCI formats with CRC scrambled by a C-RNTI and the UE is provided a non-zero value for *searchSpaceID* in *PDCCH-ConfigCommon* for a Type0/0A/2-PDCCH CSS set, or monitors PDCCH candidates for DCI formats with CRC scrambled by a MCCH-RNTI or a G-RNTI and the UE is provided a non-zero value for *searchSpaceBroadcast* in *pdcch-Config-MCCH* and *pdcch-Config-MTCH* for a Type0/0B-PDCCH CSS set, the UE determines monitoring occasions for PDCCH candidates of the Type0/0A/2-PDCCH CSS set, or of the Type0/0B-PDCCH set, respectively, based on the search space set associated with the value of *searchSpaceID*.

The UE may assume that the DM-RS antenna port associated with PDCCH receptions in the CORESET configured by *pdcch-ConfigSIB1* in *MIB*, the DM-RS antenna port associated with corresponding PDSCH receptions, and the corresponding SS/PBCH block are quasi co-located with respect to average gain, quasi co-location 'typeA' and 'typeD' properties, when applicable [6, TS 38.214], if the UE is not provided a TCI state indicating quasi co-location information of the DM-RS antenna port for PDCCH reception in the CORESET. The value for the DM-RS scrambling sequence initialization is the cell ID. For operation without shared spectrum channel access in FR1 and FR2-1, a SCS is provided by *subCarrierSpacingCommon* in *MIB*. For operation with shared spectrum channel access in FR1 and for operation in FR2-2, a SCS is same as the SCS of a corresponding SS/PBCH block.

For single cell operation or for operation with carrier aggregation in a same frequency band, a UE does not expect to monitor a PDCCH in a Type0/0A/0B/2/3-PDCCH CSS set or in a USS set if a DM-RS for monitoring a PDCCH in a Type1-PDCCH CSS set is not configured with same *qcl-Type* set to 'typeD' properties [6, TS 38.214] with a DM-RS for monitoring the PDCCH in the Type0/0A/0B/2/3-PDCCH CSS set or in the USS set, and if the PDCCH or an associated PDSCH overlaps in at least one symbol with a PDCCH the UE monitors in a Type1-PDCCH CSS set or with an associated PDSCH.

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

A UE expects to monitor PDCCH candidates for up to 4 sizes of DCI formats that include up to 3 sizes of DCI formats with CRC scrambled by C-RNTI per serving cell. The UE counts a number of sizes for DCI formats per serving cell based on a number of configured PDCCH candidates in respective search space sets for the corresponding active DL BWP.

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, 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 \*\*\*

A UE does not expect to be configured CSS sets, except for CSS sets provided by *searchSpaceBroadcast* or by *searchSpace-Multicast*, 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 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 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.

For cross-carrier scheduling, the number of PDCCH candidates for monitoring and the number of non-overlapped CCEs per span or per slot are separately counted for each scheduled cell.

For all search space sets 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 *searchSpaceBroadcast* or by *searchSpace-Multicast*, with cardinality of and by a set of USS sets and CSS sets provided by *searchSpaceBroadcast* or by *searchSpace-Multicast* with cardinality of . 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 \*\*\*

If a UE

- is configured for single cell operation or for operation with carrier aggregation in a same frequency band, and

- monitors PDCCH candidates in overlapping PDCCH monitoring occasions in multiple CORESETs where none of the CORESETs has TCI-states configured with *qcl-Type* set to 'typeD',

the UE is required to monitor PDCCH candidates in overlapping PDCCH monitoring occasions for search space sets associated with different CORESETs.

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 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 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 cell or uplink cell, 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 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 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 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.

If a UE detects a DCI format with inconsistent information, the UE discards all the information in the DCI format.

A UE configured with a bandwidth part indicator in a DCI format determines, in case of an active DL BWP or of an active UL BWP change, that the information in the DCI format is applicable to the new active DL BWP or UL BWP, respectively, as described in clause 12.

For unpaired spectrum operation, if a UE is not configured for PUSCH/PUCCH transmission on serving cell , the UE does not expect to monitor PDCCH on serving cell if the PDCCH overlaps in time with SRS transmission (including any interruption due to uplink or downlink RF retuning time [10, TS 38.133]) on serving cell and if the UE is not capable of simultaneous reception and transmission on serving cell and serving cell .

If a UE is provided *resourceBlocks* and s*ymbolsInResourceBlock* in *RateMatchPattern* of *PDSCH-Config*, or if the UE is additionally provided *periodicityAndPattern* in *RateMatchPattern* of *PDSCH-Config*, the UE can determine a set of RBs in symbols of a slot that are not available for PDSCH reception scheduled by a unicast DCI format as described in [6, TS 38.214]. If a PDCCH candidate that provides a unicast DCI format is mapped to one or more REs that overlap with REs of any RB in the set of RBs in symbols of the slot, the UE does not expect to monitor the PDCCH candidate.

If a UE is provided *resourceBlocks* and s*ymbolsInResourceBlock* in *RateMatchPattern* of *PDSCH-Config-Multicast*, or if the UE is additionally provided *periodicityAndPattern* in *RateMatchPattern* of *PDSCH-Config-Multicast*, the UE can determine a set of RBs in symbols of a slot that are not available for PDSCH reception scheduled by a multicast DCI format. If a PDCCH candidate that provides a multicast DCI format is mapped to one or more REs that overlap with REs of any RB in the set of RBs in symbols of the slot, the UE does not expect to monitor the PDCCH candidate.

A UE does not expect to be configured with *dci-FormatsSL* and *dci-FormatsExt* in a same USS.

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

## 10.2 PDCCH validation for DL SPS and UL grant Type 2

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

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

- the new data indicator field in the DCI format for the enabled transport block is set to '0', and

- the DFI flag field, if present, in the DCI format is set to '0', and

- if validation is for scheduling activation and if the PDSCH-to-HARQ\_feedback timing indicator field in the DCI format is present, the PDSCH-to-HARQ\_feedback timing indicator field does not provide an inapplicable value from *dl-DataToUL-ACK-r16*.

If a UE is provided a single configuration for UL grant Type 2 PUSCH or for SPS PDSCH, validation of the DCI format is achieved if all fields for the DCI format are set according to Table 10.2-1 or Table 10.2-2.

If a UE is provided more than one configuration for UL grant Type 2 PUSCH or for SPS PDSCH, a value of the HARQ process number field in a DCI format indicates an activation for a corresponding UL grant Type 2 PUSCH or for a SPS PDSCH configuration with a same value as provided by *ConfiguredGrantConfigIndex* or by *sps-ConfigIndex*, respectively. Validation of the DCI format is achieved if the RV field for the DCI format is set as in Table 10.2-3.

If a UE is provided more than one configuration for UL grant Type 2 PUSCH or for SPS PDSCH

- if the UE is provided *ConfiguredGrantConfigType2DeactivationStateList* or *sps-ConfigDeactivationStateList*, a value of the HARQ process number field in a DCI format indicates a corresponding entry for scheduling release of one or more UL grant Type 2 PUSCH or SPS PDSCH configurations

- if the UE is not provided *ConfiguredGrantConfigType2DeactivationStateList* or *sps-ConfigDeactivationStateList*, a value of the HARQ process number field in a DCI format indicates a release for a corresponding UL grant Type 2 PUSCH or for a SPS PDSCH configuration with a same value as provided by *ConfiguredGrantConfigIndex* or by *sps-ConfigIndex*, respectively

Validation of the DCI format is achieved if all fields for the DCI format are set according to Table 10.2-4.

If validation is achieved, the UE considers the information in the DCI format as a valid activation or valid release of DL SPS or configured UL grant Type 2. If validation is not achieved, the UE discards all the information in the DCI format.

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

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

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

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

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

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

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

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

A UE is expected to provide HARQ-ACK information in response to a SPS PDSCH release after symbols from the last symbol of a PDCCH providing the SPS PDSCH release. If *processingType2Enabled* of *PDSCH-ServingCellConfig* is set to *enable* for the serving cell with the PDCCH providing the SPS PDSCH release, for , for , and for , otherwise, for , for , for , for , for , and for , wherein corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH providing the SPS PDSCH release and the SCS configuration of a PUCCH carrying the HARQ-ACK information in response to a SPS PDSCH release.

\*\*\* 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 in the RRC\_IDLE state or in the RRC\_INACTIVE state 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 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 when a number of HARQ-ACK information bits is more than four, or 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, when a number of HARQ-ACK information bits is 2, 3, or 4, the UE can be indicated by *moreThanOneNackOnly-Mode* 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. When a number of HARQ-ACK information bits is more than 4, the UE provides HARQ-ACK information according to the first HARQ-ACK reporting mode.

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 the second HARQ-ACK reporting mode.

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-FeedbackEnabler-Multicast* with value set to 'enabled', to provide HARQ-ACK information for PDSCH receptions. When the UE is not provided *harq-FeedbackEnabler-Multicast* for a G-RNTI or G-CS-RNTI, or when the UE is provided *harq-FeedbackEnabler-Multicast* with value set to 'disabled', the UE does not provide HARQ-ACK information for respective PDSCH receptions. If a UE is provided *harq-FeedbackEnabler-Multicast* 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 HARQ-ACK information that the UE would provide according to the second HARQ-ACK reporting mode with other UCI 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 the UE multiplexes HARQ-ACK information of same priority value 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 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.

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.