**3GPP TSG-RAN WG1 Meeting #100-e *R1-200xxxx***

**E-meeting, 25 May – 5 June, 2020**

|  |
| --- |
| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
|  |
|  | **38.212** | **CR** | **0044** | **rev** | **1** | **Current version:** | **16.1.0** |  |
|  |
| *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)*.* |
|  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

|  |
| --- |
|  |
| ***Title:***  | Corrections on NR eURLLC  |
|  |  |
| ***Source to WG:*** | Huawei |
| ***Source to TSG:*** | R1 |
|  |  |
| ***Work item code:*** | NR\_L1enh\_URLLC-Core |  | ***Date:*** | 2020-06-07 |
|  |  |  |  |  |
| ***Category:*** | **F** |  | ***Release:*** | Rel-16 |
|  | *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)* |
|  |  |
| ***Reason for change:*** | Capture the endorsed TPs from RAN1#100bis-e and RAN1#101-e. Align the RRC parameter name in R1-2005070/R2-2006085.  |
|  |  |
| ***Summary of change:*** | 1. [100b-e-NR-L1enh-URLLC-PDCCH enhancements-03]: Add “only applicable to resource alloacation type 1,” to 1 bit case for frequency hopping flag in DCI format 0\_2 as in the endorsed TP R1-2003052.
2. [100b-e-NR-L1enh-URLLC-InterUE-03]: Updated reference to new section for DCI format 2\_4.
3. [100b-e-NR-L1enh-URLLC-eCG-01]: Clarification for the antenna port determination for PUSCH scheduled by DCI format 0\_2 as in the endosed TP R1-2003121.
4. [100b-e-NR-L1enh-URLLC-eCG-01]: The applicable RRC parameters for the PTRS-DMRS association field for DCI format 0\_1 and 0\_2 are clarified as in the endosed TP R1-2003123. The text is revised from TP R1-2003123 only for wording purpose without changing the meaning.
5. Editorial change: Brackets for an exception of CS-RNTI are removed. These brackets had been taken directly from Rel-15 for the exception of CS-RNTI with DCI format 0\_1.
6. [101-e-NR-L1enh-URLLC-PDCCH enhancements-01]: Incorporate the agreement from email discussion for the determination of the DCI sizes for the case of two HARQ-ACK codebooks as in the endorsed TP R1-2005060.
7. [101-e-NR-L1enh-URLLC-PDCCH enhancements-01]: Incorporate the agreement from email discussion about the further extension of the DCI size alignment due to the introduction of DCI format 0\_2/1\_2 as in the endorsed TP R1-20xxxxx.
8. [101-e-NR-L1enh-URLLC-PDCCH enhancements-01]: Update on DCI format 1\_2 as in the endorsed TP R1-2005062.
9. [101-e-NR-L1enh-URLLC-PUSCH-03]: Incorporate the agreement from the email discussion about UCI resource determination for PUSCH repetition Type B as shown in R1-2004741.
10. Align RRC parameters with the RAN2 LS in R1-2005070/R2-2006085
 |
|  |  |
| ***Consequences if not approved:*** | Inconsistent and incomplete specification for Rel-16 eURLLC  |
|  |  |
| ***Clauses affected:*** | 6.3.2.4.1, 7.3.1.0, 7.3.1.1.2, 7.3.1.1.3, 7.3.1.2.2, 7.3.1.2.3, 7.3.1.3.5  |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS 38.214 CR 101-e-NR-Editor-NR\_L1enh\_URLLC-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:*** |  |

#### 6.3.2.4 Rate matching

##### 6.3.2.4.1 UCI encoded by Polar code

###### 6.3.2.4.1.1 HARQ-ACK

For HARQ-ACK transmission on PUSCH with UL-SCH, the number of coded modulation symbols per layer for HARQ-ACK transmission, denoted as , is determined as follows:

 

where

-  is the number of HARQ-ACK bits;

- if , ; otherwise  is the number of CRC bits for HARQ-ACK determined according to Clause 6.3.1.2.1;

- ;

-  is the number of code blocks for UL-SCH of the PUSCH transmission;

- if the DCI format scheduling the PUSCH transmission includes a CBGTI field indicating that the UE shall not transmit the -th code block, =0; otherwise,  is the -th code block size for UL-SCH of the PUSCH transmission;

-  is the scheduled bandwidth of the PUSCH transmission, expressed as a number of subcarriers;

-  is the number of subcarriers in OFDM symbol  that carries PTRS, in the PUSCH transmission;

-  is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the PUSCH transmission and  is the total number of OFDM symbols of the PUSCH, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the PUSCH, ;

- for any OFDM symbol that does not carry DMRS of the PUSCH, ;

-  is configured by higher layer parameter *scaling*;

-  is the symbol index of the first OFDM symbol that does not carry DMRS of the PUSCH, after the first DMRS symbol(s), in the PUSCH transmission.

For HARQ-ACK transmission on an actual repetition of a PUSCH with repetition Type B with UL-SCH, the number of coded modulation symbols per layer for HARQ-ACK transmission, denoted as , is determined as follows:

where

- is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the PUSCH transmission assuming a nominal repetition without segmentation, and is the total number of OFDM symbols in a nominal repetition of the PUSCH, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the PUSCH assuming a nominal repetition without segmentation, ;

- for any OFDM symbol that does not carry DMRS of the PUSCH assuming a nominal repetition without segmentation, where is the number of subcarriers in OFDM symbol that carries PTRS, in the PUSCH transmission assuming a nominal repetition without segmentation;

- is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the actual repetition of the PUSCH transmission, and is the total number of OFDM symbols in the actual repetition of the PUSCH transmission, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the actual repetition of the PUSCH transmission, ;

- for any OFDM symbol that does not carry DMRS of the actual repetition of the PUSCH transmission, where is the number of subcarriers in OFDM symbol that carries PTRS, in the actual repetition of the PUSCH transmission;

- and all the other notations in the formula are defined the same as for PUSCH not using repetition type B.

<Unchanged parts are omitted>

6.3.2.4.1.2 CSI part 1

For CSI part 1 transmission on PUSCH with UL-SCH, the number of coded modulation symbols per layer for CSI part 1 transmission, denoted as , is determined as follows:

where

-  is the number of bits for CSI part 1;

- if , ; otherwise  is the number of CRC bits for CSI part 1 determined according to Clause 6.3.1.2.1;

- ;

-  is the number of code blocks for UL-SCH of the PUSCH transmission;

- if the DCI format scheduling the PUSCH transmission includes a CBGTI field indicating that the UE shall not transmit the -th code block, =0; otherwise, is the -th code block size for UL-SCH of the PUSCH transmission;

-  is the scheduled bandwidth of the PUSCH transmission, expressed as a number of subcarriers;

-  is the number of subcarriers in OFDM symbol  that carries PTRS, in the PUSCH transmission;

- if HARQ-ACK is present for transmission on the same PUSCH with UL-SCH and without CG-UCI, where is the number of coded modulation symbols per layer for HARQ-ACK transmitted on the PUSCH as defined in clause 6.3.2.4.1.1 if number of HARQ-ACK information bits is more than 2, and  if the number of HARQ-ACK information bits is no more than 2 bits, where  is the number of reserved resource elements for potential HARQ-ACK transmission in OFDM symbol , for , in the PUSCH transmission, defined in Clause 6.2.7; or

- if both HARQ-ACK and CG-UCI are present on the same PUSCH with UL-SCH, where is the number of coded modulation symbols per layer for HARQ-ACK and CG-UCI transmitted on the PUSCH as defined in clause 6.3.2.4.1.5; or

- if CG-UCI is present on the same PUSCH with UL-SCH and without HARQ-ACK, where is the number of coded modulation symbols per layer for CG-UCI transmitted on the PUSCH as defined in clause 6.3.2.4.1.4;

-  is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the PUSCH transmission and  is the total number of OFDM symbols of the PUSCH, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the PUSCH, ;

- for any OFDM symbol that does not carry DMRS of the PUSCH, ;

-  is configured by higher layer parameter *scaling*.

For CSI part 1 transmission on an actual repetition of a PUSCH with repetition Type B with UL-SCH, the number of coded modulation symbols per layer for CSI part 1 transmission, denoted as , is determined as follows:

where

- is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the PUSCH transmission assuming a nominal repetition without segmentation, and is the total number of OFDM symbols in a nominal repetition of the PUSCH, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the PUSCH assuming a nominal repetition without segmentation, ;

- for any OFDM symbol that does not carry DMRS of the PUSCH assuming a nominal repetition without segmentation, where is the number of subcarriers in OFDM symbol that carries PTRS, in the PUSCH transmission assuming a nominal repetition without segmentation;

- is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the actual repetition of the PUSCH transmission, and is the total number of OFDM symbols in the actual repetition of the PUSCH transmission, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the actual repetition of the PUSCH transmission, ;

- for any OFDM symbol that does not carry DMRS of the actual repetition of the PUSCH transmission, where is the number of subcarriers in OFDM symbol that carries PTRS, in the actual repetition of the PUSCH transmission;

- and all the other notations in the formula are defined the same as for PUSCH not using repetition type B.

<Unchanged parts are omitted>

###### 6.3.2.4.1.3 CSI part 2

For CSI part 2 transmission on PUSCH with UL-SCH, the number of coded modulation symbols per layer for CSI part 2 transmission, denoted as , is determined as follows:

where

-  is the number of bits for CSI part 2;

- if , ; otherwise  is the number of CRC bits for CSI part 2 determined according to Clause 6.3.1.2.1;

- ;

-  is the number of code blocks for UL-SCH of the PUSCH transmission;

- if the DCI format scheduling the PUSCH transmission includes a CBGTI field indicating that the UE shall not transmit the -th code block, =0; otherwise, is the -th code block size for UL-SCH of the PUSCH transmission;

-  is the scheduled bandwidth of the PUSCH transmission, expressed as a number of subcarriers;

-  is the number of subcarriers in OFDM symbol  that carries PTRS, in the PUSCH transmission;

- if HARQ-ACK is present for transmission on the same PUSCH with UL-SCH and without CG-UCI, where is the number of coded modulation symbols per layer for HARQ-ACK transmitted on the PUSCH as defined in clause 6.3.2.4.1.1 if number of HARQ-ACK information bits is more than 2, and  if the number of HARQ-ACK information bits is 1 or 2 bits; or

- if both HARQ-ACK and CG-UCI are present on the same PUSCH with UL-SCH, where is the number of coded modulation symbols per layer for HARQ-ACK and CG-UCI transmitted on the PUSCH as defined in clause 6.3.2.4.1.5; or

- if CG-UCI is present on the same PUSCH with UL-SCH and without HARQ-ACK, where is the number of coded modulation symbols per layer for CG-UCI transmitted on the PUSCH as defined in clause 6.3.2.4.1.4;

-  is the number of coded modulation symbols per layer for CSI part 1 transmitted on the PUSCH;

-  is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the PUSCH transmission and  is the total number of OFDM symbols of the PUSCH, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the PUSCH, ;

- for any OFDM symbol that does not carry DMRS of the PUSCH, .

-  is configured by higher layer parameter *scaling*.

For CSI part 2 transmission on an actual repetition of a PUSCH with repetition Type B with UL-SCH, the number of coded modulation symbols per layer for CSI part 2 transmission, denoted as , is determined as follows:

where

- is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the PUSCH transmission assuming a nominal repetition without segmentation, and is the total number of OFDM symbols in a nominal repetition of the PUSCH, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the PUSCH assuming a nominal repetition without segmentation, ;

- for any OFDM symbol that does not carry DMRS of the PUSCH assuming a nominal repetition without segmentation, where is the number of subcarriers in OFDM symbol that carries PTRS, in the PUSCH transmission assuming a nominal repetition without segmentation;

- is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the actual repetition of the PUSCH transmission, and is the total number of OFDM symbols in the actual repetition of the PUSCH transmission, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the actual repetition of the PUSCH transmission, ;

- for any OFDM symbol that does not carry DMRS of the actual repetition of the PUSCH transmission, where is the number of subcarriers in OFDM symbol that carries PTRS, in the actual repetition of the PUSCH transmission;

- and all the other notations in the formula are defined the same as for PUSCH not using repetition type B.

<Unchanged parts are omitted>

#### 7.3.1.0 DCI size alignment

If necessary, padding or truncation shall be applied to the DCI formats according to the following steps executed in the order below:

Step 0:

- Determine DCI format 0\_0 monitored in a common search space according to clause 7.3.1.1.1 where  is the size of the initial UL bandwidth part.

- Determine DCI format 1\_0 monitored in a common search space according to clause 7.3.1.2.1 where  is given by

- the size of CORESET 0 if CORESET 0 is configured for the cell; and

- the size of initial DL bandwidth part if CORESET 0 is not configured for the cell.

- If DCI format 0\_0 is monitored in common search space and if the number of information bits in the DCI format 0\_0 prior to padding is less than the payload size of the DCI format 1\_0 monitored in common search space for scheduling the same serving cell, a number of zero padding bits are generated for the DCI format 0\_0 until the payload size equals that of the DCI format 1\_0.

- If DCI format 0\_0 is monitored in common search space and if the number of information bits in the DCI format 0\_0 prior to truncation is larger than the payload size of the DCI format 1\_0 monitored in common search space for scheduling the same serving cell, the bitwidth of the frequency domain resource assignment field in the DCI format 0\_0 is reduced by truncating the first few most significant bits such that the size of DCI format 0\_0 equals the size of the DCI format 1\_0.

Step 1:

- Determine DCI format 0\_0 monitored in a UE-specific search space according to clause 7.3.1.1.1 where  is the size of the active UL bandwidth part.

- Determine DCI format 1\_0 monitored in a UE-specific search space according to clause 7.3.1.2.1 where  is the size of the active DL bandwidth part.

- For a UE configured with *supplementaryUplink* in *ServingCellConfig* in a cell, if PUSCH is configured to be transmitted on both the SUL and the non-SUL of the cell and if the number of information bits in DCI format 0\_0 in UE-specific search space for the SUL is not equal to the number of information bits in DCI format 0\_0 in UE-specific search space for the non-SUL, a number of zero padding bits are generated for the smaller DCI format 0\_0 until the payload size equals that of the larger DCI format 0\_0.

- If DCI format 0\_0 is monitored in UE-specific search space and if the number of information bits in the DCI format 0\_0 prior to padding is less than the payload size of the DCI format 1\_0 monitored in UE-specific search space for scheduling the same serving cell, a number of zero padding bits are generated for the DCI format 0\_0 until the payload size equals that of the DCI format 1\_0.

- If DCI format 1\_0 is monitored in UE-specific search space and if the number of information bits in the DCI format 1\_0 prior to padding is less than the payload size of the DCI format 0\_0 monitored in UE-specific search space for scheduling the same serving cell, zeros shall be appended to the DCI format 1\_0 until the payload size equals that of the DCI format 0\_0

Step 2:

- Determine DCI format 0\_1 monitored in a UE-specific search space according to clause 7.3.1.1.2.

- Determine DCI format 1\_1 monitored in a UE-specific search space according to clause 7.3.1.2.2.

- For a UE configured with *supplementaryUplink* in *ServingCellConfig* in a cell, if PUSCH is configured to be transmitted on both the SUL and the non-SUL of the cell and if the number of information bits in format 0\_1 for the SUL is not equal to the number of information bits in format 0\_1 for the non-SUL, zeros shall be appended to smaller format 0\_1 until the payload size equals that of the larger format 0\_1.

- If the size of DCI format 0\_1 monitored in a UE-specific search space equals that of a DCI format 0\_0/1\_0 monitored in another UE-specific search space, one bit of zero padding shall be appended to DCI format 0\_1.

- If the size of DCI format 1\_1 monitored in a UE-specific search space equals that of a DCI format 0\_0/1\_0 monitored in another UE-specific search space, one bit of zero padding shall be appended to DCI format 1\_1.

Step 2A:

- Determine DCI format 0\_2 monitored in a UE-specific search space according to clause 7.3.1.1.3.

- Determine DCI format 1\_2 monitored in a UE-specific search space according to clause 7.3.1.2.3.

- For a UE configured with *supplementaryUplink* in *ServingCellConfig* in a cell, if PUSCH is configured to be transmitted on both the SUL and the non-SUL of the cell and if the number of information bits in format 0\_2 for the SUL is not equal to the number of information bits in format 0\_2 for the non-SUL, zeros shall be appended to smaller format 0\_2 until the payload size equals that of the larger format 0\_2.

Step 3:

- If both of the following conditions are fulfilled the size alignment procedure is complete

- the total number of different DCI sizes configured to monitor is no more than 4 for the cell

- the total number of different DCI sizes with C-RNTI configured to monitor is no more than 3 for the cell

Step 4:

- Otherwise

Step 4A:

- Remove the padding bit (if any) introduced in step 2 above.

- Determine DCI format 1\_0 monitored in a UE-specific search space according to clause 7.3.1.2.1 where  is given by

- the size of CORESET 0 if CORESET 0 is configured for the cell; and

- the size of initial DL bandwidth part if CORESET 0 is not configured for the cell.

- Determine DCI format 0\_0 monitored in a UE-specific search space according to clause 7.3.1.1.1 where  is the size of the initial UL bandwidth part.

- If the number of information bits in the DCI format 0\_0 monitored in a UE-specific search space prior to padding is less than the payload size of the DCI format 1\_0 monitored in UE-specific search space for scheduling the same serving cell, a number of zero padding bits are generated for the DCI format 0\_0 monitored in a UE-specific search space until the payload size equals that of the DCI format 1\_0 monitored in a UE-specific search space.

- If the number of information bits in the DCI format 0\_0 monitored in a UE-specific search space prior to truncation is larger than the payload size of the DCI format 1\_0 monitored in UE-specific search space for scheduling the same serving cell, the bitwidth of the frequency domain resource assignment field in the DCI format 0\_0 is reduced by truncating the first few most significant bits such that the size of DCI format 0\_0 monitored in a UE-specific search space equals the size of the DCI format 1\_0 monitored in a UE-specific search space.

Step 4B:

- If the total number of different DCI sizes configured to monitor is more than 4 for the cell after applying the above steps, or if the total number of different DCI sizes with C-RNTI configured to monitor is more than 3 for the cell after applying the above steps

- If the number of information bits in the DCI format 0\_2 prior to padding is less than the payload size of the DCI format 1\_2 for scheduling the same serving cell, a number of zero padding bits are generated for the DCI format 0\_2 until the payload size equals that of the DCI format 1\_2.

- If the number of information bits in the DCI format 1\_2 prior to padding is less than the payload size of the DCI format 0\_2 for scheduling the same serving cell, zeros shall be appended to the DCI format 1\_2 until the payload size equals that of the DCI format 0\_2.

Step 4C:

- If the total number of different DCI sizes configured to monitor is more than 4 for the cell after applying the above steps, or if the total number of different DCI sizes with C-RNTI configured to monitor is more than 3 for the cell after applying the above steps

- If the number of information bits in the DCI format 0\_1 prior to padding is less than the payload size of the DCI format 1\_1 for scheduling the same serving cell, a number of zero padding bits are generated for the DCI format 0\_1 until the payload size equals that of the DCI format 1\_1.

- If the number of information bits in the DCI format 1\_1 prior to padding is less than the payload size of the DCI format 0\_1 for scheduling the same serving cell, zeros shall be appended to the DCI format 1\_1 until the payload size equals that of the DCI format 0\_1.

The UE is not expected to handle a configuration that, after applying the above steps, results in

- the total number of different DCI sizes configured to monitor is more than 4 for the cell; or

- the total number of different DCI sizes with C-RNTI configured to monitor is more than 3 for the cell; or

- the size of DCI format 0\_0 in a UE-specific search space is equal to DCI format 0\_1 in another UE-specific search space; or

- the size of DCI format 1\_0 in a UE-specific search space is equal to DCI format 1\_1 in another UE-specific search space; or

- the size of DCI format 0\_0 in a UE-specific search space is equal to DCI format 0\_2 in another UE-specific search space; or

- the size of DCI format 1\_0 in a UE-specific search space is equal to DCI format 1\_2 in another UE-specific search space.

<Unchanged parts are omitted>

##### 7.3.1.1.2 Format 0\_1

<Unchanged parts are omitted>

- Frequency hopping flag – 0 or 1 bit:

- 0 bit if only resource allocation type 0 is configured, or if the higher layer parameter *frequencyHopping* is not configured and the higher layer parameter pusch-RepTypeIndicatorForDCI-Format0-1 is not configured to *pusch-RepTypeB*, or if the higher layer parameter frequencyHoppingForDCI-Format0-1 is not configured and pusch-RepTypeIndicatorForDCI-Format0-1 is configured to *pusch-RepTypeB*, or if only resource allocation type 2 is configured;

- 1 bit according to Table 7.3.1.1.1-3 otherwise, only applicable to resource allocation type 1, as defined in Clause 6.3 of [6, TS 38.214].

<Unchanged parts are omitted>

- 1st downlink assignment index – 1, 2 or 4 bits:

- 1 bit for semi-static HARQ-ACK codebook;

- 2 bits for dynamic HARQ-ACK codebook, or for enhanced dynamic HARQ-ACK codebook without *UL-TotalDAI-Included-r16* configured;

- 4 bits for enhanced dynamic HARQ-ACK codebook and with *UL-TotalDAI-Included-r16 = "enable"*..

 When two HARQ-ACK codebooks are configured for the same serving cell and if higher layer parameter *priorityIndicatorForDCI-Format0-1* is configured, if the bit width of the 1st downlink assignment index in DCI format 0\_1 for one HARQ-ACK codebook is not equal to that of the 1st downlink assignment index in DCI format 0\_1 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller 1st downlink assignment index until the bit width of the 1st downlink assignment index in DCI format 0\_1 for the two HARQ-ACK codebooks are the same.

- 2nd downlink assignment index – 0, 2 or 4 bits:

- 2 bits for dynamic HARQ-ACK codebook with two HARQ-ACK sub-codebooks, or for enhanced dynamic HARQ-ACK codebook with two HARQ-ACK sub-codebooks and without *UL-TotalDAI-Included-r16* configured;

- 4 bits for enhanced dynamic HARQ-ACK codebook with two HARQ-ACK sub-codebooks and with *UL-TotalDAI-Included-r16 = "enable"*;

- 0 bit otherwise.

 When two HARQ-ACK codebooks are configured for the same serving cell and if higher layer parameter *priorityIndicatorForDCI-Format0-1* is configured, if the bit width of the 2nd downlink assignment index in DCI format 0\_1 for one HARQ-ACK codebook is not equal to that of the 2nd downlink assignment index in DCI format 0\_1 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller 2nd downlink assignment index until the bit width of the 2nd downlink assignment index in DCI format 0\_1 for the two HARQ-ACK codebooks are the same.

<Unchanged parts are omitted>

CBG transmission information (CBGTI) – 0 bit if higher layer parameter *codeBlockGroupTransmission* for PUSCH is not configured or if the number of scheduled PUSCH indicated by the Time domain resource assignment field is larger than 1; otherwise, 2, 4, 6, or 8 bits determined by higher layer parameter *maxCodeBlockGroupsPerTransportBlock* for PUSCH.

<Unchanged parts are omitted>

- PTRS-DMRS association – number of bits determined as follows

- 0 bit if *PTRS-UplinkConfi*g is not configured in either *dmrs-UplinkForPUSCH-MappingTypeA* or *dmrs-UplinkForPUSCH-MappingTypeB* and transform precoder is disabled, or if transform precoder is enabled, or if *maxRank=1*;

- 2 bits otherwise, where Table 7.3.1.1.2-25 and 7.3.1.1.2-26 are used to indicate the association between PTRS port(s) and DMRS port(s) for transmission of one PT-RS port and two PT-RS ports respectively, and the DMRS ports are indicated by the Antenna ports field.

If "Bandwidth part indicator" field indicates a bandwidth part other than the active bandwidth part and the "PTRS-DMRS association" field is present for the indicated bandwidth part but not present for the active bandwidth part, the UE assumes the "PTRS-DMRS association" field is not present for the indicated bandwidth part.

- beta\_offset indicator – 0 if the higher layer parameter *betaOffsets = semiStatic*; otherwise 2 bits as defined by Table 9.3-3 in [5, TS 38.213].

When two HARQ-ACK codebooks are configured for the same serving cell and if higher layer parameter *priorityIndicatorForDCI-Format0-1* is configured, if the bit width of the beta\_offset indicator in DCI format 0\_1 for one HARQ-ACK codebook is not equal to that of the beta\_offset indicator in DCI format 0\_1 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller beta\_offset indicator until the bit width of the beta\_offset indicator in DCI format 0\_1 for the two HARQ-ACK codebooks are the same.

- DMRS sequence initialization – 0 bit if transform precoder is enabled; 1 bit if transform precoder is disabled.

- UL-SCH indicator – 0 or 1 bit as follows

- 0 bit if the number of scheduled PUSCH indicated by the Time domain resource assignment field is larger than 1;

- 1 bit otherwise. A value of "1" indicates UL-SCH shall be transmitted on the PUSCH and a value of "0" indicates UL-SCH shall not be transmitted on the PUSCH. Except for DCI format 0\_1 with CRC scrambled by SP-CSI-RNTI, a UE is not expected to receive a DCI format 0\_1 with UL-SCH indicator of "0" and CSI request of all zero(s).

- ChannelAccess-CPext-CAPC – 0, 1, 2, 3, 4, 5 or 6 bits. The bitwidth for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *ul-dci-triggered-UL-ChannelAccess-CPext-CAPC-r16* for operation in a cell with shared spectrum channel access and *ChannelAccessMode-r16* = "*dynamic*"; otherwise 0 bit. One or more entries from Table 7.3.1.1.2-35 are configured by the higher layer parameter *ul-dci-triggered-UL-ChannelAccess-CPext-CAPC-r16.*

- Open-loop power control parameter set indication – 0 or 1 or 2 bits.

- 0 bit if the higher layer parameter *p0-PUSCH-SetList* is not configured;

- 1 or 2 bits otherwise,

- 1 bit if SRS resource indicator is present in the DCI format 0\_1;

- 1 or 2 bits as determined by higher layer parameter *olpc-ParameterSetForDCI-Format0-1* if SRS resource indicator is not present in the DCI format 0\_1.

- Priority indicator – 0 bit if higher layer parameter *priorityIndicatorForDCI-Format0-1* is not configured; otherwise 1 bit as defined in Clause 9 in [5, TS 38.213].

- Invalid symbol pattern indicator – 0 bit if higher layer parameter *InvalidSymbolPatternIndicator-ForDCIFormat0\_1* is not configured; otherwise 1 bit as defined in Clause 6.1.2.1 in [6, TS 38.214].

- Minimum applicable scheduling offset indicator – 0 or 1 bit

- 0 bit if higher layer parameter *minimumSchedulingOffset* is not configured;

- 1 bit if higher layer parameter *minimumSchedulingOffset* is configured. The 1 bit indication is used to determine the minimum applicable K0 for the active DL BWP and the minimum applicable K2 value for the active UL BWP according to Table 7.3.1.1.2-33. If the minimum applicable K0 is indicated, the minimum applicable value of the aperiodic CSI-RS triggering offset for an active DL BWP shall be the same as the minimum applicable K0 value.

- SCell dormancy indication – 0 bit if higher layer parameter *Scell-groups-for-dormancy-within-active-time* is not configured; otherwise 1, 2, 3, 4 or 5 bits bitmap determined according to higher layer parameter *Scell-groups-for-dormancy-within-active-time,* where each bit corresponds to one of the SCell group(s) configured by higher layers parameter *Scell-groups-for-dormancy-within-active-time,* with MSB to LSB of the bitmap corresponding to the first to last configured SCell group. The field is only present when this format is carried by PDCCH on the primary cell within DRX Active Time and the UE is configured with at least two DL BWPs for an SCell.

<Unchanged parts are omitted>

##### 7.3.1.1.3 Format 0\_2

DCI format 0\_2 is used for the scheduling of PUSCH in one cell.

The following information is transmitted by means of the DCI format 0\_2 with CRC scrambled by C-RNTI or CS-RNTI or SP-CSI-RNTI or MCS-C-RNTI:

- Identifier for DCI formats – 1 bit

- The value of this bit field is always set to 0, indicating an UL DCI format

- Carrier indicator – 0, 1, 2 or 3 bits determined by higher layer parameter *carrierIndicatorSizeForDCI-Format0-2*, as defined in Clause 10.1 of [5, TS38.213].

- UL/SUL indicator – 0 bit for UEs not configured with *supplementaryUplink* in *ServingCellConfig* in the cell or UEs configured with *supplementaryUplink* in *ServingCellConfig* in the cell but only one carrier in the cell is configured for PUSCH transmission; otherwise, 1 bit as defined in Table 7.3.1.1.1-1.

<Unchanged parts are omitted>

- Frequency hopping flag – 0 or 1 bit:

- 0 bit if the higher layer parameter *frequencyHoppingForDCI-Format0-2* is not configured;

- 1 bit according to Table 7.3.1.1.1-3 otherwise, only applicable to resource allocation type 1, as defined in Clause 6.3 of [6, TS 38.214].

- Modulation and coding scheme –5 bits as defined in Clause 6.1.4.1 of [6, TS 38.214]

- New data indicator – 1 bit

- Redundancy version – 0, 1 or 2 bits determined by higher layer parameter *numberOfBitsForRV-ForDCI-Format0-2*

- If 0 bit is configured, *rvid* to be applied is 0;

- 1 bit according to Table 7.3.1.2.3-1;

- 2 bits according to Table 7.3.1.1.1-2.

- HARQ process number – 0, 1, 2, 3 or 4 bits determined by higher layer parameter harq-ProcessNumberSizeForDCI-Format0-2

- Downlink assignment index – 0, 1, 2 or 4 bits

- 0 bit if the higher layer parameter *downlinkAssignmentIndexForDCI-Format0-2* is not configured;

- 1, 2 or 4 bits otherwise,

- 1st downlink assignment index – 1 or 2 bits:

- 1 bit for semi-static HARQ-ACK codebook;

- 2 bits for dynamic HARQ-ACK codebook.

- 2nd downlink assignment index – 0 or 2 bits

- 2 bits for dynamic HARQ-ACK codebook with two HARQ-ACK sub-codebooks;

- 0 bit otherwise.

When two HARQ-ACK codebooks are configured for the same serving cell cell and if higher layer parameter *priorityIndicatorForDCI-Format0-2* is configured,, if the bit width of the Downlink assignment index in DCI format 0\_2 for one HARQ-ACK codebook is not equal to that of the Downlink assignment index in DCI format 0\_2 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller Downlink assignment index until the bit width of the Downlink assignment index in DCI format 0\_2 for the two HARQ-ACK codebooks are the same.

<Unchanged parts are omitted>

- SRS resource indicator – or bits, where is the number of configured SRS resources in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModListForDCI-Format0-2*, and associated with the higher layer parameter *usage* of value '*codeBook*' or '*nonCodeBook*',

-  bits according to Tables 7.3.1.1.2-28/29/30/31 if the higher layer parameter *txConfig = nonCodebook*, where is the number of configured SRS resources in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModListForDCI-Format0-2*, and associated with the higher layer parameter *usage* of value '*nonCodeBook*' and

- if UE supports operation with *maxMIMO-LayersForDCI-Format0-2*and the higher layer parameter *maxMIMO-LayersForDCI-Format0-2* of *PUSCH-ServingCellConfig* of the serving cell is configured, *Lmax* is given by that parameter

- otherwise, *Lmax* is given by the maximum number of layers for PUSCH supported by the UE for the serving cell for non-codebook based operation.

- bits according to Tables 7.3.1.1.2-32 if the higher layer parameter *txConfig = codebook*, where is the number of configured SRS resources in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModListForDCI-Format0-2*and associated with the higher layer parameter *usage* of value '*codeBook*'.

- Precoding information and number of layers – number of bits determined by the following:

- 0 bits if the higher layer parameter *txConfig = nonCodeBook*;

- 0 bits for 1 antenna port and if the higher layer parameter *txConfig = codebook*;

- 4, 5, or 6 bits according to Table 7.3.1.1.2-2 for 4 antenna ports, if *txConfig = codebook,* and according to whether transform precoder is enabled or disabled, and the values of higher layer parameters *maxRankForDCI-Format0-2*, and *codebookSubsetForDCI-Format0-2*;

- 2, 4, or 5 bits according to Table 7.3.1.1.2-3 for 4 antenna ports, if *txConfig = codebook,* and according to whether transform precoder is enabled or disabled, and the values of higher layer parameters *maxRankForDCI-Format0-2*, and *codebookSubsetForDCI-Format0-2*;

- 2 or 4 bits according to Table7.3.1.1.2-4 for 2 antenna ports, if *txConfig = codebook,* and according to whether transform precoder is enabled or disabled, and the values of higher layer parameters *maxRankForDCI-Format0-2* and *codebookSubsetForDCI-Format0-2*;

- 1 or 3 bits according to Table7.3.1.1.2-5 for 2 antenna ports, if *txConfig = codebook,* and according to whether transform precoder is enabled or disabled, and the values of higher layer parameters *maxRankForDCI-Format0-2* and *codebookSubsetForDCI-Format0-2*.

- Antenna ports – number of bits determined by the following:

- 0 bit if higher layer parameter *antennaPortsFieldPresenceForDCI-Format0-2* is notconfigured;

- 2, 3, 4, or 5 bits otherwise,

- 2 bits as defined by Tables 7.3.1.1.2-6, if transform precoder is enabled, *dmrs-Type*=1, and *maxLength*=1;

- 4 bits as defined by Tables 7.3.1.1.2-7, if transform precoder is enabled, *dmrs-Type*=1, and *maxLength*=2;

- 3 bits as defined by Tables 7.3.1.1.2-8/9/10/11, if transform precoder is disabled, *dmrs-Type*=1, and *maxLength*=1, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 4 bits as defined by Tables 7.3.1.1.2-12/13/14/15, if transform precoder is disabled, *dmrs-Type*=1, and *maxLength*=2, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 4 bits as defined by Tables 7.3.1.1.2-16/17/18/19, if transform precoder is disabled, *dmrs-Type*=2, and *maxLength*=1, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 5 bits as defined by Tables 7.3.1.1.2-20/21/22/23, if transform precoder is disabled, *dmrs-Type*=2, and *maxLength*=2, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*.

where the number of CDM groups without data of values 1, 2, and 3 in Tables 7.3.1.1.2-6 to 7.3.1.1.2-23 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively.

If a UE is configured with both *dmrs-UplinkForPUSCH-MappingTypeA-ForDCIFormat0-2* and *dmrs-UplinkForPUSCH-MappingTypeB-ForDCI-Format0-2* and is configured with *antennaPortsFieldPresenceForDCI-Format0-2*, the bitwidth of this field equals , where is the "Antenna ports" bitwidth derived according to *dmrs-UplinkForPUSCH-MappingTypeA-ForDCIFormat0-2* and is the "Antenna ports" bitwidthderived according to *dmrs-UplinkForPUSCH-MappingTypeB-ForDCI-Format0-2*. A number of zeros are padded in the MSB of this field, if the mapping type of the PUSCH corresponds to the smaller value of and .

If a UE is not configured with higher layer parameter *AntennaPorts-FieldPresence-ForDCIFormat0\_2,* antenna port(s) are defined assuming bit field index value 0 in Tables 7.3.1.1.2-6 to 7.3.1.1.2-23.

- SRS request – 0, 1, 2 or 3 bits

- 0 bit if the higher layer parameter *srs-RequestForDCI-Format0-2* is not configured;

- 1 bit as defined by Table 7.3.1.1.3-1 if higher layer parameter *srs-RequestForDCI-Format0-2= 1* and for UEs not configured with *supplementaryUplink* in *ServingCellConfig* in the cell;

- 2 bits if higher layer parameter *srs-RequestForDCI-Format0-2= 1* and for UEs configured with *supplementaryUplink* in *ServingCellConfig* in the cell, where the first bit is the non-SUL/SUL indicator as defined in Table 7.3.1.1.1-1 and the second bit is defined by Table 7.3.1.1.3-1;

- 2 bits as defined by Table 7.3.1.1.2-24 if higher layer parameter *srs-RequestForDCI-Format0-2= 2* and for UEs not configured with *supplementaryUplink* in *ServingCellConfig* in the cell;

- 3 bits if higher layer parameter *srs-RequestForDCI-Format0-22 = 2* and for UEs configured with *supplementaryUplink* in *ServingCellConfig* in the cell, where the first bit is the non-SUL/SUL indicator as defined in Table 7.3.1.1.1-1 and the second and third bits are defined by Table 7.3.1.1.2-24;

- CSI request – 0, 1, 2, 3, 4, 5, or 6 bits determined by higher layer parameter *reportTriggerSizeForDCI-Format0-2*.

- PTRS-DMRS association – number of bits determined as follows

- 0 bit if *PTRS-UplinkConfi*g is not configured in either *dmrs-UplinkForPUSCH-MappingTypeA* or *dmrs-UplinkForPUSCH-MappingTypeB* and transform precoder is disabled, or if transform precoder is enabled, or if *maxRank-ForDCIFormat0\_2=1*;

- 2 bits otherwise, where Table 7.3.1.1.2-25 and 7.3.1.1.2-26 are used to indicate the association between PTRS port(s) and DMRS port(s) for transmission of one PT-RS port and two PT-RS ports respectively, and the DMRS ports are indicated by the Antenna ports field.

If "Bandwidth part indicator" field indicates a bandwidth part other than the active bandwidth part and the "PTRS-DMRS association" field is present for the indicated bandwidth part but not present for the active bandwidth part, the UE assumes the "PTRS-DMRS association" field is not present for the indicated bandwidth part.

- beta\_offset indicator – 0 bit if the higher layer parameter *betaOffsets = semiStatic*; otherwise 1 bit if 2 offset indexes are configured by higher layer parameter *dynamicForDCI-Format0-2* as defined by Table 9.3-3A in [5, TS 38.213], and 2 bits if 4 offset indexes are configured by higher layer parameter *dynamicForDCI-Format0-2* as defined by Table 9.3-3 in [5, TS 38.213].

When two HARQ-ACK codebooks are configured for the same serving cell cell and if higher layer parameter *priorityIndicatorForDCI-Format0-2* is configured, if the bit width of the beta\_offset indicator in DCI format 0\_2 for one HARQ-ACK codebook is not equal to that of the beta\_offset indicator in DCI format 0\_2 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller beta\_offset indicator until the bit width of the beta\_offset indicator in DCI format 0\_2 for the two HARQ-ACK codebooks are the same.

- DMRS sequence initialization – 0 or 1 bit

- 0 bit if the higher layer parameter *dmrs-SequenceInitializationForDCI-Format0-2* is not configured or if transform precoder is enabled;

- 1 bit if transform precoder is disabled and the higher layer parameter *dmrs-SequenceInitializationForDCI-Format0-2* is configured.

- UL-SCH indicator – 1 bit. A value of "1" indicates UL-SCH shall be transmitted on the PUSCH and a value of "0" indicates UL-SCH shall not be transmitted on the PUSCH. Except for DCI format 0\_2 with CRC scrambled by SP-CSI-RNTI, a UE is not expected to receive a DCI format 0\_2 with UL-SCH indicator of "0" and CSI request of all zero(s).

- Open-loop power control parameter set indication – 0 or 1 or 2 bits.

- 0 bit if the higher layer parameter *p0-PUSCH-SetList* is not configured;

- 1 or 2 bits otherwise,

- 1 bit if SRS resource indicator is present in the DCI format 0\_2;

- 1 or 2 bits as determined by higher layer parameter *olpc-ParameterSetForDCI-Format0-2* if SRS resource indicator is not present in the DCI format 0\_2;

- Priority indicator – 0 bit if higher layer parameter *priorityIndicatorForDCI-Format0-2* is not configured; otherwise 1 bit as defined in Clause 9 in [5, TS 38.213].

<Unchanged parts are omitted>

##### 7.3.1.2.2 Format 1\_1

<Unchanged parts are omitted>

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

- 6 bits if more than one serving cell are configured in the DL and the higher layer parameter *NFI-TotalDAI-Included-r16 = enable*. The 4 MSB bits are the counter DAI and the total DAI for the scheduled PDSCH group, and the 2 LSB bits are the total DAI for the non-scheduled PDSCH group.

- 4 bits if only one serving cell are configured in the DL and the higher layer parameter *NFI-TotalDAI-Included-r16 = enable.* The 2 MSB bits are the counter DAI for the scheduled PDSCH group, and the 2 LSB bits are the total DAI for the non-scheduled PDSCH group;

- 4 bits if more than one serving cell are configured in the DL, the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic* or *pdsch-HARQ-ACK-Codebook=enhancedDynamic-r16*, and *NFI-TotalDAI-Included-r16* is not configured, where the 2 MSB bits are the counter DAI and the 2 LSB bits are the total DAI;

- 4 bits if one serving cell is configured in the DL, and the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic*, and the UE is not provided *CORESETPoolIndex* or is provided *CORESETPoolIndex* with value 0 for one or more first CORESETs and is provided *CORESETPoolIndex* with value 1 for one or more second CORESETs, and is provided *ACKNACKFeedbackMode = JointFeedback*, where the 2 MSB bits are the counter DAI and the 2 LSB bits are the total DAI;

- 2 bits if only one serving cell is configured in the DL, the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic* or *pdsch-HARQ-ACK-Codebook=enhancedDynamic-r16*, and *NFI-TotalDAI-Included-r16* is not configured, when the UE is not configured with *CORESETPoolIndex* or the value of *CORESETPoolIndex* is the same for all CORESETs if *CORESETPoolIndex* is provided or the UE is not configured with *ACKNACKFeedbackMode = JointFeedback*, where the 2 bits are the counter DAI;

- 0 bits otherwise.

If higher layer parameter *priorityIndicatorForDCI-Format1-1* is configured, if the bit width of the Downlink assignment index in DCI format 1\_1 for one HARQ-ACK codebook is not equal to that of the Downlink assignment index in DCI format 1\_1 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller Downlink assignment index until the bit width of the Downlink assignment index in DCI format 1\_1 for the two HARQ-ACK codebooks are the same.

<Unchanged parts are omitted>

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

If higher layer parameter *priorityIndicatorForDCI-Format1-1* is configured, if the bit width of the PDSCH-to-HARQ\_feedback timing indicator in DCI format 1\_1 for one HARQ-ACK codebook is not equal to that of the PDSCH-to-HARQ\_feedback timing indicator in DCI format 1\_1 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller PDSCH-to-HARQ\_feedback timing indicator until the bit width of the PDSCH-to-HARQ\_feedback timing indicator in DCI format 1\_1 for the two HARQ-ACK codebooks are the same.

<Unchanged parts are omitted>

- CBG transmission information (CBGTI) – 0 bit if higher layer parameter *codeBlockGroupTransmission* for PDSCH is not configured, otherwise, 2, 4, 6, or 8 bits as defined in Clause 5.1.7 of [6, TS38.214], determined by the higher layer parameters *maxCodeBlockGroupsPerTransportBlock* and *maxNrofCodeWordsScheduledByDCI* for the PDSCH.

If higher layer parameter *priorityIndicatorForDCI-Format1-1* is configured, if the bit width of the CBG transmission information in DCI format 1\_1 for one HARQ-ACK codebook is not equal to that of the CBG transmission information in DCI format 1\_1 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller CBG transmission information until the bit width of the CBG transmission information in DCI format 1\_1 for the two HARQ-ACK codebooks are the same.

- CBG flushing out information (CBGFI) – 1 bit if higher layer parameter *codeBlockGroupFlushIndicator* is configured as "TRUE", 0 bit otherwise.

If higher layer parameter *priorityIndicatorForDCI-Format1-1* is configured, if the bit width of the CBG flushing out information in DCI format 1\_1 for one HARQ-ACK codebook is not equal to that of the CBG flushing out information in DCI format 1\_1 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller CBG flushing out information until the bit width of the CBG flushing out information in DCI format 1\_1 for the two HARQ-ACK codebooks are the same.

- DMRS sequence initialization – 1 bit.

- Priority indicator – 0 bit if higher layer parameter *priorityIndicatorForDCI-Format1-1* is not configured; otherwise 1 bit as defined in Clause 9 in [5, TS 38.213].

<Unchanged parts are omitted>

##### 7.3.1.2.3 Format 1\_2

DCI format 1\_2 is used for the scheduling of PDSCH in one cell.

The following information is transmitted by means of the DCI format 1\_2 with CRC scrambled by C-RNTI or CS-RNTI or MCS-C-RNTI:

- Identifier for DCI formats – 1 bits

- The value of this bit field is always set to 1, indicating a DL DCI format.

- Carrier indicator – 0, 1, 2 or 3 bits determined by higher layer parameter *carrierIndicatorSizeForDCI-Format1-2*, as defined in Clause 10.1 of [5, TS38.213].

- Bandwidth part indicator – 0, 1 or 2 bits as determined by the number of DL BWPs configured by higher layers, excluding the initial DL bandwidth part. The bitwidth for this field is determined as bits, where

- if , in which case the bandwidth part indicator is equivalent to the ascending order of the higher layer parameter *BWP-Id*;

- otherwise , in which case the bandwidth part indicator is defined in Table 7.3.1.1.2-1;

If a UE does not support active BWP change via DCI, the UE ignores this bit field.

- Frequency domain resource assignment – number of bits determined by the following:

- bits if only resource allocation type 0 is configured, where is defined in Clause 5.1.2.2.1 of [6, TS 38.214];

- bits if only resource allocation type 1 is configured, or bits if both resource allocation type 0 and 1 are configured, where , is the size of the active DL bandwidth part, is defined as in clause 4.4.4.4 of [4, TS 38.211] and is determined by higher layer parameter *ResourceAllocationType1-granularity-ForDCIFormat1\_2*. If the higher layer parameter *ResourceAllocationType1-granularity-ForDCIFormat1\_2* is not configured, is equal to 1.

- If both resource allocation type 0 and 1 are configured, the MSB bit is used to indicate resource allocation type 0 or resource allocation type 1, where the bit value of 0 indicates resource allocation type 0 and the bit value of 1 indicates resource allocation type 1.

- For resource allocation type 0, the LSBs provide the resource allocation as defined in Clause 5.1.2.2.1 of [6, TS 38.214].

- For resource allocation type 1, the LSBs provide the resource allocation as defined in Clause 5.1.2.2.2 of [6, TS 38.214]

If "Bandwidth part indicator" field indicates a bandwidth part other than the active bandwidth part and if both resource allocation type 0 and 1 are configured for the indicated bandwidth part, the UE assumes resource allocation type 0 for the indicated bandwidth part if the bitwidth of the "Frequency domain resource assignment" field of the active bandwidth part is smaller than the bitwidth of the "Frequency domain resource assignment" field of the indicated bandwidth part.

- Time domain resource assignment – 0, 1, 2, 3, or 4 bits as defined in Clause 5.1.2.1 of [6, TS 38.214]. The bitwidth for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *pdsch-TimeDomainAllocationListForDCI-Format1-2* if the higher layer parameter is configured, or *I* is the number of entries in the higher layer parameter *pdsch-TimeDomainAllocationList* if the higher layer parameter *pdsch-TimeDomainAllocationList* is configured when the higher layer parameter *pdsch-TimeDomainAllocationListForDCI-Format1-2* is not configured; otherwise *I* is the number of entries in the default table.

- VRB-to-PRB mapping – 0 or 1 bit:

- 0 bit if the higher layer parameter *vrb-ToPRB-InterleaverForDCI-Format1-2* is not configured;

- 1 bit according to Table 7.3.1.2.2-5 otherwise, only applicable to resource allocation type 1, as defined in Clause 7.3.1.6 of [4, TS 38.211].

- PRB bundling size indicator – 0 bit if the higher layer parameter *prb-BundlingTypeForDCI-Format1-2* is not configured or is set to 'static', or 1 bit if the higher layer parameter *prb-BundlingTypeForDCI-Format1-2*is set to 'dynamic' according to Clause 5.1.2.3 of [6, TS 38.214].

- Rate matching indicator – 0, 1, or 2 bits according to higher layer parameters *rateMatchPatternGroup1ForDCI-Format1-2* and *rateMatchPatternGroup2ForDCI-Format1-2*, where the MSB is used to indicate *rateMatchPatternGroup1ForDCI-Format1-2* and the LSB is used to indicate *rateMatchPatternGroup2ForDCI-Format1-2* when there are two groups.

- ZP CSI-RS trigger – 0, 1, or 2 bits as defined in Clause 5.1.4.2 of [6, TS 38.214]. The bitwidth for this field is determined as bits, where is the number of aperiodic ZP CSI-RS resource sets configured by higher layer parameter *aperiodicZP-CSI-RS-ResourceSetsToAddModListForDCI-Format1-2*.

- Modulation and coding scheme – 5 bits as defined in Clause 5.1.3.1 of [6, TS 38.214]

- New data indicator – 1 bit

- Redundancy version – 0, 1 or 2 bits determined by higher layer parameter *numberOfBitsForRV-ForDCI-Format1-2*

- If 0 bit is configured, *rvid* to be applied is 0;

- 1 bit according to Table 7.3.1.2.3-1;

- 2 bits according to Table 7.3.1.1.1-2.

- HARQ process number – 0, 1, 2, 3 or 4 bits determined by higher layer parameter *harq-ProcessNumberSizeForDCI-Format1-2*

- Downlink assignment index – 0, 1, 2 or 4 bits

- 0 bit if the higher layer parameter *downlinkAssignmentIndexForDCI-Format1-2* is not configured;

- 1, 2 or 4 bits determined by higher layer parameter *downlinkAssignmentIndexForDCI-Format1-2* otherwise,

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

- 1 or 2 bits if only one serving cell is configured in the DL and the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic*, where the 1 bit or 2 bits are the counter DAI.

If higher layer parameter *priorityIndicatorForDCI-Format1-2* is configured, if the bit width of the Downlink assignment index in DCI format 1\_2 for one HARQ-ACK codebook is not equal to that of the Downlink assignment index in DCI format 1\_2 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller Downlink assignment index until the bit width of the Downlink assignment index in DCI format 1\_2 for the two HARQ-ACK codebooks are the same.

<Unchanged parts are omitted>

- PUCCH resource indicator – 0 or 1 or 2 or 3 bits determined by higher layer parameter *numberOfBitsForPUCCH-ResourceIndicatorForDCI-Format1-2*

- PDSCH-to-HARQ\_feedback timing indicator – 0, 1, 2, or 3 bits as defined in Clause 9.2.3 of [5, TS 38.213]. The bitwidth for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *dl-DataToUL-ACK-ForDCI-Format1-2.*

If higher layer parameter *priorityIndicatorForDCI-Format1-2* is configured, if the bit width of the PDSCH-to-HARQ\_feedback timing indicator in DCI format 1\_2 for one HARQ-ACK codebook is not equal to that of the PDSCH-to-HARQ\_feedback timing indicator in DCI format 1\_2 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller PDSCH-to-HARQ\_feedback timing indicator until the bit width of the PDSCH-to-HARQ\_feedback timing indicator in DCI format 1\_2 for the two HARQ-ACK codebooks are the same.

- Antenna port(s) – 0, 4, 5, or 6 bits

- 0 bit if higher layer parameter *antennaPortsFieldPresenceForDCI-Format1-2* is notconfigured;

- Otherwise 4, 5 or 6 bits as defined by Tables 7.3.1.2.2-1/2/3/4, where the number of CDM groups without data of values 1, 2, and 3 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively. The antenna ports shall be determined according to the ordering of DMRS port(s) given by Tables 7.3.1.2.2-1/2/3/4. If a UE is configured with both *dmrs-DownlinkForPDSCH-MappingTypeA-ForDCI-Format1-2* and *dmrs-DownlinkForPDSCH-MappingTypeB-ForDCI-Format1-2* andis configured with higher layer parameter *antennaPortsFieldPresenceForDCI-Format1-2*, the bitwidth of this field equals, where is the "Antenna ports" bitwidth derived according to *dmrs-DownlinkForPDSCH-MappingTypeA-ForDCI-Format1-2* and is the "Antenna ports" bitwidthderived according to *dmrs-DownlinkForPDSCH-MappingTypeB-ForDCI-Format1-2*. A number of zeros are padded in the MSB of this field, if the mapping type of the PDSCH corresponds to the smaller value of and .

If a UE is not configured with higher layer parameter *antennaPortsFieldPresenceForDCI-Format1-2*, antenna port(s) are defined assuming bit field index value 0 in Tables 7.3.1.2.2-1/2/3/4.

- Transmission configuration indication – 0 bit if higher layer parameter *tci-PresentForDCI-Format1-2* is not enabled; otherwise 1 or 2 or 3 bits determined by higher layer parameter *tci-PresentForDCI-Format1-2* as defined in Clause 5.1.5 of [6, TS38.214].

If "Bandwidth part indicator" field indicates a bandwidth part other than the active bandwidth part,

- if the higher layer parameter *tci-PresentForDCI-Format1-2* is not enabled for the CORESET used for the PDCCH carrying the DCI format 1\_2,

- the UE assumes *tci-PresentForDCI-Format1-2* is not enabled for all CORESETs in the indicated bandwidth part;

- otherwise,

- the UE assumes *tci-PresentForDCI-Format1-2* is enabled for all CORESETs in the indicated bandwidth part.

- SRS request – 0, 1, 2 or 3 bits

- 0 bit if the higher layer parameter *srs-RequestForDCI-Format1-2* is not configured;

- 1 bit as defined by Table 7.3.1.1.3-1 if the higher layer parameter *srs-RequestForDCI-Format1-2 = 1* and for UEs not configured with *supplementaryUplink* in *ServingCellConfig* in the cell;

- 2 bits if the higher layer parameter *srs-RequestForDCI-Format1-2 = 1* and for UEs configured with *supplementaryUplink* in *ServingCellConfig* in the cell, where the first bit is the non-SUL/SUL indicator as defined in Table 7.3.1.1.1-1 and the second bit is defined by Table 7.3.1.1.3-1;

- 2 bits as defined by Table 7.3.1.1.2-24 if the higher layer parameter *srs-RequestForDCI-Format1-2 = 2* and for UEs not configured with *supplementaryUplink* in *ServingCellConfig* in the cell;

- 3 bits if the higher layer parameter *srs-RequestForDCI-Format1-2 = 2* and for UEs configured with *supplementaryUplink* in *ServingCellConfig* in the cell, where the first bit is the non-SUL/SUL indicator as defined in Table 7.3.1.1.1-1 and the second and third bits are defined by Table 7.3.1.1.2-24;

- DMRS sequence initialization – 0 or 1 bit

- 0 bit if the higher layer parameter *dmrs-SequenceInitializationForDCI-Format1-2* is not configured;

- 1 bit otherwise.

- Priority indicator – 0 bit if higher layer parameter *priorityIndicatorForDCI-Format1-2* is not configured; otherwise 1 bit as defined in Clause 9 in [5, TS 38.213].

If DCI formats 1\_2 are monitored in multiple search spaces associated with multiple CORESETs in a BWP for scheduling the same serving cell, zeros shall be appended until the payload size of the DCI formats 1\_2 monitored in the multiple search spaces equal to the maximum payload size of the DCI format 1\_2 monitored in the multiple search spaces.

<Unchanged parts are omitted>

##### 7.3.1.3.5 Format 2\_4

DCI format 2\_4 is used for notifying the PRB(s) and OFDM symbol(s) where UE cancels the corresponding UL transmission from the UE according to Clause 11.2A of [5, TS 38.213].

The following information is transmitted by means of the DCI format 2\_4 with CRC scrambled by ci-RNTI:

- Cancellation indication 1, Cancellation indication 2, …, Cancellation indication indication *N*.

The size of DCI format 2\_4 is configurable by higher layers parameter *dci-PayloadSizeForCI* up to 126 bits, according to Clause 11.2A of [5, TS 38.213]. The number of bits for each cancellation indication is configurable by higher layer parameter *ci-PayloadSize*. For a UE, there is at most one cancellation indication for an UL carrier.

<Unchanged parts are omitted>