**3GPP TSG RAN WG1 Meeting #106-e R1-21xxxxx**

**August 16th – 27th, 2021**

**Agenda item: 7.2.2**

**Source: Moderator (Qualcomm Incorporated)**

**Title: Editorial CRs email discussion for Rel.16 NR-U**

**Document for: Discussion and Decision**

# Introduction

The paper summarizes the email discussion for the following email thread

[106-e-NR-NRU-03] Email discussion on editorial changes to be recommended to the specification editors on issues E1, E2, E3, E4, E6, E7 and E9 in R1-2108222 until August 20 – Jing (Qualcomm)

# Email discussion

From the preparation email discussion, the following relatively editorial issues have been identified for further discussion during the meeting

|  |  |  |
| --- | --- | --- |
| Issue ID | Brief summary | Supporting document |
| E1 | Correction on RRC parameter name of HARQ-ACK codebook in TS 38.213 | CR for 38.213: [3] |
| E2 | Correction on DFI flag in DCI format 0-1 in TS38.212 | CR for 38.212: [4] |
| E3 | Editorial correction on the channel access for type-2 random access | CR for 38.213: [7] |
| E4 | Alignment CR on the parameter name of discovery burst window length | CR for 38.213: [8] |
| E6 | Clarification on OCC for PUCCH format 1 | CR for 38.213: [12] |
| E7 | PDSCH-to-HARQ feedback timing indicator field values | CR for 38.213: [13] |
| E9 | Correction on channel access type and CP extension indication | CR for 38.212: [19]CR for 38.213: [20] |

## Correction on RRC parameter name of HARQ-ACK codebook in TS 38.213 (E1)

In section 9.1.3.3, Type-2 HARQ-ACK codebook grouping is based on enhanced dynamic codebook introduced in NRU Rel-16. However, the RRC parameter of *pdsch-HARQ-ACK-Codebook* is configured for regular dynamic codebook firstly specified in NR Rel-15.

===========TP from [3] for 38.213=======================

9.1.3.3 Type-2 HARQ-ACK codebook grouping and HARQ-ACK retransmission

If a UE is provided *pdsch-HARQ-ACK-Codebook-r16*, the UE determines HARQ-ACK information for multiplexing in a PUCCH transmission occasion according to the following procedure.

Set $g$ to the value of a PDSCH group index field in a last DCI format that provides a value of $g$ and indicates a PUCCH transmission occasion.

Set $i(g)$ to denote a PUCCH transmission occasion for multiplexing HARQ-ACK information

Set $k$ to the value of a PDSCH-to-HARQ\_feedback timing field, if any, in a DCI format providing a value of $g$

- If the DCI format does not include a PDSCH-to-HARQ\_feedback timing field, set $k$ to the value provided by *dl-DataToUL-ACK*

Set $h(g)$ to the value of a first New feedback indicator field in the last DCI format providing the value of $g$

Set $h^{\left(g+1\right)mod2}(g)$ to a value of a second New feedback indicator field in the last DCI format providing the value of $g$

Set $V\_{DAI}^{\left(g+1\right)mod2}$ to the value of a total DAI field for group $\left(g+1\right)mod2$ in the last DCI format providing the value of $g$

- If $g=1$ and the UE detects a DCI format that does not include a PDSCH group index field in a PDCCH reception that is after the PDCCH reception for the last DCI format detection providing the value of $g$ and indicating a same slot for a PUCCH transmission occasion, set $V\_{DAI}^{\left(g+1\right)mod2}=∅$

Set $q$ to the value of a number of requested PDSCH group(s) field in the last DCI format providing the value of *g*

A UE does not expect to detect DCI formats with respective

- Number of requested PDSCH group(s) field values of 0, and

- PDSCH-to-HARQ\_feedback timing field values that indicate a same PUCCH transmission occasion, and

- PDSCH group index field values that are different

< Unchanged part is omitted >

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## Correction on DFI flag in DCI format 0-1 in TS38.212 (E2)

According to section 10.2 of TS38.214, when the field of DFI flag is set to “0” in DCI format 0-1 scrambled with CS-RNTI, the DCI is used to activate or release type 2 CG. In section 7.3.1.1.2 of TS38.212, only activation of type 2 CG is mentioned in the field description.

===========TP from [4] for 38.212=======================

7.3.1.1.2 Format 0\_1

DCI format 0\_1 is used for the scheduling of one or multiple PUSCH in one cell, or indicating CG downlink feedback information (CG-DFI) to a UE.

The following information is transmitted by means of the DCI format 0\_1 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 or 3 bits, as defined in Clause 10.1 of [5, TS38.213].

- DFI flag – 0 or 1 bit

- 1 bit if the UE is configured to monitor DCI format 0\_1 with CRC scrambled by CS-RNTI and for operation in a cell with shared spectrum channel access. For a DCI format 0\_1 with CRC scrambled by CS-RNTI, the bit value of 0 indicates activating or releasing type 2 CG transmission and the bit value of 1 indicates CG-DFI. For a DCI format 0\_1 with CRC scrambled by C-RNTI/SP-CSI-RNTI/MCS-C-RNTI and for operation in a cell with shared spectrum channel access, the bit is reserved.

- 0 bit otherwise;

< Unchanged part is omitted >

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## 2.3. Editorial correction on the channel access for type-2 random access (E3)

A duplicated sentence “as defined in Table 7.3.1.1.1-4 in TS 38.212” appears in Clause 8.2A.

===========TP from [7] for 38.212=======================

8.2A Random access response - Type-2 random access procedure

< Unchanged parts are omitted >

If the UE detects the DCI format 1\_0, with CRC scrambled by the corresponding MsgB-RNTI and LSBs of a SFN field in the DCI format 1\_0, if applicable, are same as corresponding LSBs of the SFN where the UE transmitted PRACH, and the UE receives a transport block in a corresponding PDSCH within the window, the UE passes the transport block to higher layers. The higher layers indicate to the physical layer

- an uplink grant if the RAR message(s) is for fallbackRAR and a random access preamble identity (RAPID) associated with the PRACH transmission is identified, and the UE procedure continues as described in clauses 8.2, 8.3, and 8.4 when the UE detects a RAR UL grant, or

- transmission of a PUCCH with HARQ-ACK information having ACK value if the RAR message(s) is for successRAR, where

- a PUCCH resource for the transmission of the PUCCH is indicated by PUCCH resource indicator field of 4 bits in the successRAR from a PUCCH resource set that is provided by *pucch-ResourceCommon*

- a slot for the PUCCH transmission is indicated by a HARQ Feedback Timing Indicator field of 3 bits in the successRAR having a value $k$ from {1, 2, 3, 4, 5, 6, 7, 8} and, with reference to slots for PUCCH transmission having duration $T\_{slot}$, the slot is determined as $n+k+∆$, where $n$ is a slot of the PDSCH reception and $∆$ is as defined for PUSCH transmission in Table 6.1.2.1.1-5 of [6, TS 38.214]

- the UE does not expect the first symbol of the PUCCH transmission to be after the last symbol of the PDSCH reception by a time smaller than $N\_{T,1}+0.5$ msec where $N\_{T,1}$ is the PDSCH processing time for UE processing capability 1 [6, TS 38.214]

- for operation with shared spectrum channel access, a channel access type and CP extension [15, TS 37.213] for a PUCCH transmission is indicated by a ChannelAccess-CPext field in the successRAR as defined in Table 7.3.1.1.1-4 in TS 38.212 or Table 7.3.1.1.1-4A in TS 38.212 if *ChannelAccessMode-r16* = "*semistatic*" is provided

- the PUCCH transmission is with a same spatial domain transmission filter and in a same active UL BWP as a last PUSCH transmission

< Unchanged parts are omitted >

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## 2.4. Alignment CR on the parameter name of discovery burst window length (E4)

Misalignment of the parameter name of discovery burst window length between 38.213 and 38.331.

===========TP from [8] for 38.213=======================

4 Synchronization procedures

4.1 Cell search

< Unchanged parts are omitted >

For operation with shared spectrum channel access, a UE assumes that transmission of SS/PBCH blocks in a half frame is within a discovery burst transmission window that starts from the first symbol of the first slot in a half-frame. The UE can be provided per serving cell by *~~DiscoveryBurst-WindowLength~~discoveryBurstWindowLength* a duration of the discovery burst transmission window. If *~~DiscoveryBurst-WindowLength~~discoveryBurstWindowLength* is not provided, the UE assumes that the duration of the discovery burst transmission window is a half frame. For a serving cell, the UE assumes that a periodicity of the discovery burst transmission window is same as a periodicity of half frames for receptions of SS/PBCH blocks in the serving cell. The UE assumes that one or more SS/PBCH blocks indicated by *ssb-PositionsInBurst* may be transmitted within the discovery burst transmission window and have candidate SS/PBCH blocks indexes corresponding to SS/PBCH block indexes provided by *ssb-PositionsInBurst*. If MSB $k$, $k\geq 1$, of *ssb-PositionsInBurst* is set to 1, the UE assumes that SS/PBCH block(s) within the discovery burst transmission window with candidate SS/PBCH block index(es) corresponding to SS/PBCH block index equal to $k-1$ may be transmitted; if MSB $k$ is set to 0, the UE assumes that the SS/PBCH block(s) are not transmitted.

< Unchanged parts are omitted >

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## 2.5. Clarification on OCC for PUCCH format 1 (E6)

In 38.213, there is a contradiction between OCC index determination for a PUCCH resource with PUCCH format 1. If interlaced PUCCH transmission and index 3, 7, or 11 in Table 9.2.1-1 are configured, both OCC index 0 and OCC index 1 should be used to determine PUCCH resources with PUCCH format 1. This contradicts with “An orthogonal cover code with index 0 is used for a PUCCH resource with PUCCH format 1 in Table 9.2.1-1”.

===========TP from [12] for 38.213=======================

9.2.1 PUCCH Resource Sets

If a UE does not have dedicated PUCCH resource configuration, provided by *PUCCH-ResourceSet* in *PUCCH-Config*, a PUCCH resource set is provided by *pucch-ResourceCommon* through an index to a row of Table 9.2.1-1 for transmission of HARQ-ACK information on PUCCH in an initial UL BWP of $N\_{BWP}^{size}$ PRBs.

The PUCCH resource set includes sixteen resources, each corresponding to a PUCCH format, a first symbol, a duration, a PRB offset $RB\_{BWP}^{offset}$, and a cyclic shift index set for a PUCCH transmission.

The UE transmits a PUCCH using frequency hopping if not provided *useInterlacePUCCH-PUSCH* in *BWP-UplinkCommon*; otherwise, the UE transmits a PUCCH without frequency hopping.

An orthogonal cover code with index 0 is used for a PUCCH resource with PUCCH format 1 in Table 9.2.1-1 except when index 3, 7, or 11 is indicated by *pucch-ResourceCommon* and *useInterlacePUCCH-PUSCH* in *BWP-UplinkCommon* is provided.

The UE transmits the PUCCH using the same spatial domain transmission filter as for a PUSCH transmission scheduled by a RAR UL grant as described in clause 8.3.

If a UE is not provided any of *pdsch-HARQ-ACK-Codebook*, *pdsch-HARQ-ACK-Codebook-r16*, or *pdsch-HARQ-ACK-OneShotFeedback*, the UE generates at most one HARQ-ACK information bit.

If the UE provides HARQ-ACK information in a PUCCH transmission in response to detecting a DCI format scheduling a PDSCH reception or a SPS PDSCH release, the UE determines a PUCCH resource with index $r\_{PUCCH}$, $0\leq r\_{PUCCH}\leq 15$, as $r\_{PUCCH}=\left⌊\frac{2⋅n\_{CCE,0}}{N\_{CCE}}\right⌋+2⋅∆\_{PRI}$, where $N\_{CCE}$ is a number of CCEs in a CORESET of a PDCCH reception with the DCI format, as described in clause 10.1, $n\_{CCE,0}$ is the index of a first CCE for the PDCCH reception, and $∆\_{PRI}$ is a value of the PUCCH resource indicator field in the DCI format.

If $\left⌊{r\_{PUCCH}}/{8}\right⌋=0$ and a UE is provided a PUCCH resource by *pucch-ResourceCommon* and is not provided *useInterlacePUCCH-PUSCH* in *BWP-UplinkCommon*

- the UE determines the PRB index of the PUCCH transmission in the first hop as $RB\_{BWP}^{offset}+\left⌊{r\_{PUCCH}}/{N\_{CS}}\right⌋$ and the PRB index of the PUCCH transmission in the second hop as $N\_{BWP}^{size}-1-RB\_{BWP}^{offset}-\left⌊{r\_{PUCCH}}/{N\_{CS}}\right⌋$, where $N\_{CS}$ is the total number of initial cyclic shift indexes in the set of initial cyclic shift indexes

- the UE determines the initial cyclic shift index in the set of initial cyclic shift indexes as $r\_{PUCCH}modN\_{CS}$

If $\left⌊{r\_{PUCCH}}/{8}\right⌋=1$ and a UE is provided a PUCCH resource by *pucch-ResourceCommon* and is not provided *useInterlacePUCCH-PUSCH* in *BWP-UplinkCommon*

- the UE determines the PRB index of the PUCCH transmission in the first hop as $N\_{BWP}^{size}-1-RB\_{BWP}^{offset}-\left⌊{\left(r\_{PUCCH}-8\right)}/{N\_{CS}}\right⌋$ and the PRB index of the PUCCH transmission in the second hop as $RB\_{BWP}^{offset}+\left⌊{\left(r\_{PUCCH}-8\right)}/{N\_{CS}}\right⌋$

- the UE determines the initial cyclic shift index in the set of initial cyclic shift indexes as 

If a UE is provided a PUCCH resource by *pucch-ResourceCommon* and is provided *useInterlacePUCCH-PUSCH* in *BWP-UplinkCommon*

- the UE determines for the PUCCH resource an interlace index $m$ as $m=\left(m\_{0}+\left⌊{r\_{PUCCH}}/{N\_{CS}}\right⌋\right)modM$ where $M$ is a number of interlaces [4, TS 38.211] and $m\_{0}=RB\_{BWP}^{offset}$ is an interlace index offset and $RB\_{BWP}^{offset}$ is as given in Table 9.2.1-1

- the UE determines an initial cyclic shift index in a set of initial cyclic shift indexes as $r\_{PUCCH}modN\_{CS}$, where $N\_{CS}$ is the total number of initial cyclic shifts indexes in the set of initial cyclic shift indexes in Table 9.2.1-1

- if *pucch-ResourceCommon* indicates

- index 0: the first symbol is 9 for a PUCCH resource with PUCCH format 0 if $r\_{PUCCH}\geq 10$

- index 1 or 2: the first symbol is 9 for a PUCCH resource with PUCCH format 0 if $r\_{PUCCH}=15$

- index 3, 7, or 11: an orthogonal cover code with index 1 is used for a PUCCH resource with PUCCH format 1 if $r\_{PUCCH}\geq 10$; otherwise, an orthogonal cover code with index 0 is used

- the UE does not expect *pucch-ResourceCommon* to indicate index 15

**Table 9.2.1-1: PUCCH resource sets before dedicated PUCCH resource configuration**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Index** | **PUCCH format** | **First symbol** | **Number of symbols** | **PRB offset**  | **Set of initial CS indexes** |
| 0 | 0 | 12 | 2 | 0 | {0, 3} |
| 1 | 0 | 12 | 2 | 0 | {0, 4, 8} |
| 2 | 0 | 12 | 2 | 3 | {0, 4, 8} |
| 3 | 1 | 10 | 4 | 0 | {0, 6} |
| 4 | 1 | 10 | 4 | 0 | {0, 3, 6, 9} |
| 5 | 1 | 10 | 4 | 2 | {0, 3, 6, 9} |
| 6 | 1 | 10 | 4 | 4 | {0, 3, 6, 9} |
| 7 | 1 | 4 | 10 | 0 | {0, 6} |
| 8 | 1 | 4 | 10 | 0 | {0, 3, 6, 9} |
| 9 | 1 | 4 | 10 | 2 | {0, 3, 6, 9} |
| 10 | 1 | 4 | 10 | 4 | {0, 3, 6, 9} |
| 11 | 1 | 0 | 14 | 0 | {0, 6} |
| 12 | 1 | 0 | 14 | 0 | {0, 3, 6, 9} |
| 13 | 1 | 0 | 14 | 2 | {0, 3, 6, 9} |
| 14 | 1 | 0 | 14 | 4 | {0, 3, 6, 9} |
| 15 | 1 | 0 | 14 |  | {0, 3, 6, 9} |

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## 2.6. PDSCH-to-HARQ feedback timing indicator field values (E7)

In current spec, for a DCI format, other than DCI format 1\_0, scheduling a PDSCH reception or a SPS PDSCH release, the PDSCH-to-HARQ\_feedback timing indicator field values are configured by high layer signaling

To support Type 3 HARQ-ACK codebook, DCI requesting Type3 HARQ-ACK codebook report but not scheduling a PDSCH is introduced. However, it is not clear how to determine PDSCH-to-HARQ\_feedback timing indicator field values for DCI requesting Type3 HARQ-ACK codebook report but not scheduling a PDSCH.

It is straightforward to reuse the same solution as DCI scheduling a PDSCH reception or a SPS PDSCH release, i.e. configured by high layer signaling.

===========TP from [13] for 38.213=======================

9.2.3 UE procedure for reporting HARQ-ACK

<Unchanged part omitted>

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 a DCI format, other than DCI format 1\_0, scheduling a PDSCH reception or a SPS PDSCH release, or requesting Type-3 HARQ-ACK codebook report and does not schedule 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*, as defined in Table 9.2.3-1.

<Unchanged part omitted>

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## 2.7. Correction on channel access type and CP extension indication (E9)

Currently ChannelAccess-CPext field is present or not is based on the following dexcription: “2 bits ... **if ChannelAccessMode-r16 = "semistatic" is provided for operation in a cell with shared spectrum channel access**; 0 bit **otherwise**” . The original intention is that “otherwise” correponds to the case operation without shared spectrum channel access, while the current formulation could be intepretted as ”otherwise” is against the whole “if”condition, i.e. 0 bit could be applicable to the case *channelAccessMode ='dynamic'* which is undesired.

Also, the case which of Table 7.3.1.1.1-4 and Table 7.3.1.1.1-4A is applied is not clearly defined and table name of Table 7.3.1.1.1-4A is inconsistent.

===========TP1 from [19] for 38.212=======================

7.3.1.1.1 Format 0\_0

DCI format 0\_0 is used for the scheduling of PUSCH in one cell.

The following information is transmitted by means of the DCI format 0\_0 with CRC scrambled by C-RNTI or CS-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

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

-  bits if neither of the higher layer parameters *useInterlacePUCCH-PUSCH* in *BWP-UplinkCommon* and *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated* is configured, where  is defined in clause 7.3.1.0

- For PUSCH hopping with resource allocation type 1:

-  MSB bits are used to indicate the frequency offset according to Clause 6.3 of [6, TS 38.214], where  if the higher layer parameter *frequencyHoppingOffsetLists* contains two offset values and  if the higher layer parameter *frequencyHoppingOffsetLists* contains four offset values

-  bits provide the frequency domain resource allocation according to Clause 6.1.2.2.2 of [6, TS 38.214]

- For non-PUSCH hopping with resource allocation type 1:

-  bits provide the frequency domain resource allocation according to Clause 6.1.2.2.2 of [6, TS 38.214]

- If any of the higher layer parameters *useInterlacePUCCH-PUSCH* in *BWP-UplinkCommon* and *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated* is configured

- 5+Y bits provide the frequency domain resource allocation according to Clause 6.1.2.2.3 of [6, TS 38.214] if the subcarrier spacing for the active UL bandwidth part is 30 kHz.

- 6+Y bits provide the frequency domain resource allocation according to Clause 6.1.2.2.3 of [6, TS 38.214] if the subcarrier spacing for the active UL bandwidth part is 15 kHz.

 If the DCI format 0\_0 is monitored in a UE-specific search space, the value of Y is determined by $\left⌈log\_{2}\left(\frac{N\_{RB-set,UL}^{BWP}\left(N\_{RB-set,UL}^{BWP}+1\right)}{2}\right)\right⌉$ where $N\_{RB-set,UL}^{BWP}$ is the number of RB sets contained in the active UL BWP as defined in clause 7 of [6, TS38.214]. If the DCI 0\_0 is monitored in a common search space Y = 0.

- Time domain resource assignment – 4 bits as defined in Clause 6.1.2.1 of [6, TS 38.214]

- Frequency hopping flag – 1 bit according to Table 7.3.1.1.1-3, 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 – 2 bits as defined in Table 7.3.1.1.1-2

- HARQ process number – 4 bits

- TPC command for scheduled PUSCH – 2 bits as defined in Clause 7.1.1 of [5, TS 38.213]

- ChannelAccess-CPext – 2 bits indicating combinations of channel access type and CP extension as defined in Table 7.3.1.1.1-4, or Table 7.3.1.1.1-4A, for operation in a cell with shared spectrum channel access; 0 bit otherwise.

- Padding bits, if required.

- UL/SUL indicator – 1 bit for UEs configured with *supplementaryUplink* in *ServingCellConfig* in the cell as defined in Table 7.3.1.1.1-1 and the number of bits for DCI format 1\_0 before padding is larger than the number of bits for DCI format 0\_0 before padding; 0 bit otherwise. The UL/SUL indicator, if present, locates in the last bit position of DCI format 0\_0, after the padding bit(s).

- If the UL/SUL indicator is present in DCI format 0\_0 and the higher layer parameter *pusch-Config* is not configured on both UL and SUL the UE ignores the UL/SUL indicator field in DCI format 0\_0, and the corresponding PUSCH scheduled by the DCI format 0\_0 is for the UL or SUL for which high layer parameter *pucch-Config* is configured;

- If the UL/SUL indicator is not present in DCI format 0\_0 and *pucch-Config* is configured, the corresponding PUSCH scheduled by the DCI format 0\_0 is for the UL or SUL for which high layer parameter *pucch-Config* is configured.

- If the UL/SUL indicator is not present in DCI format 0\_0 and *pucch-Config* is not configured, the corresponding PUSCH scheduled by the DCI format 0\_0 is for the uplink on which the latest PRACH is transmitted.

The following information is transmitted by means of the DCI format 0\_0 with CRC scrambled by TC-RNTI:

- Identifier for DCI formats – 1 bit

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

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

- bits if the higher layer parameter *useInterlacePUCCH-PUSCH* in *BWP-UplinkCommon* is not configured, where

-  is the size of the initial UL bandwidth part.

- For PUSCH hopping with resource allocation type 1:

-  MSB bits are used to indicate the frequency offset according to Table 8.3-1 in Clause 8.3 of [5, TS 38.213], where  if  and  otherwise

-  bits provide the frequency domain resource allocation according to Clause 6.1.2.2.2 of [6, TS 38.214]

- For non-PUSCH hopping with resource allocation type 1:

-  bits provide the frequency domain resource allocation according to Clause 6.1.2.2.2 of [6, TS 38.214]

- If the higher layer parameter *useInterlacePUCCH-PUSCH* in *BWP-UplinkCommon* is configured

- 5 bits provide the frequency domain resource allocation according to Clause 6.1.2.2.3 of [6, TS 38.214] if the subcarrier spacing for the active UL bandwidth part is 30 kHz

- 6 bits provide the frequency domain resource allocation according to Clause 6.1.2.2.3 of [6, TS 38.214] if the subcarrier spacing for the active UL bandwidth part is 15 kHz

- Time domain resource assignment – 4 bits as defined in Clause 6.1.2.1 of [6, TS 38.214]

- Frequency hopping flag – 1 bit according to Table 7.3.1.1.1-3, 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, reserved

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

- HARQ process number – 4 bits, reserved

- TPC command for scheduled PUSCH – 2 bits as defined in Clause 7.1.1 of [5, TS 38.213]

- ChannelAccess-CPext – 2 bits indicating combinations of channel access type and CP extension as defined in Table 7.3.1.1.1-4, or Table 7.3.1.1.1-4A, for operation in a cell with shared spectrum channel access; 0 bit otherwise

- Padding bits, if required.

- UL/SUL indicator – 1 bit if the cell has two ULs and the number of bits for DCI format 1\_0 before padding is larger than the number of bits for DCI format 0\_0 before padding; 0 bit otherwise. The UL/SUL indicator, if present, locates in the last bit position of DCI format 0\_0, after the padding bit(s).

- If 1 bit, reserved, and the corresponding PUSCH is always on the same UL carrier as the previous transmission of the same TB

**Table 7.3.1.1.1-1: UL/SUL indicator**

|  |  |
| --- | --- |
| Value of UL/SUL indicator | Uplink |
| 0 | The non-supplementary uplink  |
| 1 | The supplementary uplink |

**Table 7.3.1.1.1-2: Redundancy version**

|  |  |
| --- | --- |
| Value of the Redundancy version field | Value of  to be applied |
| 00 | 0 |
| 01 | 1 |
| 10 | 2 |
| 11 | 3 |

**Table 7.3.1.1.1-3: Frequency hopping indication**

|  |  |
| --- | --- |
| **Bit field mapped to index** | **PUSCH frequency hopping** |
| 0 | Disabled |
| 1 | Enabled |

**Table 7.3.1.1.1-4: Channel access type & CP extension for DCI format 0\_0 and DCI format 1\_0 if *ChannelAccessMode-r16* = "*dynamic*" is provided**

|  |  |  |
| --- | --- | --- |
| **Bit field mapped to index** | **Channel Access Type**  | **The CP extension T\_"ext" index defined in Clause 5.3.1 of [4, TS 38.211]** |
| 0 | Type2C-ULChannelAccess defined in [clause 4.2.1.2.3 in 37.213] | 2 |
| 1 | Type2A-ULChannelAccess defined in [clause 4.2.1.2.1 in 37.213] | 3 |
| 2 | Type2A-ULChannelAccess defined in [clause 4.2.1.2.1 in 37.213] | 1 |
| 3 | Type1-ULChannelAccess defined in [clause 4.2.1.1 in 37.213] | 0 |

**Table 7.3.1.1.1-4A: Channel access type & CP extension if *ChannelAccessMode-r16* = "*semistatic*" is provided**

|  |  |  |
| --- | --- | --- |
| **Bit field mapped to index** | **Channel Access Type**  | **The CP extension T\_"ext" index defined in Clause 5.3.1 of [4, TS 38.211]** |
| 0 | No sensing as defined in Clause 4.3 in TS 37.213 | 0 |
| 1 | No sensing as defined in Clause 4.3 in TS 37.213 | 2 |
| 2 | 9us sensing within a 25us interval as defined in Clause 4.3 in TS 37.213 | 0 |
| 3 | - | - |

7.3.1.1.2 Format 0\_1

DCI format 0\_1 is used for the scheduling of one or multiple PUSCH in one cell, or indicating CG downlink feedback information (CG-DFI) to a UE.

The following information is transmitted by means of the DCI format 0\_1 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 or 3 bits, as defined in Clause 10.1 of [5, TS38.213].

- DFI flag – 0 or 1 bit

- 1 bit if the UE is configured to monitor DCI format 0\_1 with CRC scrambled by CS-RNTI and for operation in a cell with shared spectrum channel access. For a DCI format 0\_1 with CRC scrambled by CS-RNTI, the bit value of 0 indicates activating type 2 CG transmission and the bit value of 1 indicates CG-DFI. For a DCI format 0\_1 with CRC scrambled by C-RNTI/SP-CSI-RNTI/MCS-C-RNTI and for operation in a cell with shared spectrum channel access, the bit is reserved.

- 0 bit otherwise;

If DCI format 0\_1 is used for indicating CG-DFI, all the remaining fields are set as follows:

- HARQ-ACK bitmap – 16 bits , where the order of the bitmap to HARQ process index mapping is such that HARQ process indices are mapped in ascending order from MSB to LSB of the bitmap. For each bit of the bitmap, value 1 indicates ACK, and value 0 indicates NACK.

- TPC command for scheduled PUSCH – 2 bits as defined in Clause 7.1.1 of [5, TS38.213]

- All the remaining bits in format 0\_1 are set to zero.

Otherwise, all the remaining fields are set as follows:

- 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.

- Bandwidth part indicator – 0, 1 or 2 bits as determined by the number of UL BWPs  configured by higher layers, excluding the initial UL 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, where  is the size of the active UL bandwidth part:

- If higher layer parameter *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated* is not configured

-  bits if only resource allocation type 0 is configured, where  is defined in Clause 6.1.2.2.1 of [6, TS 38.214],

- bits if only resource allocation type 1 is configured, or  bits if *resourceAllocation* is configured as '*dynamicSwitch'*.

- If *resourceAllocation* is configured as '*dynamicSwitch'*, 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 6.1.2.2.1 of [6, TS 38.214].

- For resource allocation type 1, the  LSBs provide the resource allocation as follows:

- For PUSCH hopping with resource allocation type 1:

-  MSB bits are used to indicate the frequency offset according to Clause 6.3 of [6, TS 38.214], where  if the higher layer parameter *frequencyHoppingOffsetLists* contains two offset values and  if the higher layer parameter *frequencyHoppingOffsetLists* contains four offset values

-  bits provide the frequency domain resource allocation according to Clause 6.1.2.2.2 of [6, TS 38.214]

- For non-PUSCH hopping with resource allocation type 1:

-  bits provide the frequency domain resource allocation according to Clause 6.1.2.2.2 of [6, TS 38.214]

If "Bandwidth part indicator" field indicates a bandwidth part other than the active bandwidth part and if *resourceAllocation* is configured as '*dynamicSwitch'* 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.

- If the higher layer parameter *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated* is configured

- 5 + Y bits provide the frequency domain resource allocation according to Clause 6.1.2.2.3 of [6, TS 38.214] if the subcarrier spacing for the active UL bandwidth part is 30 kHz. The 5 MSBs provide the interlace allocation and the Y LSBs provide the RB set allocation.

- 6 + Y bits provide the frequency domain resource allocation according to Clause 6.1.2.2.3 of [6, TS 38.214] if the subcarrier spacing for the active UL bandwidth part is 15 kHz. The 6 MSBs provide the interlace allocation and the Y LSBs provide the RB set allocation.

The value of Y is determined by $\left⌈log\_{2}\left(\frac{N\_{RB-set,UL}^{BWP}\left(N\_{RB-set,UL}^{BWP}+1\right)}{2}\right)\right⌉ $ where $N\_{RB-set,UL}^{BWP}$ is the number of RB sets contained in the active UL BWP as defined in clause 7 of [6, TS38.214].

- Time domain resource assignment – 0, 1, 2, 3, 4, 5, or 6 bits

- If the higher layer parameter *pusch-TimeDomainAllocationListDCI-0-1* is not configured and if the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH* is not configured and if the higher layer parameter *pusch-TimeDomainAllocationList* is configured, 0, 1, 2, 3, or 4 bits as defined in Clause 6.1.2.1 of [6, TS38.214]. The bitwidth for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *pusch-TimeDomainAllocationList*;

- If the higher layer parameter *pusch-TimeDomainAllocationListDCI-0-1* is configured or if the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH is configured*, 0, 1, 2, 3, 4, 5 or 6 bits as defined in Clause 6.1.2.1 of [6, TS38.214]. The bitwidth for this field is determined as $\left⌈log\_{2}(I)\right⌉ $bits, where *I* is the number of entries in the higher layer parameter *pusch-TimeDomainAllocationListDCI-0-1* or *pusch-TimeDomainAllocationListForMultiPUSCH*;

- otherwise the bitwidth for this field is determined as $\left⌈log\_{2}(I)\right⌉ $bits, where *I* is the number of entries in the default table*.*

- 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-RepTypeIndicatorDCI-0-1* is not configured to *pusch-RepTypeB*, or if the higher layer parameter *frequencyHoppingDCI-0-1* is not configured and *pusch-RepTypeIndicatorDCI-0-1* 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].

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

- New data indicator – 1 bit if the number of scheduled PUSCH indicated by the Time domain resource assignment field is 1; otherwise 2, 3, 4, 5, 6, 7 or 8 bits determined based on the maximum number of schedulable PUSCH among all entries in the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH*, where each bit corresponds to one scheduled PUSCH as defined in clause 6.1.4 in [6, TS 38.214].

- Redundancy version – – number of bits determined by the following:

- 2 bits as defined in Table 7.3.1.1.1-2 if the number of scheduled PUSCH indicated by the Time domain resource assignment field is 1;

- otherwise 2, 3, 4, 5, 6, 7 or 8 bits determined by the maximum number of schedulable PUSCHs among all entries in the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH*, where each bit corresponds to one scheduled PUSCH as defined in clause 6.1.4 in [6, TS 38.214] and redundancy version is determined according to Table 7.3.1.1.2-34.

- HARQ process number – 4 bits

- 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* configured;

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

 When two HARQ-ACK codebooks are configured for the same serving cell and if higher layer parameter *priorityIndicatorDCI-0-1* 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* configured;

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

- 0 bit otherwise.

 When two HARQ-ACK codebooks are configured for the same serving cell and if higher layer parameter *priorityIndicatorDCI-0-1* 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.

- TPC command for scheduled PUSCH – 2 bits as defined in Clause 7.1.1 of [5, TS38.213]

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

- if UE supports operation with *maxMIMO-Layers* and the higher layer parameter *maxMIMO-Layers* 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, 7.3.1.1.2-32A and 7.3.1.1.2-32B 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-ResourceSetToAddModList*, 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,* *ul-FullPowerTransmission* is not configured or configured to *fullpowerMode2* or configured to *fullpower,* and according to whether transform precoder is enabled or disabled, and the values of higher layer parameters *maxRank*, and *codebookSubset*;

- 4 or 5 bits according to Table 7.3.1.1.2-2A for 4 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission = fullpowerMode1, maxRank=2,* transform precoder is disabled, and according to the values of higher layer parameter *codebookSubset*;

- 4 or 6 bits according to Table 7.3.1.1.2-2B for 4 antenna ports, if *txConfig = codebook, ul-FullPowerTransmission = fullpowerMode1,* *maxRank=3 or 4,* transform precoder is disabled, and according to the values of higher layer parameter *codebookSubset*;

- 2, 4, or 5 bits according to Table 7.3.1.1.2-3 for 4 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission* is not configured or configured to *fullpowerMode2* or configured to *fullpower,* and according to whether transform precoder is enabled or disabled, and the values of higher layer parameters *maxRank*, and *codebookSubset*;

- 3 or 4 bits according to Table 7.3.1.1.2-3A for 4 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission = fullpowerMode1*, *maxRank=1*, and according to whether transform precoder is enabled or disabled, and the values of higher layer parameter *codebookSubset*;

- 2 or 4 bits according to Table7.3.1.1.2-4 for 2 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission* is not configured or configured to *fullpowerMode2* or configured to *fullpower,* and according to whether transform precoder is enabled or disabled, and the values of higher layer parameters *maxRank* and *codebookSubset*;

- 2 bits according to Table 7.3.1.1.2-4A for 2 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission = fullpowerMode1*, transform precoder is disabled, *maxRank=2*, and *codebookSubset=nonCoherent*;

- 1 or 3 bits according to Table7.3.1.1.2-5 for 2 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission* is not configured or configured to *fullpowerMode2* or configured to *fullpower,* and according to whether transform precoder is enabled or disabled, and the values of higher layer parameters *maxRank* and *codebookSubset*;

- 2 bits according to Table 7.3.1.1.2-5A for 2 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission = fullpowerMode1*, *maxRank=1*, and according to whether transform precoder is enabled or disabled, and the values of higher layer parameter *codebookSubset*;

For the higher layer parameter *txConfig=codebook*, if *ul-FullPowerTransmission* is configured to *fullpowerMode2*, maxRank is configured to be larger than 2, and at least one SRS resource with 4 antenna ports is configured in an SRS resource set with usage set to 'codebook' and an SRS resource with 2 antenna ports is indicated via SRI in the same SRS resource set, then Table 7.3.1.1.2-4 is used.

For the higher layer parameter *txConfig = codebook*, if different SRS resources with different number of antenna ports are configured, the bitwidth is determined according to the maximum number of ports in an SRS resource among the configured SRS resources in an SRS resource set with usage set to 'codebook'. If the number of ports for a configured SRS resource in the set is less than the maximum number of ports in an SRS resource among the configured SRS resources, a number of most significant bits with value set to '0' are inserted to the field.

- Antenna ports – number of bits determined by the following

- 2 bits as defined by Tables 7.3.1.1.2-6, if transform precoder is enabled, *dmrs-Type*=1, and *maxLength*=1, except that *dmrs-UplinkTransformPrecoding* and *tp-pi2BPSK* are both configured and π/2 BPSK modulation is used;

- 2 bits as defined by Tables 7.3.1.1.2-6A, if transform precoder is enabled and *dmrs-UplinkTransformPrecoding* and *tp-pi2BPSK* are both configured, π/2 BPSK modulation is used, *dmrs-Type*=1, and *maxLength*=1, where nSCID is the scrambling identity for antenna ports defined in [Clause 6.4.1.1.1.2, TS38.211];

- 4 bits as defined by Tables 7.3.1.1.2-7, if transform precoder is enabled, *dmrs-Type*=1, and *maxLength*=2, except that *dmrs-UplinkTransformPrecoding* and *tp-pi2BPSK* are both configured and π/2 BPSK modulation is used;

- 4 bits as defined by Tables 7.3.1.1.2-7A, if transform precoder is enabled and *dmrs-UplinkTransformPrecoding* and *tp-pi2BPSK* are both configured, π/2 BPSK modulation is used, *dmrs-Type*=1, and *maxLength*=2, where nSCID is the scrambling identity for antenna ports defined in [Clause 6.4.1.1.1.2, TS38.211];

- 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* and *dmrs-UplinkForPUSCH-MappingTypeB*, the bitwidth of this field equals , where  is the "Antenna ports" bitwidth derived according to *dmrs-UplinkForPUSCH-MappingTypeA* and  is the "Antenna ports" bitwidthderived according to *dmrs-UplinkForPUSCH-MappingTypeB*. 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 .

- SRS request – 2 bits as defined by Table 7.3.1.1.2-24 for UEs not configured with *supplementaryUplink* in *ServingCellConfig* in the cell; 3 bits 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. This bit field may also indicate the associated CSI-RS according to Clause 6.1.1.2 of [6, TS 38.214].

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

- 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.

- 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) when one PT-RS port and two PT-RS ports are configured by *maxNrofPorts* in *PTRS-UplinkConfig* 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 *priorityIndicatorDCI-0-1* 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 $\left⌈log\_{2}(I)\right⌉$ bits, where *I* is the number of entries in the higher layer parameter *ul-AccessConfigListDCI-0-1* or in Table 7.3.1.1.1-4A for operation in a cell with shared spectrum channel access; otherwise 0 bit. One or more entries from Table 7.3.1.1.2-35 are configured by the higher layer parameter *ul-AccessConfigListDCI-0-1.*

- 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-ParameterSetDCI-0-1* if SRS resource indicator is not present in the DCI format 0\_1.

- Priority indicator – 0 bit if higher layer parameter *priorityIndicatorDCI-0-1* 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 *invalidSymbolPatternIndicatorDCI-0-1* 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 *minimumSchedulingOffsetK2* is not configured;

- 1 bit if higher layer parameter *minimumSchedulingOffsetK2* is configured. The 1 bit indication is used to determine the minimum applicable K2 for the active UL BWP and the minimum applicable K0 value for the active DL BWP, if configured respectively, 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 *dormancyGroupWithinActiveTime* is not configured; otherwise 1, 2, 3, 4 or 5 bits bitmap determined according to higher layer parameter *dormancyGroupWithinActiveTime,* where each bit corresponds to one of the SCell group(s) configured by higher layers parameter *dormancyGroupWithinActiveTime,* 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.

- Sidelink assignment index – 0, 1 or 2 bits:

- 1 bit if the UE is configured with *pdsch-HARQ-ACK-Codebook* = *semi-static* and, in addition, the UE is configured with a SL configured grant type 1 or to monitor DCI format 3\_0 with CRC scrambled by SL-RNTI or SL-CS-RNTI;

- 2 bits if the UE is configured with *pdsch-HARQ-ACK-Codebook* = *dynamic* and, in addition, the UE is configured with a SL configured grant type 1 or to monitor DCI format 3\_0 with CRC scrambled by SL-RNTI or SL-CS-RNTI;

- 0 bit otherwise.

7.3.1.2.1 Format 1\_0

DCI format 1\_0 is used for the scheduling of PDSCH in one DL cell.

The following information is transmitted by means of the DCI format 1\_0 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

- Frequency domain resource assignment –  bits where  is given by clause 7.3.1.0

If the CRC of the DCI format 1\_0 is scrambled by C-RNTI and the "Frequency domain resource assignment" field are of all ones, the DCI format 1\_0 is for random access procedure initiated by a PDCCH order, with all remaining fields set as follows:

- Random Access Preamble index – 6 bits according to *ra-PreambleIndex* in Clause 5.1.2 of [8, TS38.321]

- UL/SUL indicator – 1 bit. If the value of the "Random Access Preamble index" is not all zeros and if the UE is configured with *supplementaryUplink* in *ServingCellConfig* in the cell, this field indicates which UL carrier in the cell to transmit the PRACH according to Table 7.3.1.1.1-1; otherwise, this field is reserved

- SS/PBCH index – 6 bits. If the value of the "Random Access Preamble index" is not all zeros, this field indicates the SS/PBCH that shall be used to determine the RACH occasion for the PRACH transmission; otherwise, this field is reserved.

- PRACH Mask index – 4 bits. If the value of the "Random Access Preamble index" is not all zeros, this field indicates the RACH occasion associated with the SS/PBCH indicated by "SS/PBCH index" for the PRACH transmission, according to Clause 5.1.1 of [8, TS38.321]; otherwise, this field is reserved

- Reserved bits – 12 bits for operation in a cell with shared spectrum channel access; otherwise 10 bits

Otherwise, all remaining fields are set as follows:

- Time domain resource assignment – 4 bits as defined in Clause 5.1.2.1 of [6, TS 38.214]

- VRB-to-PRB mapping – 1 bit according to Table 7.3.1.2.2-5

- Modulation and coding scheme – 5 bits as defined in Clause 5.1.3 of [6, TS 38.214]

- New data indicator – 1 bit

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

- HARQ process number – 4 bits

- Downlink assignment index – 2 bits as defined in Clause 9.1.3 of [5, TS 38.213], as counter DAI

- TPC command for scheduled PUCCH – 2 bits as defined in Clause 7.2.1 of [5, TS 38.213]

- PUCCH resource indicator – 3 bits as defined in Clause 9.2.3 of [5, TS 38.213]

- PDSCH-to-HARQ\_feedback timing indicator – 3 bits as defined in Clause 9.2.3 of [5, TS38.213]

- ChannelAccess-CPext – 2 bits indicating combinations of channel access type and CP extension as defined in Table 7.3.1.1.1-4, or Table 7.3.1.1.1-4A, for operation in a cell with shared spectrum channel access; 0 bits otherwise

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

- Short Messages Indicator – 2 bits according to Table 7.3.1.2.1-1.

- Short Messages – 8 bits, according to Clause 6.5 of [9, TS38.331]. If only the scheduling information for Paging is carried, this bit field is reserved.

- Frequency domain resource assignment – bits. If only the short message is carried, this bit field is reserved.

-  is the size of CORESET 0

- Time domain resource assignment – 4 bits as defined in Clause 5.1.2.1 of [6, TS38.214]. If only the short message is carried, this bit field is reserved.

- VRB-to-PRB mapping – 1 bit according to Table 7.3.1.2.2-5. If only the short message is carried, this bit field is reserved.

- Modulation and coding scheme – 5 bits as defined in Clause 5.1.3 of [6, TS38.214], using Table 5.1.3.1-1. If only the short message is carried, this bit field is reserved.

- TB scaling – 2 bits as defined in Clause 5.1.3.2 of [6, TS38.214]. If only the short message is carried, this bit field is reserved.

- Reserved bits – 8 bits for operation in a cell with shared spectrum channel access; otherwise 6 bits

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

- Frequency domain resource assignment – bits

-  is the size of CORESET 0

- Time domain resource assignment – 4 bits as defined in Clause 5.1.2.1 of [6, TS38.214]

- VRB-to-PRB mapping – 1 bit according to Table 7.3.1.2.2-5

- Modulation and coding scheme – 5 bits as defined in Clause 5.1.3 of [6, TS38.214], using Table 5.1.3.1-1

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

- System information indicator – 1 bit as defined in Table 7.3.1.2.1-2

- Reserved bits – 17 bits for operation in a cell with shared spectrum channel access; otherwise 15 bits

The following information is transmitted by means of the DCI format 1\_0 with CRC scrambled by RA-RNTI or MsgB-RNTI:

- Frequency domain resource assignment – bits

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

- Time domain resource assignment – 4 bits as defined in Clause 5.1.2.1 of [6, TS38.214]

- VRB-to-PRB mapping – 1 bit according to Table 7.3.1.2.2-5

- Modulation and coding scheme – 5 bits as defined in Clause 5.1.3 of [6, TS38.214], using Table 5.1.3.1-1

- TB scaling – 2 bits as defined in Clause 5.1.3.2 of [6, TS38.214]

- LSBs of SFN – 2 bits for the DCI format 1\_0 with CRC scrambled by MsgB-RNTI as defined in Clause 8.2A of [5, TS 38.213] if *msgB-responseWindow* is configured to be larger than 10 ms; or 2 bits for the DCI format 1\_0 with CRC scrambled by RA-RNTI as defined in Clause 8.2 of [5, TS 38.213] for operation in a cell with shared spectrum channel access if *ra-ResponseWindow or ra-ResponseWindow-v1610* is configured to be larger than 10 ms; 0 bit otherwise

- Reserved bits – (16 – *A*) bits for operation in a cell without shared spectrum access, (18 – *A*) for operation in a cell with shared spectrum access, where the value of *A* is the number of bits for the field of 'LSBs of SFN' as defined above

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

- Identifier for DCI formats – 1 bit

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

- Frequency domain resource assignment – bits

-  is the size of CORESET 0

- Time domain resource assignment – 4 bits as defined in Clause 5.1.2.1 of [6, TS38.214]

- VRB-to-PRB mapping – 1 bit according to Table 7.3.1.2.2-5

- Modulation and coding scheme – 5 bits as defined in Clause 5.1.3 of [6, TS38.214], using Table 5.1.3.1-1

- New data indicator – 1 bit

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

- HARQ process number – 4 bits

- Downlink assignment index – 2 bits, reserved

- TPC command for scheduled PUCCH – 2 bits as defined in Clause 7.2.1 of [5, TS38.213]

- PUCCH resource indicator – 3 bits as defined in Clause 9.2.3 of [5, TS38.213]

- PDSCH-to-HARQ\_feedback timing indicator – 3 bits as defined in Clause 9.2.3 of [5, TS38.213]

- ChannelAccess-CPext – 2 bits indicating combinations of channel access type and CP extension as defined in Table 7.3.1.1.1-4, or Table 7.3.1.1.1-4A, for operation in a cell with shared spectrum channel access; otherwise 0 bit

**Table 7.3.1.2.1-1: Short Message indicator**

|  |  |
| --- | --- |
| **Bit field** | **Short Message indicator** |
| 00 | Reserved |
| 01 | Only scheduling information for Paging is present in the DCI |
| 10 | Only short message is present in the DCI |
| 11 | Both scheduling information for Paging and short message are present in the DCI |

**Table 7.3.1.2.1-2: System information indicator**

|  |  |
| --- | --- |
| **Bit field** | **System information indicator** |
| 0 | SIB1 [9, TS38.331, Clause 5.2.1] |
| 1 | SI message [9, TS38.331, Clause 5.2.1] |

7.3.1.2.2 Format 1\_1

DCI format 1\_1 is used for the scheduling of PDSCH in one cell.

The following information is transmitted by means of the DCI format 1\_1 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 or 3 bits as defined in Clause 10.1 of [5, TS 38.213].

- 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, where  is the size of the active DL bandwidth part:

-  bits if only resource allocation type 0 is configured, where  is defined in Clause 5.1.2.2.1 of [6, TS38.214],

- bits if only resource allocation type 1 is configured, or

-  bits if *resourceAllocation* is configured as '*dynamicSwitch'*.

- If *resourceAllocation* is configured as '*dynamicSwitch'*, 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 *resourceAllocation* is configured as '*dynamicSwitch'* 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-TimeDomainAllocationList* if the higher layer parameter is configured; otherwise *I* is the number of entries in the default table.

- VRB-to-PRB mapping – 0 or 1 bit:

- 0 bit if only resource allocation type 0 is configured or if interleaved VRB-to-PRB mapping is not configured by high layers;

- 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-BundlingType* is not configured or is set to 'staticBundling', or 1 bit if the higher layer parameter *prb-BundlingType* is set to 'dynamicBundling' 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 *rateMatchPatternGroup1* and *rateMatchPatternGroup2*, where the MSB is used to indicate *rateMatchPatternGroup1* and the LSB is used to indicate *rateMatchPatternGroup2* when there are two groups.

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

For transport block 1:

- 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 – 2 bits as defined in Table 7.3.1.1.1-2

For transport block 2 (only present if *maxNrofCodeWordsScheduledByDCI* equals 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 – 2 bits as defined in Table 7.3.1.1.1-2

If "Bandwidth part indicator" field indicates a bandwidth part other than the active bandwidth part and the value of *maxNrofCodeWordsScheduledByDCI* for the indicated bandwidth part equals 2 and the value of *maxNrofCodeWordsScheduledByDCI* for the active bandwidth part equals 1, the UE assumes zeros are padded when interpreting the "Modulation and coding scheme", "New data indicator", and "Redundancy version" fields of transport block 2 according to Clause 12 of [5, TS38.213], and the UE ignores the "Modulation and coding scheme", "New data indicator", and "Redundancy version" fields of transport block 2 for the indicated bandwidth part.

- HARQ process number – 4 bits

- 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* is configured. 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 is configured in the DL and the higher layer parameter *nfi-TotalDAI-Included* is configured*.* 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-r16= enhancedDynamic*, and *nfi-TotalDAI-Included* 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 = joint*, 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-r16=enhancedDynamic*, and *nfi-TotalDAI-Included* 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 = joint*, where the 2 bits are the counter DAI;

- 0 bits otherwise.

 If the UE is configured with a PUCCH-SCell, the number of serving cells is determined within a PUCCH group.

 If the UE is configured with a PUCCH-SCell, *pdsch-HARQ-ACK-Codebook* is replaced by *pdsch-HARQ-ACK-Codebook-secondaryPUCCHgroup-r16* if present for the secondary PUCCH group.

 If higher layer parameter *priorityIndicatorDCI-1-1* 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.

- TPC command for scheduled PUCCH – 2 bits as defined in Clause 7.2.1 of [5, TS 38.213]

- PUCCH resource indicator – 3 bits as defined in Clause 9.2.3 of [5, TS 38.213]

- 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 *priorityIndicatorDCI-1-1* 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.

- One-shot HARQ-ACK request – 0 or 1 bit.

- 1 bit if higher layer parameter *pdsch-HARQ-ACK-OneShotFeedback-r16* is configured;

- 0 bit otherwise.

- PDSCH group index – 0 or 1 bit.

- 1 bit if the higher layer parameter *pdsch-HARQ-ACK-Codebook-r16=* *enhancedDynamic*;

- 0 bit otherwise.

- New feedback indicator – 0, 1 or 2 bits.

- 1 bit if the higher layer parameter *pdsch-HARQ-ACK-Codebook-r16=* *enhancedDynamic* and the higher layer parameter *nfi-TotalDAI-Included* is not configured;

- 2 bits if the higher layer parameter *pdsch-HARQ-ACK-Codebook-r16=* *enhancedDynamic* and the higher layer parameter *nfi-TotalDAI-Included=true*; the MSB corresponds to the scheduled PDSCH group, and the LSB corresponds to the non-scheduled PDSCH group, as defined in [TS38.213] clause 9.1.3.3

- 0 bit otherwise.

- Number of requested PDSCH group(s) – 0 or 1 bit.

- 1 bit if the higher layer parameter *pdsch-HARQ-ACK-Codebook-r16=* *enhancedDynamic*;

- 0 bit otherwise.

- Antenna port(s) – 4, 5, or 6 bits as defined by Tables 7.3.1.2.2-1/2/3/4 and Tables 7.3.1.2.2-1A/2A/3A/4A, 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 or Tables 7.3.1.2.2-1A/2A/3A/4A. When a UE receives an activation command that maps at least one codepoint of DCI field '*Transmission Configuration Indication*' to two TCI states, the UE shall use Table 7.3.1.2.2-1A/2A/3A/4A; otherwise, it shall use Tables 7.3.1.2.2-1/2/3/4. The UE can receive an entry with DMRS ports equals to 1000, 1002, 1003 when two TCI states are indicated in a codepoint of DCI field '*Transmission Configuration Indication*'.

If a UE is configured with both *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB*, the bitwidth of this field equals , where  is the "Antenna ports" bitwidth derived according to *dmrs-DownlinkForPDSCH-MappingTypeA* and  is the "Antenna ports" bitwidthderived according to *dmrs-DownlinkForPDSCH-MappingTypeB*. 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 .

- Transmission configuration indication – 0 bit if higher layer parameter *tci-PresentInDCI* is not enabled; otherwise 3 bits 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-PresentInDCI* is not enabled for the CORESET used for the PDCCH carrying the DCI format 1\_1,

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

- otherwise,

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

- SRS request – 2 bits as defined by Table 7.3.1.1.2-24 for UEs not configured with *supplementaryUplink* in *ServingCellConfig* in the cell; 3 bits 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. This bit field may also indicate the associated CSI-RS according to Clause 6.1.1.2 of [6, TS 38.214].

- 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 *priorityIndicatorDCI-1-1* 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 *priorityIndicatorDCI-1-1* 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 *priorityIndicatorDCI-1-1* is not configured; otherwise 1 bit as defined in Clause 9 in [5, TS 38.213].

- ChannelAccess-CPext – 0, 1, 2, 3 or 4 bits. The bitwidth for this field is determined as $\left⌈log\_{2}(I)\right⌉$ bits, where *I* is the number of entries in the higher layer parameter *ul-AccessConfigListDCI-1-1* or in Table 7.3.1.1.1-4A for operation in a cell with shared spectrum channel access; otherwise 0 bit. One or more entries from Table 7.3.1.2.2-6 are configured by the higher layer parameter *ul-AccessConfigListDCI-1-1.*

- Minimum applicable scheduling offset indicator – 0 or 1 bit

- 0 bit if higher layer parameter *minimumSchedulingOffsetK0* is not configured;

- 1 bit if higher layer parameter *minimumSchedulingOffsetK0* 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, if configured respectively, 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 *dormancyGroupWithinActiveTime* is not configured; otherwise 1, 2, 3, 4 or 5 bits bitmap determined according to higher layer parameter *dormancyGroupWithinActiveTime,* where each bit corresponds to one of the SCell group(s) configured by higher layers parameter *dormancyGroupWithinActiveTime,* 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.

If one-shot HARQ-ACK request is not present or set to '0', and all bits of frequency domain resource assignment are set to 0 for resource allocation type 0 or set to 1 for resource allocation type 1 or set to 0 or 1 for dynamic switch resource allocation type, this field is reserved and the following fields among the fields above are used for SCell dormancy indication, where each bit corresponds to one of the configured SCell(s), with MSB to LSB of the following fields concatenated in the order below corresponding to the SCell with lowest to highest SCell index

- Modulation and coding scheme of transport block 1

- New data indicator of transport block 1

- Redundancy version of transport block 1

- HARQ process number

- Antenna port(s)

- DMRS sequence initialization

============End of TP1 =============================

|  |  |
| --- | --- |
| Company | View |
|  |  |
|  |  |
|  |  |

ChannelAccess-CPext field in RAR were updated to commodate the case ChannelAccessMode-r16 = "semistatic". However, the original texts are not cleaned up so that incomplete sentence and duplicated description exist in the current specification.

===========TP2 from [20] for 38.213=======================

8.2 Random access response - Type-1 random access procedure

In response to a PRACH transmission, a UE attempts to detect a DCI format 1\_0 with CRC scrambled by a corresponding RA-RNTI during a window controlled by higher layers [11, TS 38.321]. The window starts at the first symbol of the earliest CORESET the UE is configured to receive PDCCH for Type1-PDCCH CSS set, as defined in clause 10.1, that is at least one symbol, after the last symbol of the PRACH occasion corresponding to the PRACH transmission, where the symbol duration corresponds to the SCS for Type1-PDCCH CSS set as defined in clause 10.1. The length of the window in number of slots, based on the SCS for Type1-PDCCH CSS set, is provided by *ra-ResponseWindow*.

If the UE detects the DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI and LSBs of a SFN field in the DCI format 1\_0, if included and applicable, are same as corresponding LSBs of the SFN where the UE transmitted PRACH, and the UE receives a transport block in a corresponding PDSCH within the window, the UE passes the transport block to higher layers. The higher layers parse the transport block for a random access preamble identity (RAPID) associated with the PRACH transmission. If the higher layers identify the RAPID in RAR message(s) of the transport block, the higher layers indicate an uplink grant to the physical layer. This is referred to as random access response (RAR) UL grant in the physical layer.

If the UE does not detect the DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI within the window, or if the UE detects the DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI within the window and LSBs of a SFN field in the DCI format 1\_0, if included and applicable, are not same as corresponding LSBs of the SFN where the UE transmitted PRACH, or if the UE does not correctly receive the transport block in the corresponding PDSCH within the window, or if the higher layers do not identify the RAPID associated with the PRACH transmission from the UE, the higher layers can indicate to the physical layer to transmit a PRACH. If requested by higher layers, the UE is expected to transmit a PRACH no later than  msec after the last symbol of the window, or the last symbol of the PDSCH reception, where  is a time duration of  symbols corresponding to a PDSCH processing time for UE processing capability 1 assuming  corresponds to the smallest SCS configuration among the SCS configurations for the PDCCH carrying the DCI format 1\_0, the corresponding PDSCH when additional PDSCH DM-RS is configured, and the corresponding PRACH. For , the UE assumes  [6, TS 38.214]. For a PRACH transmission using 1.25 kHz or 5 kHz SCS, the UE determines  assuming SCS configuration .

If the UE detects a DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI and LSBs of a SFN field in the DCI format 1\_0, if included and applicable, are same as corresponding LSBs of the SFN where the UE transmitted the PRACH, and the UE receives a transport block in a corresponding PDSCH, the UE may assume same DM-RS antenna port quasi co-location properties, as described in [6, TS 38.214], as for a SS/PBCH block or a CSI-RS resource the UE used for PRACH association, as described in clause 8.1, regardless of whether or not the UE is provided *TCI-State* for the CORESET where the UE receives the PDCCH with the DCI format 1\_0.

If the UE attempts to detect the DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI in response to a PRACH transmission initiated by a PDCCH order that triggers a contention-free random access procedure for the SpCell [11, TS 38.321], the UE may assume that the PDCCH that includes the DCI format 1\_0 and the PDCCH order have same DM-RS antenna port quasi co-location properties. If the UE attempts to detect the DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI in response to a PRACH transmission initiated by a PDCCH order that triggers a contention-free random access procedure for a secondary cell, the UE may assume the DM-RS antenna port quasi co-location properties of the CORESET associated with the Type1-PDCCH CSS set for receiving the PDCCH that includes the DCI format 1\_0.

A RAR UL grant schedules a PUSCH transmission from the UE. The contents of the RAR UL grant, starting with the MSB and ending with the LSB, are given in Table 8.2-1.

If the value of the frequency hopping flag is 0, the UE transmits the PUSCH without frequency hopping; otherwise, the UE transmits the PUSCH with frequency hopping.

The UE determines the MCS of the PUSCH transmission from the first sixteen indexes of the applicable MCS index table for PUSCH as described in [6, TS 38.214].

The TPC command value  is used for setting the power of the PUSCH transmission, as described in clause 7.1.1, and is interpreted according to Table 8.2-2.

The CSI request field is reserved.

The ChannelAccess-CPext field indicates a channel access type and CP extension for operation with shared spectrum channel access [15, TS 37.213] as defined in Table 7.3.1.1.1-4 in TS 38.212 or Table 7.3.1.1.1-4A in TS 38.212 if *ChannelAccessMode-r16* = "*semistatic*" is provided.

**Table 8.2-1: Random Access Response Grant Content field size**

|  |  |
| --- | --- |
| **RAR grant field** | **Number of bits** |
| Frequency hopping flag | 1 |
| PUSCH frequency resource allocation | 14, for operation without shared spectrum channel access 12, for operation with shared spectrum channel access |
| PUSCH time resource allocation | 4 |
| MCS | 4 |
| TPC command for PUSCH | 3 |
| CSI request | 1 |
| ChannelAccess-CPext | 0, for operation without shared spectrum channel access2, for operation with shared spectrum channel access |

**Table 8.2-2: TPC Command  for PUSCH**

|  |  |
| --- | --- |
| **TPC Command** | **Value (in dB)** |
| 0 | -6 |
| 1 | -4 |
| 2 | -2 |
| 3 | 0 |
| 4 | 2 |
| 5 | 4 |
| 6 | 6 |
| 7 | 8 |

Unless the UE is configured a SCS, the UE receives subsequent PDSCH using same SCS as for the PDSCH reception providing the RAR message.

If the UE does not detect the DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI within the window, or if the UE detects the DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI within the window and the LSBs of a SFN field in the DCI format 1\_0, if included and applicable, are not same as corresponding LSBs of the SFN where the UE transmitted the PRACH, or the UE does not correctly receive a corresponding transport block within the window, the UE procedure is as described in [11, TS 38.321].

8.2A Random access response - Type-2 random access procedure

In response to a transmission of a PRACH and a PUSCH, or to a transmission of only a PRACH if the PRACH preamble is mapped to a valid PUSCH occasion, a UE attempts to detect a DCI format 1\_0 with CRC scrambled by a corresponding MsgB-RNTI during a window controlled by higher layers [11, TS 38.321]. The window starts at the first symbol of the earliest CORESET the UE is configured to receive PDCCH for Type1-PDCCH CSS set, as defined in clause 10.1, that is at least one symbol, after the last symbol of the PUSCH occasion corresponding to the PRACH transmission, where the symbol duration corresponds to the SCS for Type1-PDCCH CSS set. The length of the window in number of slots, based on the SCS for Type1-PDCCH CSS set, is provided by *msgB-ResponseWindow*.

In response to a transmission of a PRACH, if the PRACH preamble is not mapped to a valid PUSCH occasion, a UE attempts to detect a DCI format 1\_0 with CRC scrambled by a corresponding MsgB-RNTI during a window controlled by higher layers [11, TS 38.321]. The window starts at the first symbol of the earliest CORESET the UE is configured to receive PDCCH for Type1-PDCCH CSS set, as defined in clause 10.1, that is at least one symbol, after the last symbol of the PRACH occasion corresponding to the PRACH transmission, where the symbol duration corresponds to the SCS for Type1-PDCCH CSS set. The length of the window in number of slots, based on the SCS for Type1-PDCCH CSS set, is provided by *msgB-ResponseWindow*.

If the UE detects the DCI format 1\_0, with CRC scrambled by the corresponding MsgB-RNTI and LSBs of a SFN field in the DCI format 1\_0, if applicable, are same as corresponding LSBs of the SFN where the UE transmitted PRACH, and the UE receives a transport block in a corresponding PDSCH within the window, the UE passes the transport block to higher layers. The higher layers indicate to the physical layer

- an uplink grant if the RAR message(s) is for fallbackRAR and a random access preamble identity (RAPID) associated with the PRACH transmission is identified, and the UE procedure continues as described in clauses 8.2, 8.3, and 8.4 when the UE detects a RAR UL grant, or

- transmission of a PUCCH with HARQ-ACK information having ACK value if the RAR message(s) is for successRAR, where

- a PUCCH resource for the transmission of the PUCCH is indicated by PUCCH resource indicator field of 4 bits in the successRAR from a PUCCH resource set that is provided by *pucch-ResourceCommon*

- a slot for the PUCCH transmission is indicated by a HARQ Feedback Timing Indicator field of 3 bits in the successRAR having a value $k$ from {1, 2, 3, 4, 5, 6, 7, 8} and, with reference to slots for PUCCH transmission having duration $T\_{slot}$, the slot is determined as $n+k+∆$, where $n$ is a slot of the PDSCH reception and $∆$ is as defined for PUSCH transmission in Table 6.1.2.1.1-5 of [6, TS 38.214]

- the UE does not expect the first symbol of the PUCCH transmission to be after the last symbol of the PDSCH reception by a time smaller than $N\_{T,1}+0.5$ msec where $N\_{T,1}$ is the PDSCH processing time for UE processing capability 1 [6, TS 38.214]

- for operation with shared spectrum channel access, a channel access type and CP extension [15, TS 37.213] for a PUCCH transmission is indicated by a ChannelAccess-CPext field in the successRAR as defined in Table 7.3.1.1.1-4 in TS 38.212 or Table 7.3.1.1.1-4A in TS 38.212 if *ChannelAccessMode-r16* = "*semistatic*" is provided

- the PUCCH transmission is with a same spatial domain transmission filter and in a same active UL BWP as a last PUSCH transmission

If the UE detects the DCI format 1\_0 with CRC scrambled by a C-RNTI and a transport block in a corresponding PDSCH within the window, the UE transmits a PUCCH with HARQ-ACK information having ACK value if the UE correctly detects the transport block or NACK value if the UE incorrectly detects the transport block and the time alignment timer is running [11, TS 38.321].

If the UE detects a DCI format 1\_0 with CRC scrambled by the corresponding MsgB-RNTI and receives a transport block within the window in a corresponding PDSCH, the UE may assume same DM-RS antenna port quasi co-location properties, as described in [6, TS 38.214], as for a SS/PBCH block the UE used for PRACH association, as described in clause 8.1, regardless of whether or not the UE is provided *TCI-State* for the CORESET where the UE receives the PDCCH with the DCI format 1\_0.

The UE does not expect to be indicated to transmit the PUCCH with the HARQ-ACK information at a time that is prior to a time when the UE applies a TA command that is provided by the transport block. If the UE does not detect the DCI format 1\_0 with CRC scrambled by the corresponding MsgB-RNTI within the window, or if the UE detects the DCI format 1\_0 with CRC scrambled by the corresponding MsgB-RNTI within the window and LSBs of a SFN field in the DCI format 1\_0, if applicable, are not same as corresponding LSBs of the SFN where the UE transmitted the PRACH, or if the UE does not correctly receive the transport block in the corresponding PDSCH within the window, or if the higher layers do not identify the RAPID associated with the PRACH transmission from the UE, the higher layers can indicate to the physical layer to transmit only PRACH according to Type-1 random access procedure or to transmit both PRACH and PUSCH according to Type-2 random access procedure [11, TS 38.321]. If requested by higher layers, the UE is expected to transmit a PRACH no later than $N\_{T,1}+0.75$ msec after the last symbol of the window, or the last symbol of the PDSCH reception, where $N\_{T,1}$ is a time duration of $N\_{1}$ symbols corresponding to a PDSCH processing time for UE processing capability 1 when additional PDSCH DM-RS is configured. For $μ=0$, the UE assumes $N\_{1,0}=14$ [6, TS 38.214].

Unless the UE is configured a SCS, the UE receives subsequent PDSCH using same SCS as for the PDSCH reception providing the RAR message.

If the UE does not detect the DCI format 1\_0 with CRC scrambled by the corresponding MsgB-RNTI within the window, or if the UE detects the 1\_0 with CRC scrambled by the corresponding MsgB-RNTI within the window and LSBs of a SFN field in the DCI format 1\_0, if applicable, are not same as corresponding LSBs of the SFN where the UE transmitted the PRACH, or the UE does not correctly receive a corresponding transport block within the window, the UE procedure is as described in [11, TS 38.321].

============End of TP2 =============================

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