

DRAFT CHANGE REQUEST					CR-Form-v12.0
38.212	CR	xxxx	rev	-	Current version: 15.7.0

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<http://www.3gpp.org/Change-Requests>.

Proposed change affects: UICC apps ☐ ME ☒ Radio Access Network ☒ Core Network ☐

Title:	Introduction of Physical Layer Enhancements for NR URLLC	
Source to WG:	Huawei	
Source to TSG:	R1	
Work item code:	NR_L1enh_URLLC-Core	Date: 2019-10-28
Category:	B Use <u>one</u> of the following categories: F (correction) A (mirror corresponding to a change in an earlier release) B (addition of feature), C (functional modification of feature) D (editorial modification) Detailed explanations of the above categories can be found in 3GPP TR 21.900 .	Release: Rel-16 Use <u>one</u> 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:	Inclusion of Physical Layer Enhancements for NR URLLC
Summary of change:	Support of Physical Layer Enhancements for NR URLLC
Consequences if not approved:	Physical Layer Enhancements for NR URLLC will be incomplete

Clauses affected:	7.3.1, 7.3.1.1.2, 7.3.1.1.3 (new), 7.3.1.2.3 (new), 7.3.1.3.5 (new)					
Other specs affected:	<table border="1"> <tr> <td>Y</td> <td>N</td> </tr> <tr> <td>☒</td> <td>☐</td> </tr> </table> Other core specifications	Y	N	☒	☐	TS 38.213, TS 38.214
Y	N					
☒	☐					
(show related CRs)	☒ Test specifications					
	☒ O&M Specifications					
Other comments:						
This CR's revision history:						

< Unchanged parts are omitted >

7.3.1 DCI formats

The DCI formats defined in table 7.3.1-1 are supported.

Table 7.3.1-1: DCI formats

DCI format	Usage
0_0	Scheduling of PUSCH in one cell
0_1	Scheduling of PUSCH in one cell
0_2	Scheduling of PUSCH in one cell
1_0	Scheduling of PDSCH in one cell
1_1	Scheduling of PDSCH in one cell
1_2	Scheduling of PDSCH in one cell
2_0	Notifying a group of UEs of the slot format
2_1	Notifying a group of UEs of the PRB(s) and OFDM symbol(s) where UE may assume no transmission is intended for the UE
2_2	Transmission of TPC commands for PUCCH and PUSCH
2_3	Transmission of a group of TPC commands for SRS transmissions by one or more UEs
2_4	Notifying a group of UEs of the PRB(s) and OFDM symbol(s) where UE may cancel the corresponding UL transmission from the UE

The fields defined in the DCI formats below are mapped to the information bits a_0 to a_{A-1} as follows.

Each field is mapped in the order in which it appears in the description, including the zero-padding bit(s), if any, with the first field mapped to the lowest order information bit a_0 and each successive field mapped to higher order information bits. The most significant bit of each field is mapped to the lowest order information bit for that field, e.g. the most significant bit of the first field is mapped to a_0 .

If the number of information bits in a DCI format is less than 12 bits, zeros shall be appended to the DCI format until the payload size equals 12.

The size of each DCI format is determined by the configuration of the corresponding active bandwidth part of the scheduled cell and shall be adjusted as described in clause 7.3.1.0 if necessary.

7.3.1.1.2 Format 0_1

DCI format 0_1 is used for the scheduling of PUSCH in one cell.

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 Subclause 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 PUCCH 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 $n_{\text{BWP,RRC}}$ configured by higher layers, excluding the initial UL bandwidth part. The bitwidth for this field is determined as $\lceil \log_2(n_{\text{BWP}}) \rceil$ bits, where
 - $n_{\text{BWP}} = n_{\text{BWP,RRC}} + 1$ if $n_{\text{BWP,RRC}} \leq 3$, in which case the bandwidth part indicator is equivalent to the ascending order of the higher layer parameter *BWP-Id*;
 - otherwise $n_{\text{BWP}} = n_{\text{BWP,RRC}}$, 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 $N_{\text{RB}}^{\text{UL,BWP}}$ is the size of the active UL bandwidth part:
 - N_{RBG} bits if only resource allocation type 0 is configured, where N_{RBG} is defined in Subclause 6.1.2.2.1 of [6, TS 38.214],
 - $\lceil \log_2(N_{\text{RB}}^{\text{UL,BWP}}(N_{\text{RB}}^{\text{UL,BWP}} + 1)/2) \rceil$ bits if only resource allocation type 1 is configured, or $\max(\lceil \log_2(N_{\text{RB}}^{\text{UL,BWP}}(N_{\text{RB}}^{\text{UL,BWP}} + 1)/2) \rceil, N_{\text{RBG}}) + 1$ bits if both resource allocation type 0 and 1 are configured.
 - 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 N_{RBG} LSBs provide the resource allocation as defined in Subclause 6.1.2.2.1 of [6, TS 38.214].
 - For resource allocation type 1, the $\lceil \log_2(N_{\text{RB}}^{\text{UL,BWP}}(N_{\text{RB}}^{\text{UL,BWP}} + 1)/2) \rceil$ LSBs provide the resource allocation as follows:
 - For PUSCH hopping with resource allocation type 1:
 - $N_{\text{UL,hop}}$ MSB bits are used to indicate the frequency offset according to Subclause 6.3 of [6, TS 38.214], where $N_{\text{UL,hop}} = 1$ if the higher layer parameter *frequencyHoppingOffsetLists* contains two offset values and $N_{\text{UL,hop}} = 2$ if the higher layer parameter *frequencyHoppingOffsetLists* contains four offset values
 - $\lceil \log_2(N_{\text{RB}}^{\text{UL,BWP}}(N_{\text{RB}}^{\text{UL,BWP}} + 1)/2) \rceil - N_{\text{UL,hop}}$ bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]
 - For non-PUSCH hopping with resource allocation type 1:

- $\left\lceil \log_2(N_{RB}^{UL,BWP}(N_{RB}^{UL,BWP} + 1)/2) \right\rceil$ bits provides the frequency domain resource allocation according to Subclause 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 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, 4, 5, or 6 bits
 - If the higher layer parameter *PUSCH-TimeDomainResourceAllocationList-ForDCIformat0_1* is not configured and if the higher layer parameter *pusch-TimeDomainAllocationList* is configured, 0, 1, 2, 3, or 4 bits as defined in Subclause 6.1.2.1 of [6, TS38.214]. The bitwidth for this field is determined as $\left\lceil \log_2(I) \right\rceil$ bits, where I is the number of entries in the higher layer parameter *pusch-TimeDomainAllocationList* ~~if the higher layer parameter is configured~~;
 - If the higher layer parameter *PUSCH-TimeDomainResourceAllocationList-ForDCIformat0_1* is configured, 0, 1, 2, 3, 4, 5 or 6 bits as defined in Subclause 6.1.2.1 of [6, TS38.214]. The bitwidth for this field is determined as $\left\lceil \log_2(I) \right\rceil$ bits, where I is the number of entries in the higher layer parameter *PUSCH-TimeDomainResourceAllocationList-ForDCIformat0_1*;
 - otherwise 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;
 - 1 bit according to Table 7.3.1.1.1-3 otherwise, only applicable to resource allocation type 1, as defined in Subclause 6.3 of [6, TS 38.214].
- Modulation and coding scheme – 5 bits as defined in Subclause 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
- 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.
- TPC command for scheduled PUSCH – 2 bits as defined in Subclause 7.1.1 of [5, TS38.213]
- SRS resource indicator – $\left\lceil \log_2 \left(\sum_{k=1}^{\min\{L_{SRS}, N_{SRS}\}} \binom{N_{SRS}}{k} \right) \right\rceil$ or $\left\lceil \log_2(N_{SRS}) \right\rceil$ bits, where N_{SRS} is the number of configured SRS resources in the SRS resource set associated with the higher layer parameter *usage* of value 'codeBook' or 'nonCodeBook'.

- $\left\lceil \log_2 \left(\sum_{k=1}^{\min\{L_{\max}, N_{\text{SRS}}\}} \binom{N_{\text{SRS}}}{k} \right) \right\rceil$ bits according to Tables 7.3.1.1.2-28/29/30/31 if the higher layer parameter $txConfig = nonCodebook$, where N_{SRS} is the number of configured SRS resources in the SRS resource set 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, $L_{\max}$ is given by that parameter
 - otherwise, $L_{\max}$ is given by the maximum number of layers for PUSCH supported by the UE for the serving cell for non-codebook based operation.
- $\left\lceil \log_2(N_{\text{SRS}}) \right\rceil$ bits according to Tables 7.3.1.1.2-32 if the higher layer parameter $txConfig = codebook$, where N_{SRS} is the number of configured SRS resources in the SRS resource set 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 *maxRank*, and *codebookSubset*;
 - 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 *maxRank*, and *codebookSubset*;
 - 2 or 4 bits according to Table 7.3.1.1.2-4 for 2 antenna ports, if $txConfig = codebook$, and according to whether transform precoder is enabled or disabled, and the values of higher layer parameters *maxRank* and *codebookSubset*;
 - 1 or 3 bits according to Table 7.3.1.1.2-5 for 2 antenna ports, if $txConfig = codebook$, and according to whether transform precoder is enabled or disabled, and the values of higher layer parameters *maxRank* and *codebookSubset*.
- 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;
 - 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* and *dmrs-UplinkForPUSCH-MappingTypeB*, the bitwidth of this field equals $\max\{x_A, x_B\}$, where x_A is the "Antenna ports" bitwidth derived according to *dmrs-UplinkForPUSCH-MappingTypeA* and x_B is the "Antenna ports" bitwidth derived according to *dmrs-UplinkForPUSCH-MappingTypeB*. A number of $|x_A - x_B|$ zeros are padded in the MSB of this field, if the mapping type of the PUSCH corresponds to the smaller value of x_A and x_B .

- 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 Subclause 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 PDSCH is not configured, 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-UplinkConfig* is not configured 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].
 - DMRS sequence initialization – 0 bit if transform precoder is enabled; 1 bit if transform precoder is disabled.
 - 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_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).

A UE does not expect that the bit width of a field in DCI format 0_1 with CRC scrambled by CS-RNTI is larger than corresponding bit width of same field in DCI format 0_1 with CRC scrambled by C-RNTI for the same serving cell. If the bit width of a field in the DCI format 0_1 with CRC scrambled by CS-RNTI is not equal to that of the corresponding field in the DCI format 0_1 with CRC scrambled by C-RNTI for the same serving cell, a number of most significant bits with value set to '0' are inserted to the field in DCI format 0_1 with CRC scrambled by CS-RNTI until the bit width equals that of the corresponding field in the DCI format 0_1 with CRC scrambled by C-RNTI for the same serving cell.

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 *CarrierIndicatorSize-ForDCIFormat0_2*.
- 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 $n_{BWP,RRC}$ configured by higher layers, excluding the initial UL bandwidth part. The bitwidth for this field is determined as $\lceil \log_2(n_{BWP}) \rceil$ bits, where
 - $n_{BWP} = n_{BWP,RRC} + 1$ if $n_{BWP,RRC} \leq 3$, in which case the bandwidth part indicator is equivalent to the ascending order of the higher layer parameter *BWP-Id*;
 - otherwise $n_{BWP} = n_{BWP,RRC}$, 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 – $\lceil \log_2 \left(\left(\lceil N_{RB}^{UL,BWP} / K1 \rceil \right) \left(\lceil N_{RB}^{UL,BWP} / K1 \rceil + 1 \right) / 2 \right) \rceil$ bits where $N_{RB}^{UL,BWP}$ is defined in subclause 7.3.1.0 and $K1$ is given by higher layer parameter *ResourceAllocationType1-granularity-ForDCIFormat0_2*. If the higher layer parameter *ResourceAllocationType1-granularity-ForDCIFormat0_2* is not configured, $K1$ is equal to 1.
 - For PUSCH hopping with resource allocation type 1:
 - $N_{UL,hop}$ MSB bits are used to indicate the frequency offset according to Subclause 6.3 of [6, TS 38.214], where $N_{UL,hop} = 1$ if the higher layer parameter *frequencyHoppingOffsetLists-ForDCIFormat0_2* contains two offset values and $N_{UL,hop} = 2$ if the higher layer parameter *frequencyHoppingOffsetLists-ForDCIFormat0_2* contains four offset values
 - $\lceil \log_2 \left(\left(\lceil N_{RB}^{UL,BWP} / K1 \rceil \right) \left(\lceil N_{RB}^{UL,BWP} / K1 \rceil + 1 \right) / 2 \right) \rceil - N_{UL,hop}$ 1 bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]
 - For non-PUSCH hopping with resource allocation type 1:
 - $\lceil \log_2 \left(\left(\lceil N_{RB}^{UL,BWP} / K1 \rceil \right) \left(\lceil N_{RB}^{UL,BWP} / K1 \rceil + 1 \right) / 2 \right) \rceil$ 1 bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]
- Time domain resource assignment – 0, 1, 2, 3, 4, 5 or 6 bits as defined in Subclause 6.1.2.1 of [6, TS38.214]. The bitwidth for this field is determined as $\lceil \log_2(I) \rceil$ bits, where I is the number of entries in the higher layer parameter *PUSCH-TimeDomainResourceAllocationList-ForDCIformat0_2* if the higher layer parameter is configured; [otherwise I is the number of entries in the default table].
- Frequency hopping flag – 0 or 1 bit:
 - 0 bit if the higher layer parameter *frequencyHopping-ForDCIFormat0_2* is not configured;
 - 1 bit according to Table 7.3.1.1.1-3 otherwise, as defined in Subclause 6.3 of [6, TS 38.214].
- Modulation and coding scheme – **x bits**
- New data indicator – 1 bit

Commented [Huawei1]: Editor's note: We have the following agreement, but there is no details on how to ensure same DCI size, thus no text for the agreement below for now.

Agreements:

- The new UL DCI format with CRC scrambled by CS-RNTI and the new UL DCI format with CRC scrambled by C-RNTI should have the same total DCI size.

Editor's note: Further update may be needed on the referred sections in 38.213 and 38.214.

Commented [Huawei2]: Editor's note: Further update may be needed depending on whether to introduce new RNTI or not for URLLC

Commented [Huawei3]: Editor's note: Further update may be needed depending on whether to additionally support resource allocation type 0

Commented [Huawei4]: Editor's note: Put here just as placeholder, will be updated later once agreements achieved

- Redundancy version – x bits
- HARQ process number – 0, 1, 2, 3 or 4 bits determined by higher layer parameter *HARQProcessNumberSize-ForDCIFormat0_2*
- Downlink assignment index – 0, 1, 2 or 4 bits
 - 0 bit if the higher layer parameter *Downlinkassignmentindex-ForDCIFormat0_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.
- TPC command for scheduled PUSCH – 2 bits as defined in Subclause 7.1.1 of [5, TS38.213]
- SRS resource indicator – 0, 1, 2, 3 or 4 bits
- Precoding information and number of layers – 0, 1, 2, 3, 4, 5 or 6 bits
- Antenna ports – 0, 2, 3, 4 or 5 bits
- SRS request – 0, 2 or 3 bits
- CSI request – 0, 1, 2, 3, 4, 5, or 6 bits determined by higher layer parameter *reportTriggerSize-ForDCIFormat0_2*
- PTRS-DMRS association – 0 or 2 bits
- beta_offset indicator – 0, 1 or 2 bits
- DMRS sequence initialization – 0 or 1 bit
 - 0 bit if the higher layer parameter *DMRSsequenceinitialization-ForDCIFormat0_2* is not configured or if transform precoder is enabled;
 - 1 bit if transform precoder is disabled.
- 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 bit. 0 bit if the higher layer parameter *P0-PUSCH-Set-List* is not configured; 1 bit otherwise.

Commented [Huawei5]: Editor's note: Put here just as placeholder, will be updated later once agreements achieved

Commented [Huawei6]: Editor's note: Further update may be needed depending on whether to move this field to a fixed location in the DCI format

Commented [ZK7]: This is the new DCI format that was added for uplink configured grants at the same time as the changes to 38.213. It has RV and HARQ process number fields (as did all the other DCI formats since forever). But here the size of the HARQ field is configurable via RRC parameter *HARQProcessNumberSize-ForDCIFormat0_2* (final name omitted the "For" from the name), which is the "second configuration parameter" in the claims.

The RV field doesn't name the "first configuration parameter," but the reference to "x bits" may suggest that was the intention. (They were still considering the range of number of bits.) And more importantly, the RRC "first configuration parameter" is named in DCI format 1_2, which is for downlink SPS configurations. See below.

Commented [Huawei8]: Editor's note: The following fields will be further updated based on further agreements on the details of configuration

- SRS resource indicator
- Precoding information and number of layers
- Antenna ports
- SRS request
- PTRS-DMRS association

Commented [Huawei9]: Editor's note: Will be further updated depending on further clarification/agreements on the description and value of range for the RRC parameter "dynamic-ForDCIFormat0_2".

Commented [Huawei210]: Editor note: Check further this field also applies to DCI format 0_1.

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 *CarrierIndicatorSize-ForDCIFormat1_2*
- Bandwidth part indicator – 0, 1 or 2 bits as determined by the number of DL BWPs $n_{BWP,RRC}$ configured by higher layers, excluding the initial DL bandwidth part. The bitwidth for this field is determined as $\lceil \log_2(n_{BWP}) \rceil$ bits, where
 - $n_{BWP} = n_{BWP,RRC} + 1$ if $n_{BWP,RRC} \leq 3$, in which case the bandwidth part indicator is equivalent to the ascending order of the higher layer parameter *BWP-Id*;
 - otherwise $n_{BWP} = n_{BWP,RRC}$, 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 – $\lceil \log_2 \left(\left(\lceil N_{RB}^{DL,BWP} / K2 \rceil \right) \left(\lceil N_{RB}^{DL,BWP} / K2 \rceil + 1 \right) / 2 \right) \rceil$ bits where $N_{RB}^{DL,BWP}$ is given by subclause 7.3.1.0 and $K2$ is determined by higher layer parameter *ResourceAllocationType1-granularity-ForDCIFormat1_2*. If the higher layer parameter *ResourceAllocationType1-granularity-ForDCIFormat1_2* is not configured, $K2$ is equal to 1.
- Time domain resource assignment – 0, 1, 2, 3, or 4 bits as defined in Subclause 5.1.2.1 of [6, TS 38.214]. The bitwidth for this field is determined as $\lceil \log_2(I) \rceil$ bits, where I is the number of entries in the higher layer parameter *pdsch-TimeDomainAllocationList-ForDCIFormat1_2* 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 the higher layer parameter *vrB-ToPRB-Interleaver-ForDCIFormat1_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 Subclause 7.3.1.6 of [4, TS 38.211].
- PRB bundling size indicator – 0 bit if the higher layer parameter *prb-BundlingType-ForDCIFormat1_2* is not configured or is set to 'static', or 1 bit if the higher layer parameter *prb-BundlingType-ForDCIFormat1_2* is set to 'dynamic' according to Subclause 5.1.2.3 of [6, TS 38.214].
- Rate matching indicator – 0, 1, or 2 bits according to higher layer parameters *rateMatchPatternGroup1-ForDCIFormat1_2* and *rateMatchPatternGroup2-ForDCIFormat1_2*, where the MSB is used to indicate *rateMatchPatternGroup1-ForDCIFormat1_2* and the LSB is used to indicate *rateMatchPatternGroup2-ForDCIFormat1_2* when there are two groups.
- ZP CSI-RS trigger – 0, 1, or 2 bits as defined in Subclause 5.1.4.2 of [6, TS 38.214]. The bitwidth for this field is determined as $\lceil \log_2(n_{ZP} + 1) \rceil$ bits, where n_{ZP} is the number of aperiodic ZP CSI-RS resource sets configured by higher layer parameter *aperiodic-ZP-CSI-RS-ResourceSetsToAddModList-ForDCIFormat1_2*.
- Modulation and coding scheme – x bits
- New data indicator – 1 bit
- Redundancy version – 0, 1 or 2 bits determined by higher layer parameter *NumberOfbitsforRV-ForDCIFormat1_2*
 - If 0 bit is configured, rv_{id} to be applied is 0;
 - 1 bit according to Table 7.3.1.2.3-1;

Commented [Huawei11]: Editor's note: Further update may be needed on the referred sections in 38.213 and 38.214.

Commented [Huawei12]: Editor's note: Further update may be needed depending on whether to introduce new RNTI or not for URLLC

Commented [Huawei13]: Editor's note: Put here just as placeholder, will be updated later once agreements achieved

- 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 *HARQProcessNumberSize-ForDCIFormat1_2*
- Downlink assignment index – 0, 1, 2 or 4 bits
 - 0 bit if the higher layer parameter *Downlinkassignmentindex-ForDCIFormat1_2* is not configured;
 - 1, 2 or 4 bits determined by higher layer parameter *Downlinkassignmentindex-ForDCIFormat1_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.
- TPC command for scheduled PUCCH – 2 bits as defined in Subclause 7.2.1 of [5, TS 38.213]
- PUCCH resource indicator – 0 or 1 or 2 or 3 bits determined by higher layer parameter *Numbersofbits-forPUCCHresourceindicator-ForDCIFormat1_2*
- *PDSCCH-to-HARQ feedback timing indicator* – 0, 1, 2, or 3 bits as defined in Subclause 9.2.3 of [5, TS 38.213]. The bitwidth for this field is determined as $\lceil \log_2(I) \rceil$ bits, where I is the number of entries in the higher layer parameter *dl-DataToUL-ACK-ForDCIFormat1_2*.
- Antenna port(s) – 0, 4, 5, or 6 bits
 - 0 bit if both higher layer parameter *dmrs-DownlinkForPDSCH-MappingTypeA-ForDCIFormat1_2* and higher layer parameter *dmrs-DownlinkForPDSCH-MappingTypeB-ForDCIFormat1_2* are not configured;
 - 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 $\{p_0, \dots, p_{V-1}\}$ 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-ForDCIFormat1_2* and *dmrs-DownlinkForPDSCH-MappingTypeB-ForDCIFormat1_2*, the bitwidth of this field equals $\max\{x_A, x_B\}$, where x_A is the "Antenna ports" bitwidth derived according to *dmrs-DownlinkForPDSCH-MappingTypeA-ForDCIFormat1_2* and x_B is the "Antenna ports" bitwidth derived according to *dmrs-DownlinkForPDSCH-MappingTypeB-ForDCIFormat1_2*. A number of $|x_A - x_B|$ zeros are padded in the MSB of this field, if the mapping type of the PDSCH corresponds to the smaller value of x_A and x_B .
- Transmission configuration indication – 0 bit if higher layer parameter *tci-PresentInDCI-ForDCIFormat1_2* is not enabled; otherwise 3 bits as defined in Subclause 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-ForDCIFormat1_2* is not enabled for the CORESET used for the PDCCH carrying the DCI format 1_2,
 - the UE assumes *tci-PresentInDCI-ForDCIFormat1_2* is not enabled for all CORESETs in the indicated bandwidth part;
 - otherwise,
 - the UE assumes *tci-PresentInDCI-ForDCIFormat1_2* is enabled for all CORESETs in the indicated bandwidth part.
- SRS request – 0, 2 or 3 bits
- DMRS sequence initialization – 0 or 1 bit
 - 0 bit if the higher layer parameter *DMRSsequenceinitialization-ForDCIFormat1_2* is not configured;
 - 1 bit otherwise.

Commented [Huawei14]: Editor's note: Further update may be needed depending on the relationship between DCI formats and HARQ-ACK codebook with different priorities

Commented [Huawei15]: Editor's note: Further updated may be needed depending on further clarification/agreements on the description and value of range for the RRC parameter "*dl-DataToUL-ACK-ForDCIFormat1_2*".

Commented [Huawei16]: Editor's note: Further updated may be needed depending whether other values will also be supported

Commented [Huawei17]: Editor's note: Further updated based on further agreements on the details of configuration

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.

Table 7.3.1.2.3-1: Redundancy version

Value of the Redundancy version field	Value of rv_{id} to be applied
0	0
1	3

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 Subclause x.x 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-PayloadSize-forCI* up to x bits, according to Subclause 11.x of [5, TS 38.213]. The number of bits for each cancellation indication is configurable by higher layer parameter *CI-PayloadSize*.

Commented [Huawei218]: Editor Notes: It is assumed that the UE behaviour of cancelling PUSCH/SRS and not cancelling PUCCH will be described in other specs. If not, this part in 212 will need to be revised.