**3GPP TSG-RAN WG1 Meeting #106b-e *R1-210xxxx***

**Electronic Meeting, October 11th – 19th, 2021**

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| *CR-Form-v12.1* | | | | | | | | |
| **DRAFT CHANGE REQUEST** | | | | | | | | |
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|  | **38.214** | **CR** | **<CR#>** | **rev** | **-** | **Current version:** | **16.7.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

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| ***Title:*** | Introduction of NR Multicast and Broadcast Services | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Nokia | | | | | | | | | |
| ***Source to TSG:*** |  | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_MBS-Core | | | | |  | ***Date:*** | | | 2021-11-01 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Introduction of NR Multicast and Broadcast Services | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | In section 5.1, defined multiplexing rules for PDSCH scrambled with C-RNTI and G-RNTI  In section 5.1.2.1, introduced slot-level repetition for GC-PDSCH scrambled with G-RNTI and SPS GC-PDSCH scrambled with G-CS-RNTI  In section 5.1.2.2.1, introduced the DL resource allocation type 0 for G-RNTI or G-CS-RNTI  In section 5.1.2.2.3, introduced the downlink resource allocation type 1 for multicast  In section 5.1.2.3, RBG and PRG for multicast GC-PDSCH in CFR are defined using the same procedure as for unicast PDSCH in DL BWP.  In section 5.1.3.1, defined the modulation order and target code rate determination for G-RNTI.  In section 5.1.3.2, defined the transport block size determination for G-RNTI. | | | | | | | | |
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| ***Consequences if not approved:*** | | Incomplete support of NR Multicast and Broadcast Services | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 5.1, 5.1.2.1, 5.1.2.1.1, 5.1.2.2.1, 5.1.2.2.3 (new), 5.1.2.3, 5.1.3.1, 5.1.3.2 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

<omitted text>

# 5 Physical downlink shared channel related procedures

## 5.1 UE procedure for receiving the physical downlink shared channel

For downlink, a maximum of 16 HARQ processes per cell is supported by the UE. The number of processes the UE may assume will at most be used for the downlink is configured to the UE for each cell separately by higher layer parameter *nrofHARQ-ProcessesForPDSCH*, and when no configuration is provided the UE may assume a default number of 8 processes.

A UE shall upon detection of a PDCCH with a configured DCI format 1\_0, 1\_1 or 1\_2 decode the corresponding PDSCHs as indicated by that DCI. A UE shall upon detection of a PDCCH scrambled with G-RNTI or GS-RNTI decode the corresponding PDSCHs scrambled with G-RNTI or GS-RNTI for broadcast and multicast reception. For any HARQ process ID(s) in a given scheduled cell, the UE is not expected to receive a PDSCH that overlaps in time with another PDSCH. The UE is not expected to receive another PDSCH for a given HARQ process until after the end of the expected transmission of HARQ-ACK for that HARQ process, where the timing is given by Clause 9.2.3 of [6]. Except for the case when a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *coresetPoolIndex* in *ControlResourceSet* and PDCCHs that schedule two PDSCHs are associated to different *ControlResourceSets* having different values of *coresetPoolIndex,* in a given scheduled cell, the UE is not expected to receive a first PDSCH and a second PDSCH, starting later than the first PDSCH, with its corresponding HARQ-ACK assigned to be transmitted on a resource ending before the start of a different resource for the HARQ-ACK assigned to be transmitted for the first PDSCH, where the two resources are in different slots for the associated HARQ-ACK transmissions, each slot is composed of symbols [4] or a number of symbols indicated by *subslotLengthForPUCCH* if provided, and the HARQ-ACK for the two PDSCHs are associated with the HARQ-ACK codebook of the same priority. Except for the case when a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *coresetPoolIndex* in *ControlResourceSet* and PDCCHs that schedule two PDSCHs are associated to different *ControlResourceSets* having different values of *coresetPoolIndex,* in a given scheduled cell, the UE is not expected to receive a first PDSCH, and a second PDSCH, starting later than the first PDSCH, with its corresponding HARQ-ACK assigned to be transmitted on a resource ending before the start of a different resource for the HARQ-ACK assigned to be transmitted for the first PDSCH if the HARQ-ACK for the two PDSCHs are associated with HARQ-ACK codebooks of different priorities. For any two HARQ process IDs in a given scheduled cell, if the UE is scheduled to start receiving a first PDSCH starting in symbol *j* by a PDCCH ending in symbol *i*, the UE is not expected to be scheduled to receive a PDSCH starting earlier than the end of the first PDSCH with a PDCCH that ends later than symbol *i*. In a given scheduled cell, for any PDSCH corresponding to SI-RNTI, the UE is not expected to decode a re-transmission of an earlier PDSCH with a starting symbol less than *N* symbols after the last symbol of that PDSCH, where the value of *N* depends on the PDSCH subcarrier spacing configuration *m,* with *N*=13 for *m*=0, *N*=13 for *m*=1, *N*=20 for *m*=2, and *N*=24 for *m*=3.

When receiving PDSCH scheduled with SI-RNTI, P-RNTI, G-RNTI or MCCH-RNTI, the UE may assume that the DM-RS port of PDSCH is quasi co-located with the associated SS/PBCH block with respect to Doppler shift, Doppler spread, average delay, delay spread, spatial RX parameters when applicable.

When receiving PDSCH scheduled with RA-RNTI, or MSGB-RNTI, the UE may assume that the DM-RS port of PDSCH is quasi co-located with the SS/PBCH block or the CSI-RS resource the UE used for RACH association as applicable, and transmission with respect to Doppler shift, Doppler spread, average delay, delay spread, spatial RX parameters when applicable. When receiving a PDSCH scheduled with RA-RNTI in response to a random access procedure triggered by a PDCCH order which triggers contention-free random access procedure for the SpCell [10, TS 38.321], the UE may assume that the DM-RS port of the received PDCCH order and the DM-RS ports of the corresponding PDSCH scheduled with RA-RNTI are quasi co-located with the same SS/PBCH block or CSI-RS with respect to Doppler shift, Doppler spread, average delay, delay spread, spatial RX parameters when applicable.

When receiving PDSCH in response to a PUSCH transmission scheduled by a RAR UL grant or corresponding PUSCH retransmission, or when receiving PDSCH in response to a PUSCH for Type-2 random access procedure, or a PUSCH scheduled by a fallbackRAR UL grant or corresponding PUSCH retransmission, the UE may assume that the DM-RS port of PDSCH is quasi co-located with the SS/PBCH block the UE selected for RACH association and transmission with respect to Doppler shift, Doppler spread, average delay, delay spread, spatial RX parameters when applicable.

If the UE is not configured for PUSCH/PUCCH transmission for at least one serving cell configured with slot formats comprised of DL and UL symbols, and if the UE is not capable of simultaneous reception and transmission on serving cell *c1*and serving cell *c2*, the UE is not expected to receive PDSCH on serving cell *c1* if the PDSCH overlaps in time with SRS transmission (including any interruption due to uplink or downlink RF retuning time [10]) on serving cell *c2* not configured for PUSCH/PUCCH transmission.

The UE is not expected to decode a PDSCH in a serving cell scheduled by a PDCCH with C-RNTI, CS-RNTI or MCS-C-RNTI and one or multiple PDSCH(s) required to be received according to this Clause in the same serving cell without a corresponding PDCCH transmission if the PDSCHs partially or fully overlap in time except if the PDCCH scheduling the PDSCH ends at least 14 symbols before the earliest starting symbol of the PDSCH(s) without the corresponding PDCCH transmission, where the symbol duration is based on the smallest numerology between the scheduling PDCCH and the PDSCH, in which case the UE shall decode the PDSCH scheduled by the PDCCH.

The UE is not expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI if another PDSCH in the same cell scheduled with RA-RNTI or MSGB-RNTI partially or fully overlap in time.

The UE in RRC\_IDLE and RRC\_INACTIVE modes shall be able to decode two PDSCHs each scheduled with SI-RNTI, P-RNTI, RA-RNTI or TC-RNTI, with the two PDSCHs partially or fully overlapping in time in non-overlapping PRBs.

On a frequency range 1 cell, the UE shall be able to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI and, during a process of P-RNTI triggered SI acquisition, another PDSCH scheduled with SI-RNTI that partially or fully overlap in time in non-overlapping PRBs, unless the PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI requires Capability 2 processing time according to clause 5.3 in which case the UE may skip decoding of the scheduled PDSCH with C-RNTI, MCS-C-RNTI, or CS-RNTI.

On a frequency range 2 cell, the UE is not expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI if in the same cell, during a process of P-RNTI triggered SI acquisition, another PDSCH scheduled with SI-RNTI partially or fully overlap in time.

The UE is expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI during a process of autonomous SI acquisition.

The maximum number of PDSCHs scheduled per slot per component carrier with C-RNTI and G-RNTI that the UE shall be able to decode is the same as the indicated UE capability for the number of unicast PDSCHs per slot per component carrier. [If the UE is capable of receiving more than one unicast PDSCH per slot per carrier], the UE shall be able to decode a PDSCH scheduled with C-RNTI and a PDSCH scheduled with G-RNTI that partially or fully overlap in time in non-overlapping PRBs

If the UE is configured by higher layers to decode a PDCCH with its CRC scrambled by a CS-RNTI or G-CS-RNTI, the UE shall receive PDSCH transmissions without corresponding PDCCH transmissions using the higher-layer-provided PDSCH configuration for those PDSCHs.

If a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *coresetPoolIndex* in *ControlResourceSet*, the UE may expect to receive multiple PDCCHs scheduling fully/partially/non-overlapped PDSCHs in time and frequency domain. The UE may expect the reception of full/partially-overlapped PDSCHs in time, only when PDCCHs that schedule two PDSCHs are associated to different *ControlResourceSets* having different values of *coresetPoolIndex*. For a *ControlResourceSet* without *coresetPoolIndex*, the UE may assume that the *ControlResourceSet* is assigned with *coresetPoolIndex* as 0. When the UE is scheduled with full/partially/non-overlapped PDSCHs in time and frequency domain, the full scheduling information for receiving a PDSCH is indicated and carried only by the corresponding PDCCH, the UE is expected to be scheduled with the same active BWP and the same SCS. When the UE is scheduled with full/partially-overlapped PDSCHs in time and frequency domain, the UE can be scheduled with at most two codewords simultaneously. When PDCCHs that schedule two PDSCHs are associated to different *ControlResourceSets* having different values of *coresetPoolIndex,* the following operations are allowed:

- For any two HARQ process IDs in a given scheduled cell, if the UE is scheduled to start receiving a first PDSCH starting in symbol *j* by a PDCCH associated with a value of *coresetPoolIndex* ending in symbol *i*, the UE can be scheduled to receive a PDSCH starting earlier than the end of the first PDSCH with a PDCCH associated with a different value of *coresetPoolIndex* that ends later than symbol *i*.

- In a given scheduled cell, the UE can receive a first PDSCH in slot *i*, with the corresponding HARQ-ACK assigned to be transmitted in slot *j*, and a second PDSCH associated with a value of *coresetPoolIndex* different from that of the first PDSCH starting later than the first PDSCH with its corresponding HARQ-ACK assigned to be transmitted in a slot before slot *j*.

If PDCCHs that schedule corresponding PDSCHs are associated to the same or different *ControlResourceSets* having the same value of *coresetPoolIndex*, the UE procedure for receiving the PDSCH upon detection of a PDCCH follows Clause 5.1.

A UE does not expect to be configured with *repetitionScheme* if the UE is configured with higher layer parameter *repetitionNumber* for the same PDSCH*.*

When a UE is configured by higher layer parameter *repetitionScheme* set to one of 'fdmSchemeA*'*, 'fdmSchemeB*'*, 'tdmSchemeA*'*, if the UE is indicated with two TCI states in a codepoint of the DCI field *'Transmission Configuration Indication'* and DM-RS port(s) within one CDM group in the DCI field '*Antenna Port(s)'*.

- When two TCI states are indicated in a DCI and the UE is set to 'fdmSchemeA*',* the UE shall receive a single PDSCH transmission occasion of the TB with each TCI state associated to a non-overlapping frequency domain resource allocation as described in Clause 5.1.2.3.

- When two TCI states are indicated in a DCI and the UE is set to 'fdmSchemeB*'*, the UE shall receive two PDSCH transmission occasions of the same TB with each TCI state associated to a PDSCH transmission occasion which has non-overlapping frequency domain resource allocation with respect to the other PDSCH transmission occasion as described in Clause 5.1.2.3.

- When two TCI states are indicated in a DCI and the UE is set to 'tdmSchemeA*'*, the UE shall receive two PDSCH transmission occasions of the same TB with each TCI state associated to a PDSCH transmission occasion which has non-overlapping time domain resource allocation with respect to the other PDSCH transmission occasion and both PDSCH transmission occasions shall be received within a given slot as described in Clause 5.1.2.1.

When a UE is configured by the higher layer parameter *repetitionNumber* in *PDSCH-TimeDomainResourceAllocation*, the UE may expect to be indicated with one or two TCI states in a codepoint of the DCI field *'Transmission Configuration Indication'* together with the DCI field '*Time domain resource assignment*' indicating an entry which contains *repetitionNumber* in *PDSCH-TimeDomainResourceAllocation* and DM-RS port(s) within one CDM group in the DCI field '*Antenna Port(s)'*.

- When two TCI states are indicated in a DCI with '*Transmission Configuration Indication*' field, the UE may expect to receive multiple slot level PDSCH transmission occasions of the same TB with two TCI states used across multiple PDSCH transmission occasions in the *repetitionNumber* consecutive slots as defined in Clause 5.1.2.1.

- When one TCI state is indicated in a DCI with '*Transmission Configuration Indication*' field, the UE may expect to receive multiple slot level PDSCH transmission occasions of the same TB with one TCI state used across multiple PDSCH transmission occasions in the *repetitionNumber* consecutive slots as defined in Clause 5.1.2.1.

When a UE is not indicated with a DCI that DCI field '*Time domain resource assignment*' indicating an entry which contains *repetitionNumber* in *PDSCH-TimeDomainResourceAllocation*, and it is indicated with two TCI states in a codepoint of the DCI field *'Transmission Configuration Indication'* and DM-RS port(s) within two CDM groups in the DCI field '*Antenna Port(s)'*, the UE may expect to receive a single PDSCH where the association between the DM-RS ports and the TCI states are as defined in Clause 5.1.6.2.

When a UE is not indicated with a DCI that DCI field '*Time domain resource assignment*' indicating an entry which contains *repetitionNumber* in *PDSCH-TimeDomainResourceAllocation*, and it is indicated with one TCI states in a codepoint of the DCI field *'Transmission Configuration Indication',* the UE procedure for receiving the PDSCH upon detection of a PDCCH follows Clause 5.1.

If more than one PDSCH on a serving cell each without a corresponding PDCCH transmission are in a slot, after resolving overlapping with symbols in the slot indicated as uplink by *tdd-UL-DL-ConfigurationCommon*, or by *tdd-UL-DL-ConfigurationDedicated*, a UE receives one or more PDSCHs without corresponding PDCCH transmissions in the slot as specified below.

‒ Step 0: set *j=0*, where *j* is thenumber of selected PDSCH(s) for decoding. *Q* is the set of activated PDSCHs without corresponding PDCCH transmissions within the slot

‒ Step 1: A UE receives one PDSCH with the lowest configured *sps-ConfigIndex* within *Q*, set *j=j+1*. Designate the received PDSCH as survivor PDSCH.

‒ Step 2: The survivor PDSCH in step 1 and any other PDSCH(s) overlapping (even partially) with the survivor PDSCH in step 1 are excluded from *Q*.

‒ Step 3: Repeat step 1 and 2 until *Q* is empty or *j* is equal to the number of unicast/multicast PDSCHs in a slot supported by the UE

<omitted text>

### 5.1.2 Resource allocation

#### 5.1.2.1 Resource allocation in time domain

When the UE is scheduled to receive PDSCH by a DCI, the *Time domain resource assignment* field value *m* of the DCI provides a row index *m* + 1 to an allocation table. The determination of the used resource allocation table is defined in Clause 5.1.2.1.1. The indexed row defines the slot offset *K0*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, and the PDSCH mapping type to be assumed in the PDSCH reception.

Given the parameter values of the indexed row:

- The slot allocated for the PDSCH is *Ks*, where , if UE is configured with ca-SlotOffset for at least one of the scheduled and scheduling cell, and *Ks* = , otherwise, and where *n* is the slot with the scheduling DCI, and *K0* is based on the numerology of PDSCH, and  and are the subcarrier spacing configurations for PDSCH and PDCCH, respectively, and

- and are the and the, respectively, which are determined by higher-layer configured ca-SlotOffset, for the cell receiving the PDCCH respectively, and are the and the, respectively, which are determined by higher-layer configured ca-SlotOffset for the cell receiving the PDSCH, as defined in clause 4.5 of [4, TS 38.211].

- The reference point *S0* for starting symbol *S* is defined as:

- if configured with *referenceOfSLIVDCI-1-2*, and when receiving PDSCH scheduled by DCI format 1\_2 with CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI with *K0=0*, and PDSCH mapping Type B, the starting symbol *S* is relative to the starting symbol *S0* of the PDCCH monitoring occasion where DCI format 1\_2 is detected;

- otherwise, the starting symbol *S* is relative to the start of the slot using *S0=0.*

- The number of consecutive symbols *L* counting from the starting symbol *S* allocated for the PDSCH are determined from the start and length indicator *SLIV*:

if  then



else



where, and

- the PDSCH mapping type is set to Type A or Type B as defined in Clause 7.4.1.1.2 of [4, TS 38.211].

The UE shall consider the *S* and *L* combinations defined in table 5.1.2.1-1 satisfying  for normal cyclic prefix and  for extended cyclic prefix as valid PDSCH allocations:

Table 5.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PDSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A | {0,1,2,3}  (Note 1) | {3,…,14} | {3,…,14} | {0,1,2,3}  (Note 1) | {3,…,12} | {3,…,12} |
| Type B | {0,…,12} | {2,…,13} | {2,…,14} | {0,…,10} | {2,4,6} | {2,…,12} |
| Note 1: S = 3 is applicable only if *dmrs-TypeA-Position* = 3 | | | | | | |

When receiving PDSCH scheduled by DCI format 1\_1 or 1\_2 in PDCCH with CRC scrambled by C-RNTI, MCS-C-RNTI, or CS-RNTI with NDI=1, if the UE is configured with *pdsch-AggregationFactor* in *pdsch-config*, the same symbol allocation is applied across the *pdsch-AggregationFactor* consecutive slots. When receiving PDSCH scheduled by DCI format 1\_1 or 1\_2 in PDCCH with CRC scrambled by CS-RNTI with NDI=0, or PDSCH scheduled without corresponding PDCCH transmission using *sps-Config* and activated by DCI format 1\_1 or 1\_2, the same symbol allocation is applied across the *pdsch-AggregationFactor*, in *sps-Config* if configured, or across the *pdsch-AggregationFactor* in *pdsch-config* otherwise, consecutive slots. The UE may expect that the TB is repeated within each symbol allocation among each of the *pdsch-AggregationFactor* consecutive slots and the PDSCH is limited to a single transmission layer. For PDSCH scheduled by DCI format 1\_1 or 1\_2 in PDCCH with CRC scrambled by CS-RNTI with NDI=0, or PDSCH scheduled without corresponding PDCCH transmission using *sps-Config* and activated by DCI format 1\_1 or 1\_2, the UE is not expected to be configured with the time duration for the reception of *pdsch-AggregationFactor* repetitions, in *sps-Config* if configured, or across the *pdsch-AggregationFactor* in *pdsch-config* otherwise, larger than the time duration derived by the periodicity P obtained from the corresponding *sps-Config*. The redundancy version to be applied on the *n*th transmission occasion of the TB, where *n* = 0, 1, …*pdsch-AggregationFactor* -1, is determined according to table 5.1.2.1-2 and "*rvid* indicated by the DCI scheduling the PDSCH" in table 5.1.2.1-2 is assumed to be 0 for PDSCH scheduled without corresponding PDCCH transmission using *sps-Config* and activated by DCI format 1\_1 or 1\_2.

When receiving PDSCH scheduled by DCI format 1\_1 in PDCCH with CRC scrambled by G-RNTI with NDI=1, if the UE is configured with *pdsch-AggregationFactor* in the *pdsch-Config-Multicast* associated withthe corresponding G-RNTI, the same symbol allocation is applied across the *pdsch-AggregationFactor* consecutive slots. When receiving PDSCH scheduled without corresponding PDCCH transmission using associated [*SPS-Config-Multicast*] and activated by the DCI format 1\_1 in PDCCH with CRC scrambled by G-CS-RNTI, the same symbol allocation is applied across the *pdsch-AggregationFactor*, in associated [*SPS-Config-Multicast*] if configured, or 1 otherwise, consecutive slots.

When receiving PDSCH scheduled by DCI in PDCCH with CRC scrambled by G-RNTI, if the DCI field 'Time domain resource assignment' indicates an entry which contains *repetitionNumber* in *PDSCH-TimeDomainResourceAllocation*,the same SLIV is applied for all PDSCH transmission occasions across the *repetitionNumber* consecutive slots. When receiving PDSCH scheduled without corresponding PDCCH transmission using associated [*SPS-Config-Multicast*] and activated by DCI in PDCCH with CRC scrambled by G-CS-RNTI, if the DCI field 'Time domain resource assignment' of the activating DCI indicates an entry which contains *repetitionNumber* in *PDSCH-TimeDomainResourceAllocation*,the same SLIV is applied for all PDSCH transmission occasions across the *repetitionNumber* consecutive slots.

If a UE is configured with higher layer parameter *repetitionNumber* or if the UE is configured by *repetitionScheme* set to one of 'fdmSchemeA', 'fdmSchemeB' and 'tdmSchemeA', the UE does not expect to be configured with *pdsch-AggregationFactor.*

Table 5.1.2.1-2: Applied redundancy version when *pdsch-AggregationFactor* is present

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PDSCH | *rvid* to be applied to *n*th transmission occasion | | | |
| *n* mod 4 = 0 | *n* mod 4 = 1 | *n* mod 4 = 2 | *n* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

A PDSCH reception in a slot of a multi-slot PDSCH reception is omitted according to the conditions in Clause 11.1 of [6, TS38.213].

The UE is not expected to receive a PDSCH with mapping type A in a slot, if the PDCCH scheduling the PDSCH was received in the same slot and was not contained within the first three symbols of the slot.

The UE is not expected to receive a PDSCH with mapping type B in a slot, if the first symbol of the PDCCH scheduling the PDSCH was received in a later symbol than the first symbol indicated in the PDSCH time domain resource allocation.

When the UE is configured with *minimumSchedulingOffsetK0* in an active DL BWP it applies a minimum scheduling offset restriction indicated by the 'Minimum applicable scheduling offset indicator'field in DCI format 1\_1 or DCI format 0\_1 if the same field is available. When the UE is configured with *minimumSchedulingOffsetK0* in an active DL BWP and it has not received 'Minimum applicable scheduling offset indicator' field in DCI format 0\_1 or 1\_1, the UE shall apply a minimum scheduling offset restriction indicated based on 'Minimum applicable scheduling offset indicator' value '0'. When the minimum scheduling offset restriction is applied the UE is not expected to be scheduled with a DCI in slot *n* to receive a PDSCH scheduled with C-RNTI, CS-RNTI or MCS-C-RNTI with *K*0 smaller than , where *K*0minand are the applied minimum scheduling offset restriction and the numerology of the active DL BWP of the scheduled cell when receiving the DCI in slot *n,* respectively, and is the numerology of the new active DL BWP in case of active DL BWP change in the scheduled cell and is equal to , otherwise. The minimum scheduling offset restriction is not applied when PDSCH transmission is scheduled with C-RNTI, CS-RNTI or MCS-C-RNTI in common search space associated with CORESET0 and default PDSCH time domain resource allocation is used, in the search space set provided by *recoverySearchSpaceId* when monitoring PDCCH as described in [6, TS 38.213] or when PDSCH transmission is scheduled with SI-RNTI, MSGB-RNTI or RA-RNTI. The application delay of the change of the minimum scheduling offset restriction is determined in Clause 5.3.1.

The UE is not expected to be configured with *referenceOfSLIVDCI-1-2* for serving cells configured for cross-carrier scheduling with a scheduling cell of a different downlink SCS configuration.

When a UE is configured by the higher layer parameter *repetitionScheme* set to 'tdmSchemeA*'* and indicated DM-RS port(s) within one CDM group in the DCI field '*Antenna Port(s)'*, the number of PDSCH transmission occasions is derived by the number of TCI states indicated by the DCI field *'Transmission Configuration Indication'* of the scheduling DCI*.*

- If two TCI states are indicated by the DCI field '*Transmission Configuration Indication*', the UE is expected to receive two PDSCH transmission occasions, where the first TCI state is applied to the first PDSCH transmission occasion and resource allocation in time domain for the first PDSCH transmission occasion follows Clause 5.1.2.1. The second TCI state is applied to the second PDSCH transmission occasion, and the second PDSCH transmission occasion shall have the same number of symbols as the first PDSCH transmission occasion. If the UE is configured by the higher layers with a value in *StartingSymbolOffsetK*, it shall determine that the first symbol of the second PDSCH transmission occasion starts after symbols from the last symbol of the first PDSCH transmission occasion. If the value is not configured via the higher layer parameter *StartingSymbolOffsetK*, = 0 shall be assumed by the UE. The UE is not expected to receive more than two PDSCH transmission layers for each PDSCH transmission occasion. For two PDSCH transmission occasions, the redundancy version to be applied is derived according to Table 5.1.2.1-2, where applied respectively to the first and second TCI state. The UE expects the PDSCH mapping type indicated by DCI field '*Time domain resource assignment*' to be mapping type B, and the indicated PDSCH mapping type is applied to both PDSCH transmission occasions.

- Otherwise, the UE is expected to receive a single PDSCH transmission occasion, and the resource allocation in the time domain follows Clause 5.1.2.1.

When a UE configured by the higher layer parameter *PDSCH-config* that indicates at least one entry contains*repetitionNumber* in *PDSCH-TimeDomainResourceAllocation*,

- If two TCI states are indicated by the DCI field 'Transmission Configuration Indication' together with the DCI field 'Time domain resource assignment' indicating an entry which contains *repetitionNumber* in *PDSCH-TimeDomainResourceAllocation* and DM-RS port(s) within one CDM group in the DCI field 'Antenna Port(s)', the same SLIV is applied for all PDSCH transmission occasions across the *repetitionNumber* consecutive slots, the first TCI state is applied to the first PDSCH transmission occasion and resource allocation in time domain for the first PDSCH transmission occasion follows Clause 5.1.2.1.

When the value indicated by *repetitionNumber* in *PDSCH-TimeDomainResourceAllocation* equals to two, the second TCI state is applied to the second PDSCH transmission occasion. When the value indicated by *repetitionNumber* in *PDSCH-TimeDomainResourceAllocation* is larger than two, the UE may be further configured to enable *cyclicMapping* or *sequenticalMapping* in *tciMapping*.

- When *cyclicMapping* is enabled, the first and second TCI states are applied to the first and second PDSCH transmission occasions, respectively, and the same TCI mapping pattern continues to the remaining PDSCH transmission occasions.

- When *sequenticalMapping* is enabled, first TCI state is applied to the first and second PDSCH transmission occasions, and the second TCI state is applied to the third and fourth PDSCH transmission occasions, and the same TCI mapping pattern continues to the remaining PDSCH transmission occasions.

The UE may expect that each PDSCH transmission occasion is limited to two transmission layers. For all PDSCH transmission occasions associated with the first TCI state, the redundancy version to be applied is derived according to Table 5.1.2.1-2, where is counted only considering PDSCH transmission occasions associated with the first TCI state. The redundancy version for PDSCH transmission occasions associated with the second TCI state is derived according to Table 5.1.2.1-3, where additional shifting operation for each redundancy version is configured by higher layer parameter *sequenceOffsetforRV* and is counted only considering PDSCH transmission occasions associated with the second TCI state.

Table 5.1.2.1-3: Applied redundancy version for the second TCI state when *sequenceOffsetforRV* is present

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PDSCH | *rvid* to be applied to *n*th transmission occasion with second TCI state | | | |
| *n* mod 4 = 0 | *n* mod 4 = 1 | *n* mod 4 = 2 | *n* mod 4 = 3 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

- If one TCI state is indicated by the DCI field 'Transmission Configuration Indication' together with the DCI field 'Time domain resource assignment' indicating an entry which contains *repetitionNumber* in *PDSCH-TimeDomainResourceAllocation* and DM-RS port(s) within one CDM group in the DCI field 'Antenna Port(s)', the same SLIV is applied for all PDSCH transmission occasions across the *repetitionNumber* consecutive slots, the first PDSCH transmission occasion follows Clause 5.1.2.1, the same TCI state is applied to all PDSCH transmission occasions. The UE may expect that each PDSCH transmission occasion is limited to two transmission layers. For all PDSCH transmission occasions, the redundancy version to be applied is derived according to Table 5.1.2.1-2, where is counted considering PDSCH transmission occasions.

- Otherwise, the UE is expected to receive a single PDSCH transmission occasion, and the resource allocation in the time domain follows Clause 5.1.2.1.

<omitted text>

##### 5.1.2.1.1 Determination of the resource allocation table to be used for PDSCH

Table 5.1.2.1.1-1 and Table 5.1.2.1.1-1A define which PDSCH time domain resource allocation configuration to apply. Either a default PDSCH time domain allocation A, B or C according to tables 5.1.2.1.1-2, 5.1.2.1.1-3, 5.1.2.1.1-4 and 5.1.2.1.1-5 is applied, or the higher layer configured *pdsch-TimeDomainAllocationList* or *pdsch-TimeDomainAllocationListDCI-1-2* is applied. For operation with shared spectrum channel access, as described in [16, TS 37.213], UE reinterprets *S* and *L* in row 9 of Table 5.1.2.1.1-2 as *S=6* and *L=7*.

Table 5.1.2.1.1-1: Applicable PDSCH time domain resource allocation for DCI formats 1\_0 and 1\_1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| RNTI | PDCCH search space | SS/PBCH block and CORESET multiplexing pattern | *PDSCH-ConfigCommon* includes *pdsch-TimeDomainAllocationList* | *PDSCH-Config* includes *pdsch-TimeDomainAllocationList* | PDSCH time domain resource allocation to apply |
| SI-RNTI | Type0 common | 1 | - | - | Default A for normal CP |
| 2 | - | - | Default B |
| 3 | - | - | Default C |
| SI-RNTI | Type0A common | 1 | No | - | Default A |
| 2 | No | - | Default B |
| 3 | No | - | Default C |
| 1,2,3 | Yes | - | *pdsch-TimeDomainAllocationList provided in PDSCH-ConfigCommon* |
| RA-RNTI, MSGB-RNTI, TC-RNTI | Type1 common | 1, 2, 3 | No | - | Default A |
| 1, 2, 3 | Yes | - | *pdsch-TimeDomainAllocationList* provided in *PDSCH-ConfigCommon* |
| P-RNTI | Type2 common | 1 | No | - | Default A |
| 2 | No | - | Default B |
| 3 | No | - | Default C |
| 1,2,3 | Yes | - | *pdsch-TimeDomainAllocationList provided in PDSCH-ConfigCommon* |
| G-RNTI,  GS-RNTI | Type X common | 1 | No | - | Default A |
| 2 | No | - | Default B |
| 3 | No | - | Default C |
| 1,2,3 | ? | = | *pdsch-TimeDomainAllocationList* provided in *?????* |
| C-RNTI, MCS-C-RNTI, CS-RNTI | Any common search space associated with CORESET 0 | 1, 2, 3 | No | - | Default A |
| 1, 2, 3 | Yes | - | *pdsch-TimeDomainAllocationList* provided in *PDSCH-ConfigCommon* |
| C-RNTI, MCS-C-RNTI, CS-RNTI, G-RNTI, G-CS-RNTI | Any common search space not associated with CORESET 0  UE specific search space | 1,2,3 | No | No | Default A |
| 1,2,3 | Yes | No | *pdsch-TimeDomainAllocationList* provided in *PDSCH-ConfigCommon* (Note 1) |
| 1,2,3 | No/Yes | Yes | *pdsch-TimeDomainAllocationList* provided in *PDSCH-Config* |
| Note 1: For G-RNTI and G-CS-RNTI PDSCH time domain resource allocation should be applied using the parameters provided in *PDSCH-Config-Multicast*, if configured | | | | | |

<omitted text>

##### 5.1.2.2.1 Downlink resource allocation type 0

In downlink resource allocation of type 0, the resource block assignment information includes a bitmap indicating the Resource Block Groups (RBGs) that are allocated to the scheduled UE where a RBG is a set of consecutive virtual resource blocks defined by higher layer parameter *rbg-Size* configured by *PDSCH-Config* and the size of the bandwidth part as defined in Table 5.1.2.2.1-1.

Table 5.1.2.2.1-1: Nominal RBG size *P*

|  |  |  |
| --- | --- | --- |
| Bandwidth Part Size | Configuration 1 | Configuration 2 |
| 1 – 36 | 2 | 4 |
| 37 – 72 | 4 | 8 |
| 73 – 144 | 8 | 16 |
| 145 – 275 | 16 | 16 |

The total number of RBGs () for a downlink bandwidth part *i* of size PRBs is given by , where

- the size of the first RBG is ,

- the size of last RBG is if  and *P* otherwise,

- the size of all other RBGs is *P*.

In downlink resource allocation of type 0 scheduled using a DCI with CRC scrambled by G-RNTI or G-CS-RNTI, the resource block assignment information bitmap is calculated based on the description above with the following changes: the parameter is the starting PRB of the CFR, is the size of the common frequency resource (CFR) and the value of the higher layer parameter *rbg-Size*  is configured by *PDSCH-Config-Multicast*.

The bitmap is of size bits with one bitmap bit per RBG such that each RBG is addressable. The RBGs shall be indexed in the order of increasing frequency and starting at the lowest frequency of the bandwidth part. The order of RBG bitmap is such that RBG 0 to RBG are mapped from MSB to LSB. The RBG is allocated to the UE if the corresponding bit value in the bitmap is 1, the RBG is not allocated to the UE otherwise.

##### 5.1.2.2.2 Downlink resource allocation type 1

In downlink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated non-interleaved or interleaved virtual resource blocks within the active bandwidth part of size  PRBs except for the case when DCI format 1\_0 is decoded in any common search space in which case the size of CORESET 0 shall be used if CORESET 0 is configured for the cell and the size of initial DL bandwidth part shall be used if CORESET 0 is not configured for the cell.

A downlink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting virtual resource block () and a length in terms of contiguously allocated resource blocks. The resource indication value is defined by

if  then



else



where³ 1 and shall not exceed .

When the DCI size for DCI format 1\_0 in USS is derived from the size of DCI format 1\_0 in CSS but applied to an active BWP with size of , a downlink type 1 resource block assignment field consists of a resource indication value (*RIV*) corresponding to a starting resource block and a length in terms of virtually contiguously allocated resource blocks , where  is given by

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

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

The resource indication value is defined by:

if  then



else



where, and where shall not exceed .

If , *K* is the maximum value from set {1, 2, 4, 8} which satisfies ; otherwise *K* = 1.

When the scheduling grant is received with DCI format 1\_2, a downlink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting resource block group *RBGstart*=0, 1, …, *NRBG*-1 and a length in terms of virtually contiguously allocated resource block groups *LRBGs*=1, …, *NRBG*, where the resource block groups are defined as in 5.1.2.2.1 with *P* defined by *resourceAllocationType1GranularityDCI-1-2* if the UE is configured with higher layer parameter *resourceAllocationType1GranularityDCI-1-2*, and *P*=1 otherwise*.* The resource indication value is defined by

if  then



else



where³ 1 and shall not exceed .

##### 5.1.2.2.3 Downlink resource allocation type 1 for multicast

In downlink resource allocation of type 1 scheduled using DCI format 1\_0 with CRC scrambled by G-RNTI or G-CS-RNTI, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated non-interleaved or interleaved virtual resource blocks. Here  indicates the size of CORESET 0 if CORESET 0 is configured for the cell and the size of initial DL bandwidth part shall be used if CORESET 0 is not configured for the cell.

A downlink type 1 resource block assignment field consists of a *RIV* corresponding to a starting resource block in reference to the lowest RB of the CFR and a length in terms of virtually contiguously allocated resource blocks , where  is given by

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

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

The resource indication value is defined by:

if  then



else



where, and where shall not exceed .

If , *K* is the maximum value from set {1, 2, 4, 6, 8, 10, 12} which satisfies ; otherwise *K* = 1.

In downlink resource allocation of type 1 scheduled using DCI format 1\_1 with CRC scrambled by G-RNTI or G-CS-RNTI, the description in clause 5.1.2.2.2 with the following changes:  indicates the lowest RB of the CFR and  is the size of the CFR.

#### 5.1.2.3 Physical resource block (PRB) bundling

The PRB bundling procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 1\_2, by applying the parameters of *prb-BundlingTypeDCI-1-2* instead of *prb-BundlingType* as well as *vrb-ToPRB-InterleaverDCI-1-2* instead of *vrb-ToPRB-Interleaver*.

A UE may assume that precoding granularity is  consecutive resource blocks in the frequency domain.  can be equal to one of the values among {2, 4, wideband}.

If  is determined as "wideband", the UE is not expected to be scheduled with non-contiguous PRBs and the UE may assume that the same precoding is applied to the allocated resource associated with a same TCI state or a same QCL assumption.

If  is determined as one of the values among {2, 4}, Precoding Resource Block Group (PRGs) partitions the bandwidth part *i* with  consecutive PRBs. Actual number of consecutive PRBs in each PRG could be one or more.

The first PRG size is given by  and the last PRG size given by  if , and the last PRG size is if . For PDSCH scheduled by PDCCH with DCI scrambled using G-RNTI or G-CS-RNTI, is the starting PRB of the CFR and is the CFR.

The UE may assume the same precoding is applied for any downlink contiguous allocation of PRBs in a PRG.

For PDSCH carrying SIB1 scheduled by PDCCH with CRC scrambled by SI-RNTI, a PRG is partitioned from the lowest numbered resource block of CORESET 0 if the corresponding PDCCH is associated with CORESET 0 and Type0-PDCCH common search space and is addressed to SI-RNTI; otherwise, a PRG is partitioned from common resource block 0.

If a UE is scheduled a PDSCH with DCI format 1\_0, the UE shall assume that  is equal to 2 PRBs.

When receiving PDSCH scheduled by PDCCH with DCI format 1\_1 with CRC scrambled by C-RNTI, MCS-C-RNTI, or CS-RNTI,  for bandwidth part is equal to 2 PRBs unless configured by the higher layer parameter *prb-BundlingType* given by *PDSCH-Config*.

When receiving PDSCH scheduled by PDCCH with DCI format 1\_1 with CRC scrambled by C-RNTI, MCS-C-RNTI, or CS-RNTI, if the higher layer parameter *prb-BundlingType* is set to 'dynamicBundling', the higher layer parameters *bundleSizeSet1* and *bundleSizeSet2* configure two sets of  values, the first set can take one or two  values among {2, 4, wideband}, and the second set can take one  value among {2, 4, wideband}.

If the PRB *'bundling size indicator'* signalled in DCI format 1\_1 as defined in Clause 7.3.1.2.2 of [5, TS 38.212]

- is set to '0', the UE shall use the  value from the second set of  values when receiving PDSCH scheduled by the same DCI.

- is set to '1' and one value is configured for the first set of  values, the UE shall use this  value when receiving PDSCH scheduled by the same DCI

- is set to '1' and two values are configured for the first set of  values as 'n2-wideband' (corresponding to two  values 2 and wideband) or 'n4-wideband' (corresponding to two  values 4 and wideband), the UE shall use the value when receiving PDSCH scheduled by the same DCI as follows:

- If the scheduled PRBs are contiguous and the size of the scheduled PRBs is larger than ,  is the same as the scheduled bandwidth, otherwise  is set to the remaining configured value of 2 or 4, respectively.

When receiving PDSCH scheduled by PDCCH with DCI format 1\_1 with CRC scrambled by C-RNTI, MCS-C-RNTI, or CS-RNTI, if the higher layer parameter *prb-BundlingType* is set to 'staticBundling', the  value is configured with the single value indicated by the higher layer parameter *bundleSize*.

When a UE is configured with nominal RBG size for bandwidth part *i* according to Clause 5.1.2.2.1, or when a UE is configured with interleaving unit of 2 for VRB to PRB mapping provided by the higher layer parameter *vrb-ToPRB-Interleaver* given by *PDSCH-Config* for bandwidth part *i*, the UE is not expected to be configured with = 4.

For a UE configured by the higher layer parameter *repetitionScheme* set to 'fdmSchemeA*' or* 'fdmSchemeB*', and* when the UE is indicated with two TCI states in a codepoint of the DCI field *'Transmission Configuration Indication'* and DM-RS port(s) within one CDM group in the DCI field '*Antenna Port(s)*',

- If  is determined as "wideband", the first PRBs are assigned to the first TCI state and the remaining PRBs are assigned to the second TCI state, where is the total number of allocated PRBs for the UE.

- If  is determined as one of the values among {2, 4}, even PRGs within the allocated frequency domain resources are assigned to the first TCI state and odd PRGs within the allocated frequency domain resources are assigned to the second TCI state, wherein the PRGs are numbered continuously in increasing order with the first PRG index equal to 0.

- The UE is not expected to receive more than two PDSCH transmission layers for each PDSCH transmission occasion.

For a UE configured by the higher layer parameter *repetitionScheme* set to 'fdmSchemeB*',* andwhen the UE is indicated with two TCI states in a codepoint of the DCI field *'Transmission Configuration Indication'* and DM-RS port(s) within one CDM group in the DCI field '*Antenna Port(s)',* each PDSCH transmission occasion shall follow the Clause 7.3.1 of [4, TS 38.211] with themapping to resource elements determined by the assigned PRBs for corresponding TCI state of the PDSCH transmission occasion, and the UE shall only expect at most two code blocks per PDSCH transmission occasion when a single transmission layer is scheduled and a single code block per PDSCH transmission occasion when two transmission layers are scheduled. For two PDSCH transmission occasions, the redundancy version to be applied is derived according to Table 5.1.2.1-2, where are applied to the first and second TCI state, respectively.

<omitted text>

#### 5.1.3.1 Modulation order and target code rate determination

For the PDSCH scheduled by a PDCCH with DCI format 1\_0, format 1\_1 or format 1\_2 with CRC scrambled by C-RNTI, MCS-C-RNTI, TC-RNTI, CS-RNTI, SI-RNTI, RA-RNTI, MSGB-RNTI, G-RNTI, G-CS-RNTI, MCCH-RNTI or P-RNTI, or for the PDSCH scheduled without corresponding PDCCH transmissions using the higher-layer-provided PDSCH configuration *SPS-Config* or *SPS-Config-Multicast*,

if the higher layer parameter *mcs-TableDCI-1-2* given by *PDSCH-Config* is set to 'qam256', and the PDSCH is scheduled by a PDCCH with DCI format 1\_2 with CRC scrambled by C-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is not configured with MCS-C-RNTI, the higher layer parameter *mcs-TableDCI-1-2* given by *PDSCH-Config* is set to 'qam64LowSE', and the PDSCH is scheduled by a PDCCH with DCI format 1\_2 scrambled by C-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam256', and the PDSCH is scheduled by a PDCCH with DCI format 1\_1 with CRC scrambled by C-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the higher layer parameter *mcs-Table* given by *PDSCH-Config-Multicast* is set to 'qam256', and the PDSCH is scheduled by a PDCCH with DCI format 1\_0 or 1\_1 with CRC scrambled by G-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is not configured with MCS-C-RNTI, the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam64LowSE', and the PDSCH is scheduled by a PDCCH with a DCI format other than DCI format 1\_2 in a UE-specific search space with CRC scrambled by C-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is configured with MCS-C-RNTI, and the PDSCH is scheduled by a PDCCH with CRC scrambled by MCS-C-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is not configured with the higher layer parameter *mcs-Table* given by *SPS-config*, and the higher layer parameter *mcs-TableDCI-1-2* given by *PDSCH-Config* is set to 'qam256',

- if the PDSCH is scheduled by a PDCCH with DCI format 1\_2 with CRC scrambled by CS-RNTI or

- if the PDSCH with SPS activated by DCI format 1\_2 is scheduled without corresponding PDCCH transmission using *SPS-Config*,

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is not configured with the higher layer parameter *mcs-Table* given by *SPS-Config*, and the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam256',

- if the PDSCH is scheduled by a PDCCH with DCI format 1\_1 with CRC scrambled by CS-RNTI or

- if the PDSCH with SPS activated by DCI format 1\_1 is scheduled without corresponding PDCCH transmission using *SPS-Config*,

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is configured with the higher layer parameter *mcs-Table* given by *SPS-Config* set to 'qam64LowSE'

- if the PDSCH is scheduled by a PDCCH with CRC scrambled by CS-RNTI or

- if the PDSCH is scheduled without corresponding PDCCH transmission using *SPS-Config*,

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

else

- the UE shall use *IMCS* and Table 5.1.3.1-1 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

end

<omitted text>

#### 5.1.3.2 Transport block size determination

In case the higher layer parameter *maxNrofCodeWordsScheduledByDCI* indicates that two codeword transmission is enabled, then one of the two transport blocks is disabled by DCI format 1\_1 if *IMCS* = 26 and if *rvid* = 1 for the corresponding transport block. If both transport blocks are enabled, transport block 1 and 2 are mapped to codeword 0 and 1 respectively. If only one transport block is enabled, then the enabled transport block is always mapped to the first codeword.

For the PDSCH assigned by a PDCCH with DCI format 1\_0, format 1\_1 or format 1\_2 with CRC scrambled by C-RNTI, MCS-C-RNTI, TC-RNTI, CS-RNTI, G-RNTI, G-CS-RNTI or SI-RNTI, if Table 5.1.3.1-2 is used and *,* or a table other than Table 5.1.3.1-2 is usedand *,* the UE shall, except if the transport block is disabled in DCI format 1\_1, first determine the TBS as specified below:

1) The UE shall first determine the number of REs (*NRE*) within the slot.

- A UE first determines the number of REs allocated for PDSCH within a PRB () by , where is the number of subcarriers in a physical resource block,  is the number of symbols of the PDSCH allocation within the slot,  is the number of REs for DM-RS per PRB in the scheduled duration including the overhead of the DM-RS CDM groups without data, as indicated by DCI format 1\_1 or format 1\_2 or as described for format 1\_0 in Clause 5.1.6.2, and  is the overhead configured by higher layer parameter *xOverhead* in *PDSCH-ServingCellConfig*. If the *xOverhead* in *PDSCH-ServingCellconfig* is not configured (a value from 6, 12, or 18), the  is set to 0. If the PDSCH is scheduled by PDCCH with a CRC scrambled by SI-RNTI, RA-RNTI, MSGB-RNTI or P-RNTI,  is assumed to be 0. If the PDSCH is scheduled by PDCCH with a CRC scrambled by G-RNTI or G-CS-RNTI or PDSCH without PDCCH is activated by PDCCH with a CRC scrambled by G-CS-RNTI,  is the overhead configured by higher layer parameter *xOverhead-Multicast* in *PDSCH-Config-Multicast*. If the *xOverhead-Multicast* in *PDSCH-Config-Multicast* is not configured, the  is set to 0.

- A UE determines the total number of REs allocated for PDSCH () by , where *nPRB* is the total number of allocated PRBs for the UE. If the PDSCH is scheduled by PDCCH with a CRC scrambled by G-RNTI or G-CS-RNTI, the number of PRBs is determined based on the size of CFR

- A UE determines the total number of REs allocated for PDSCH () by , where *nPRB* is the total number of allocated PRBs for the UE.

2) Unquantized intermediate variable (*Ninfo*) is obtained by .

If 

Use step 3 as the next step of the TBS determination

else

Use step 4 as the next step of the TBS determination

end if

<omitted text>