**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 solutions for NR to support non-terrestrial networks (NTN) |
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| ***Source to WG:*** | Nokia |
| ***Source to TSG:*** |  |
|  |  |
| ***Work item code:*** | NR\_NTN\_solutions-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 canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
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| ***Reason for change:*** | Introduction of solutions for NR to support non-terrestrial networks (NTN) |
|  |  |
| ***Summary of change:*** | In section 5.1, introduced the support for 32 HARQ processes and the procedure for HARQ operation when HARQ feedback is disabled.Iin section 5.2.2.5, K\_offset is introduced for CSI reference resource timingIn sections 6.1.2.1, K\_offset is introduced for the transmission timing of DCI scheduled PUSCH.In section 6.1, introduced the support for 32 HARQ processes.In section 6.2.1, K\_offset is introduced for the transmission timing of aperiodic SRS. |
|  |  |
| ***Consequences if not approved:*** | Incomplete support of solutions for NR to support non-terrestrial networks. |
|  |  |
| ***Clauses affected:*** | 5.1, 5.2.2.5, 5.3, 6.1.2.1, 6.1.2.3, 6.2.1, 6.4 |
|  |  |
|  | **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>

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

For downlink, a maximum of 16 HARQ processes per cell is supported by the UE, or, subject to UE capability, a maximum of 32 HARQ processes per cell. 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. 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. When HARQ feedback for the HARQ process ID is not disabled, 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]. When HARQ feedback for the HARQ process ID is disabled, the UE is not expected to receive another PDCCH carrying a DCI scheduling a PDSCH or set of slot-aggregated PDSCH scheduled for the given HARQ process that starts until Tproc,1 after the end of the reception of the last PDSCH or slot-aggregated PDSCH for that HARQ process. 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 *μ,* with *N*=13 for *μ*=0, *N*=13 for *μ*=1, *N*=20 for *μ*=2, and *N*=24 for *μ*=3.

When receiving PDSCH scheduled with SI-RNTI or P-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.

If the UE is configured by higher layers to decode a PDCCH with its CRC scrambled by a 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.*

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 PDSCHs in a slot supported by the UE

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#### 5.2.2.5 CSI reference resource definition

The CSI reference resource for a serving cell is defined as follows:

- In the frequency domain, the CSI reference resource is defined by the group of downlink physical resource blocks corresponding to the band to which the derived CSI relates.

- In the time domain, the CSI reference resource for a CSI reporting in uplink slot *n'* is defined by a single downlink slot *,* if UE is configured with the higher layer parameter *CellSpecific\_Koffset, n*-*nCSI\_ref*, otherwise,

*-*  is provided with a value of ms for frequency range 1 and is equal to *UESpecific\_Koffset* if *UESpecific\_Koffset* is provided in MAC CE and *CellSpecific\_Koffset* otherwise;

- where  and and  are the subcarrier spacing configurations for DL and UL, respectively, and and  are determined by higher-layer configured *ca-SlotOffset* for the cells transmitting the uplink and downlink, as defined in clause 4.5 of [4, TS 38.211]

- where for periodic and semi-persistent CSI reporting

- if a single CSI-RS/SSB resource is configured for channel measurement *nCSI\_ref* is the smallest value greater than or equal to , such that it corresponds to a valid downlink slot, or

- if multiple CSI-RS/SSB resources are configured for channel measurement *nCSI\_ref* is the smallest value greater than or equal to , such that it corresponds to a valid downlink slot.

- where for aperiodic CSI reporting, if the UE is indicated by the DCI to report CSI in the same slot as the CSI request, *nCSI\_ref* is such that the reference resource is in the same valid downlink slot as the corresponding CSI request, otherwise *nCSI\_ref* is the smallest value greater than or equal to , such that slot *n*- *nCSI\_ref* corresponds to a valid downlink slot, where *Z'* corresponds to the delay requirement as defined in Clause 5.4.

- when periodic or semi-persistent CSI-RS/CSI-IM or SSB is used for channel/interference measurements, the UE is not expected to measure channel/interference on the CSI-RS/CSI-IM/SSB whose last OFDM symbol is received up to *Z'* symbols before transmission time of the first OFDM symbol of the aperiodic CSI reporting.

A slot in a serving cell shall be considered to be a valid downlink slot if:

- it comprises at least one higher layer configured downlink or flexible symbol, and

- it does not fall within a configured measurement gap for that UE

If there is no valid downlink slot for the CSI reference resource corresponding to a CSI Report Setting in a serving cell, CSI reporting is omitted for the serving cell in uplink slot *n'*.

After the CSI report (re)configuration, serving cell activation, BWP change, or activation of SP-CSI, the UE reports a CSI report only after receiving at least one CSI-RS transmission occasion for channel measurement and CSI-RS and/or CSI-IM occasion for interference measurement no later than CSI reference resource and drops the report otherwise.

When DRX is configured, the UE reports a CSI report only if receiving at least one CSI-RS transmission occasion for channel measurement and CSI-RS and/or CSI-IM occasion for interference measurement in DRX Active Time no later than CSI reference resource and drops the report otherwise. When the UE is configured to monitor DCI format 2\_6 and if the UE configured by higher layer parameter *ps-TransmitOtherPeriodicCSI* to report CSI with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to quantities other than 'cri-RSRP' and 'ssb-Index-RSRP' when *drx-onDurationTimer* is not started, the UE shall report CSI during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside active time according to the procedure described in Clause 5.2.1.4 if receiving at least one CSI-RS transmission occasion for channel measurement and CSI-RS and/or CSI-IM occasion for interference measurement during the time duration indicated by drx-onDurationTimer in *DRX-Config* outside DRX active time or in DRX Active Time no later than CSI reference resource and drops the report otherwise. When the UE is configured to monitor DCI format 2\_6 and if the UE configured by higher layer parameter *ps-TransmitPeriodicL1-RSRP* to report L1-RSRP with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to 'cri-RSRP' or 'ssb-Index-RSRP' when *drx-onDurationTimer* is not started, the UE shall report L1-RSRP during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside active time according to the procedure described in clause 5.2.1.4 and when reportQuantity set to 'cri-RSRP' if receiving at least one CSI-RS transmission occasion for channel measurement during the time duration indicated by drx-onDurationTimer in *DRX-Config* outside DRX active time or in DRX Active Time no later than CSI reference resource and drops the report otherwise.

When deriving CSI feedback, the UE is not expected that a NZP CSI -RS resource for channel measurement overlaps with CSI-IM resource for interference measurement or NZP CSI -RS resource for interference measurement.

If configured to report CQI index, in the CSI reference resource, the UE shall assume the following for the purpose of deriving the CQI index, and if also configured, for deriving PMI and RI:

- The first 2 OFDM symbols are occupied by control signaling.

- The number of PDSCH and DM-RS symbols is equal to 12.

- The same bandwidth part subcarrier spacing configured as for the PDSCH reception

- The bandwidth as configured for the corresponding CQI report.

- The reference resource uses the CP length and subcarrier spacing configured for PDSCH reception

- No resource elements used by primary or secondary synchronization signals or PBCH.

- Redundancy Version 0.

- The ratio of PDSCH EPRE to CSI-RS EPRE is as given in Clause 5.2.2.3.1.

- Assume no REs allocated for NZP CSI-RS and ZP CSI-RS.

- Assume the same number of front-loaded DM-RS symbols as the maximum front-loaded symbols configured by the higher layer parameter *maxLength* in *DMRS-DownlinkConfig.*

- Assume the same number of additional DM-RS symbols as the additional symbols configured by the higher layer parameter *dmrs-AdditionalPosition*.

- Assume the PDSCH symbols are not containing DM-RS.

- Assume PRB bundling size of 2 PRBs.

- The PDSCH transmission scheme where the UE may assume that PDSCH transmission would be performed with up to 8 transmission layers as defined in Clause 7.3.1.4 of [4, TS 38.211]. For CQI calculation, the UE should assume that PDSCH signals on antenna ports in the set [1000,…, 1000+ν-1] for ν layers would result in signals equivalent to corresponding symbols transmitted on antenna ports [3000,…, 3000+*P*-1], as given by

 where  is a vector of PDSCH symbols from the layer mapping defined in Clause 7.3.1.4 of [4, TS 38.211],  is the number of CSI-RS ports. If only one CSI-RS port is configured, *W(i)* is 1. If the higher layer parameter *reportQuantity* in *CSI-ReportConfig* for which the CQI is reported is set to either 'cri-RI-PMI-CQI' or 'cri-RI-LI-PMI-CQI', *W(i)* is the precoding matrix corresponding to the reported PMI applicable to *x(i)*. If the higher layer parameter *reportQuantity* in *CSI-ReportConfig* for which the CQI is reported is set to 'cri-RI-CQI', *W(i)* is the precoding matrix corresponding to the procedure described in Clause 5.2.1.4.2. If the higher layer parameter *reportQuantity* in *CSI-ReportConfig* for which the CQI is reported is set to 'cri-RI-i1-CQI', *W(i)* is the precoding matrix corresponding to the reported i1 according to the procedure described in Clause 5.2.1.4.2*.*The corresponding PDSCH signals transmitted on antenna ports [3000,…,3000 + *P* - 1] would have a ratio of EPRE to CSI-RS EPRE equal to the ratio given in Clause 5.2.2.3.1.

<omitted text>

## 5.3 UE PDSCH processing procedure time

If the first uplink symbol of the PUCCH which carries the HARQ-ACK information, as defined by the assigned HARQ-ACK timing *K1* and Koffset, if configured, and the PUCCH resource to be used and including the effect of the timing advance, starts no earlier than at symbol *L1*, where *L1* is defined as the next uplink symbol with its CP starting after  after the end of the last symbol of the PDSCH carrying the TB being acknowledged, then the UE shall provide a valid HARQ-ACK message.

*- N1* is based on *µ* of table 5.3-1 and table 5.3-2 for UE processing capability 1 and 2 respectively, where *µ* corresponds to the one of (*µPDCCH*, *µPDSCH*, *µUL*) resulting with the largest *Tproc,1*, where the *µPDCCH* corresponds to the subcarrier spacing of the PDCCH scheduling the PDSCH, the *µPDSCH* corresponds to the subcarrier spacing of the scheduled PDSCH, and *µUL* corresponds to the subcarrier spacing of the uplink channel with which the HARQ-ACK is to be transmitted, and κ is defined in clause 4.1 of [4, TS 38.211].

*-* For operation with shared spectrum channel access, is calculated according to [4, TS 38.211], otherwise =0.

*-* If the PDSCH DM-RS position for the additional DM-RS in Table 7.4.1.1.2-3 in clause 7.4.1.1.2 of [4, TS 38.211] is then *N1,0=14* inTable 5.3-1*,* otherwise *N1,0=13.*

- If the UE is configured with multiple active component carriers, the first uplink symbol which carries the HARQ-ACK information further includes the effect of timing difference between the component carriers as given in [11, TS 38.133].

- For the PDSCH mapping type A as given in clause 7.4.1.1 of [4, TS 38.211]: if the last symbol of PDSCH is on the *i-*th symbol of the slot where *i* < 7, then *d1,1 = 7 - i*, otherwise *d1,1 = 0*

- If a PUCCH of a larger priority index would overlap with PUCCH/PUSCH of a smaller priority index, *d2* for the PUCCH of a larger priority is set as reported by the UE; otherwise *d2 = 0.*

- For UE processing capability 1: If the PDSCH is mapping type B as given in clause 7.4.1.1 of [4, TS 38.211], and

- if the number of PDSCH symbols allocated is *L* ≥ 7, then *d1,1* = 0,

- if the number of PDSCH symbols allocated is *L* ≥ 4 and *L* ≤ 6, then *d1,1* = 7- *L.*

- if the number of PDSCH symbols allocated is *L* = *3* then *d1,1 = 3 +* min *(d,1)*, where *d* is the number of overlapping symbols of the scheduling PDCCH and the scheduled PDSCH.

- if the number of PDSCH symbols allocated is 2, then *d1,1* = 3*+d*, where *d* is the number of overlapping symbols of the scheduling PDCCH and the scheduled PDSCH.

- For UE processing capability 2: If the PDSCH is mapping type B as given in clause 7.4.1.1 of [4, TS 38.211],

- if the number of PDSCH symbols allocated is *L* ≥ 7, then *d1,1* = 0,

- if the number of PDSCH symbols allocated is *L* ≥ 3 and *L* ≤ 6, then *d1,1* is the number of overlapping symbols of the scheduling PDCCH and the scheduled PDSCH,

- if the number of PDSCH symbols allocated is 2,

- if the scheduling PDCCH was in a 3-symbol CORESET and the CORESET and the PDSCH had the same starting symbol, then *d1,1* = 3,

- otherwise *d1,1* is the number of overlapping symbols of the scheduling PDCCH and the scheduled PDSCH.

- For UE processing capability 2 with scheduling limitation when *µPDSCH* = 1, if the scheduled RB allocation exceeds 136 RBs, the UE defaults to capability 1 processing time. The UE may skip decoding a number of PDSCHs with last symbol within 10 symbols before the start of a PDSCH that is scheduled to follow Capability 2, if any of those PDSCHs are scheduled with more than 136 RBs with 30kHz SCS and following Capability 1 processing time.

- For a UE that supports capability 2 on a given cell, the processing time according to UE processing capability 2 is applied if the high layer parameter *processingType2Enabled* in *PDSCH-ServingCellConfig* is configured for the cell and set to 'enable'.

- If this PUCCH resource is overlapping with another PUCCH or PUSCH resource, then HARQ-ACK is multiplexed following the procedure in clause 9.2.5 of [6, TS 38.213], otherwise the HARQ-ACK message is transmitted on PUCCH.

Otherwise the UE may not provide a valid HARQ-ACK corresponding to the scheduled PDSCH. The value of *Tproc,1* is used both in the case of normal and extended cyclic prefix.

For a PDSCH that consists of two PDSCH transmission occasions in time domain in one slot, *d1,1* is calculated based on the first PDSCH transmission occasion in the slot, and as described above.

Table 5.3-1: PDSCH processing time for PDSCH processing capability 1

|  |  |
| --- | --- |
|  | PDSCH decoding time *N1* [symbols] |
| *dmrs-AdditionalPosition* = 'pos0' in *DMRS-DownlinkConfig* in both of *dmrs-DownlinkForPDSCH-MappingTypeA*, *dmrs-DownlinkForPDSCH-MappingTypeB* | *dmrs-AdditionalPosition* ≠ 'pos0' in *DMRS-DownlinkConfig* in either of *dmrs-DownlinkForPDSCH-MappingTypeA*, *dmrs-DownlinkForPDSCH-MappingTypeB* *or if the higher layer parameter is not configured*  |
| 0 | 8 | *N1,0* |
| 1 | 10 | 13 |
| 2 | 17 | 20 |
| 3 | 20 | 24 |

Table 5.3-2: PDSCH processing time for PDSCH processing capability 2

|  |  |
| --- | --- |
|  | PDSCH decoding time *N1* [symbols] |
| *dmrs-AdditionalPosition* = 'pos0' in *DMRS-DownlinkConfig* in both of *dmrs-DownlinkForPDSCH-MappingTypeA*, *dmrs-DownlinkForPDSCH-MappingTypeB* |
| 0 | 3 |
| 1 | 4.5 |
| 2 | 9 for frequency range 1 |

<omitted text>

# 6 Physical uplink shared channel related procedure

## 6.1 UE procedure for transmitting the physical uplink shared channel

PUSCH transmission(s) can be dynamically scheduled by an UL grant in a DCI, or the transmission can correspond to a configured grant Type 1 or Type 2. The configured grant Type 1 PUSCH transmission is semi-statically configured to operate upon the reception of higher layer parameter of *configuredGrantConfig* including *rrc-ConfiguredUplinkGrant* without the detection of an UL grant in a DCI. The configured grant Type 2 PUSCH transmission is semi-persistently scheduled by an UL grant in a valid activation DCI according to Clause 10.2 of [6, TS 38.213] after the reception of higher layer parameter *configuredGrantConfig* not including *rrc-ConfiguredUplinkGrant*. If *configuredGrantConfigToAddModList* is configured, more than one configured grant configuration of configured grant Type 1 and/or configured grant Type 2 may be active at the same time on an active BWP of a serving cell.

For the PUSCH transmission corresponding to a Type 1 configured grant or a Type 2 configured grant activated by DCI format 0\_0 or 0\_1, the parameters applied for the transmission are provided by *configuredGrantConfig* except for *dataScramblingIdentityPUSCH*, *txConfig*, *codebookSubset*, *maxRank*, *scaling* of *UCI-OnPUSCH,* which are provided by *pusch-Config*. For the PUSCH transmission corresponding to a Type 2 configured grant activated by DCI format 0\_2, the parameters applied for the transmission are provided by *configuredGrantConfig* except for *dataScramblingIdentityPUSCH*, *txConfig*, *codebookSubsetDCI-0-2*, *maxRankForDCI-Format0-2*, *scaling* of *UCI-OnPUSCH*, *resourceAllocationType1GranularityDCI-0-2* provided by *pusch-Config*.If the UE is provided with *transformPrecoder* in *configuredGrantConfig*, the UE applies the higher layer parameter *tp-pi2BPSK*, if provided in *pusch-Config*, according to the procedure described in Clause 6.1.4 for the PUSCH transmission corresponding to a configured grant.

For the PUSCH retransmission scheduled by a PDCCH with CRC scrambled by CS-RNTI with NDI=1, the parameters in *pusch-Config* are applied for the PUSCH transmission except for *p0-NominalWithoutGrant, p0-PUSCH-Alpha, powerControlLoopToUse,* *pathlossReferenceIndex* described in Clause 7.1 of [6, TS 38.213], *mcs-Table, mcs-TableTransformPrecoder* described in Clause 6.1.4.1 and *transformPrecoder* described in Clause 6.1.3.

For a UE configured with two uplinks in a serving cell, PUSCH retransmission for a TB on the serving cell is not expected to be on a different uplink than the uplink used for the PUSCH initial transmission of that TB.

A UE shall upon detection of a PDCCH with a configured DCI format 0\_0, 0\_1 or 0\_2 transmit the corresponding PUSCH as indicated by that DCI unless the UE does not generate a transport block as described in [10, TS38.321]. Upon detection of a DCI format 0\_1 or 0\_2 with '*UL-SCH indicator*' set to '0' and with a non-zero '*CSI request*' where the associated *reportQuantity* in *CSI-ReportConfig* set to '*none*' for all CSI report(s) triggered by '*CSI request*' in this DCI format 0\_1 or 0\_2, the UE ignores all fields in this DCI except the '*CSI request*' and the UE shall not transmit the corresponding PUSCH as indicated by this DCI format 0\_1 or 0\_2. When the UE is scheduled with multiple PUSCHs by a DCI, HARQ process ID indicated by this DCI applies to the first PUSCH, as described in clause 6.1.2.1, HARQ process ID is then incremented by 1 for each subsequent PUSCH(s) in the scheduled order, with modulo 16 operation applied. For any HARQ process ID(s) in a given scheduled cell, the UE is not expected to transmit a PUSCH that overlaps in time with another PUSCH. Except for the case when a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *coresetPoolIndex* in *ControlResourceSet* for the active BWP of a serving cell and PDCCHs that schedule two non-overlapping in time domain PUSCHs are associated to different *ControlResourceSets* having different values of *coresetPoolIndex,* for any two HARQ process IDs in a given scheduled cell, if the UE is scheduled to start a first PUSCH transmission starting in symbol *j* by a PDCCH ending in symbol *i*, the UE is not expected to be scheduled to transmit a PUSCH starting earlier than the end of the first PUSCH by a PDCCH that ends later than symbol *i*. The UE is not expected to be scheduled to transmit another PUSCH by a DCI format 0\_0 with CRC scrambled by TC-RNTI, for a given HARQ process with the DCI received before the end of the expected transmission of the last PUSCH for that HARQ process if the latter is scheduled by a DCI format 0\_0 with CRC scrambled by TC-RNTI or by an UL grant in RA Response. The UE is not expected to be scheduled to transmit another PUSCH by DCI format 0\_0, 0\_1 or 0\_2 scrambled by C-RNTI, CS-RNTI or MCS-C-RNTI for a given HARQ process with the DCI received before the end of the expected transmission of the last PUSCH for that HARQ process if the latter is scheduled by a DCI with CRC scrambled by C-RNTI, CS-RNTI or MCS-C-RNTI.

If a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *coresetPoolIndex* in *ControlResourceSet* for the active BWP of a serving cell and PDCCHs that schedule two non-overlapping in time domain PUSCHs are associated to different *ControlResourceSets* having different values of *coresetPoolIndex,* for any two HARQ process IDs in a given scheduled cell, if the UE is scheduled to start a first PUSCH transmission starting in symbol *j* by a PDCCH associated with a value of *coresetPoolIndex* ending in symbol *i*, the UE can be scheduled to transmit a PUSCH starting earlier than the end of the first PUSCH by a PDCCH associated with a different value of *coresetPoolIndex* that ends later than symbol *i*.

A UE is not expected to be scheduled by a PDCCH ending in symbol to transmit a PUSCH on a given serving cell overlapping in time with a transmission occasion, where the UE is allowed to transmit a PUSCH with configured grant according to [10, TS38.321], starting in a symbol on the same serving cell if the end of symbol is not at least symbols before the beginning of symbol . The value in symbols is determined according to the UE processing capability defined in Clause 6.4, and and the symbol duration are based on the minimum of the subcarrier spacing corresponding to the PUSCH with configured grant and the subcarrier spacing of the PDCCH scheduling the PUSCH.

If a UE receives an ACK for a given HARQ process in CG-DFI in a PDCCH ending in symbol *i* to terminate a transport block repetition in a PUSCH transmission with a configured grant on a given serving cell with the same HARQ process after symbol *i*, the UE is expected to terminate the repetition of the transport block in a PUSCH transmission starting from a symbol *j* if the gap between the end of PDCCH of symbol *i* and the start of the PUSCH transmission in symbol *j* is equal to or more than *N2* symbols. The value *N2* in symbols is determined according to the UE processing capability defined in Clause 6.4, and *N2* and the symbol duration are based on the minimum of the subcarrier spacing corresponding to the PUSCH and the subcarrier spacing of the PDCCH indicating CG-DFI.

A UE is not expected to be scheduled by a PDCCH ending in symbol to transmit a PUSCH on a given serving cell for a given HARQ process, if there is a transmission occasion where the UE is allowed to transmit a PUSCH with configured grant according to [10, TS38.321] with the same HARQ process on the same serving cell starting in a symbol after symbol , and if the gap between the end of PDCCH and the beginning of symbol is less than symbols. The value in symbols is determined according to the UE processing capability defined in Clause 6.4, and and the symbol duration are based on the minimum of the subcarrier spacing corresponding to the PUSCH with configured grant and the subcarrier spacing of the PDCCH scheduling the PUSCH.

For PUSCH scheduled by DCI format 0\_0 on a cell, the UE shall transmit PUSCH according to the spatial relation, if applicable, corresponding to the dedicated PUCCH resource with the lowest ID within the active UL BWP of the cell, as described in Clause 9.2.1 of [6, TS 38.213].

For PUSCH scheduled by DCI format 0\_0 on a cell and if the higher layer parameter *enableDefaultBeamPL-ForPUSCH0-0* is set 'enabled', the UE is not configured with PUCCH resources on the active UL BWP and the UE is in RRC connected mode, the UE shall transmit PUSCH according to the spatial relation, if applicable, with a reference to the RS configured with *qcl-Type* set to 'typeD' corresponding to the QCL assumption of the CORESET with the lowest ID on the active DL BWP of the cell.

For PUSCH scheduled by DCI format 0\_0 on a cell and if the higher layer parameter *enableDefaultBeamPL-ForPUSCH0-0* is set 'enabled', the UE is configured with PUCCH resources on the active UL BWP where all the PUCCH resource(s) are not configured with any spatial relation and the UE is in RRC connected mode, the UE shall transmit PUSCH according to the spatial relation, if applicable, with a reference to the RS configured with *qcl-Type* set to 'typeD' corresponding to the QCL assumption of the CORESET with the lowest ID on the active DL BWP of the cell in case CORESET(s) are configured on the cell.

For uplink, 16 HARQ processes per cell is supported by the UE, or, subject to UE capability, a maximum of 32 HARQ processes per cell.

<omitted text>

### 6.1.2 Resource allocation

#### 6.1.2.1 Resource allocation in time domain

When the UE is scheduled to transmit a transport block and no CSI report, or the UE is scheduled to transmit a transport block and a CSI report(s) on PUSCH by a DCI, the '*Time domain resource assignment'* field value *m* of the DCI provides a row index *m* + 1to an allocated table. The determination of the used resource allocation table is defined in Clause 6.1.2.1.1. The indexed row defines the slot offset *K2*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, the PUSCH mapping type, and the number of repetitions (if *numberOfRepetitions* is present in the resource allocation table) to be applied in the PUSCH transmission.

When the UE is scheduled to transmit a PUSCH with no transport block and with a CSI report(s) by a '*CSI request'* field on a DCI, the '*Time domain resource assignment'* field value *m* of the DCI provides a row index *m* + 1to the allocated table as defined in Clause 6.1.2.1.1. The indexed row defines the start and length indicator SLIV, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission and the *K2* value is determined as , where  are the corresponding list entries of the higher layer parameter

- reportSlotOffsetListDCI-0-2, if PUSCH is scheduled by DCI format 0\_2 and reportSlotOffsetListDCI-0-2 is configured;

- *reportSlotOffsetListDCI-0-1*, if PUSCH is scheduled by DCI format 0\_1 and *reportSlotOffsetListDCI-0-1* is configured;

- *reportSlotOffsetList*, otherwise;

in *CSI-ReportConfig* for the  triggered CSI Reporting Settings and  is the *(m+1)*th entry of .

- The slot *Ks* where the UE shall transmit the PUSCH is determined by *K2* as *Ks* =, if UE is configured with ca-SlotOffset for at least one of the scheduled and scheduling cell, , if the UE is configured with the higher layer parameter *CellSpecific\_Koffset*, *Ks* =, otherwise, and where *n* is the slot with the scheduling DCI, K*2* is based on the numerology of PUSCH,  and  are the subcarrier spacing configurations for PUSCH and PDCCH, respectively, is provided with a value of ms for frequency range 1 and is equal to *UESpecific\_Koffset* if *UESpecific\_Koffset* is provided in MAC CE and *CellSpecific\_Koffset* otherwise.

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

- for PUSCH scheduled by DCI format 0\_1, if *pusch-RepTypeIndicatorDCI-0-1* is set to 'pusch-RepTypeB', the UE applies PUSCH repetition Type B procedure when determining the time domain resource allocation. For PUSCH scheduled by DCI format 0\_2, if *pusch-RepTypeIndicatorDCI-0-2* is set to 'pusch-RepTypeB', the UE applies PUSCH repetition Type B procedure when determining the time domain resource allocation. Otherwise, the UE applies PUSCH repetition Type A procedure when determining the time domain resource allocation for PUSCH scheduled by PDCCH.

- For PUSCH repetition Type A, the starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are determined from the start and length indicator *SLIV* of the indexed row:

if  then



else



where, and

- For PUSCH repetition Type B, the starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are provided by *startSymbol* and *length* of the indexed row of the resource allocation table, respectively.

- For PUSCH repetition Type A, the PUSCH mapping type is set to Type A or Type B as defined in Clause 6.4.1.1.3 of [4, TS 38.211] as given by the indexed row.

- For PUSCH repetition Type B, the PUSCH mapping type is set to Type B.

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

<omitted text>

#### 6.1.2.3 Resource allocation for uplink transmission with configured grant

When PUSCH resource allocation is semi-statically configured by higher layer parameter *configuredGrantConfig* in *BWP-UplinkDedicated* information element, and the PUSCH transmission corresponding to a configured grant, the following higher layer parameters are applied in the transmission:

- For Type 1 PUSCH transmissions with a configured grant, the following parameters are given in *configuredGrantConfig* unless mentioned otherwise:

- For the determination of the PUSCH repetition type, if the higher layer parameter *pusch-RepTypeIndicator* in *rrc-ConfiguredUplinkGrant* is configured and set to 'pusch-RepTypeB', PUSCH repetition type B is applied; otherwise, PUSCH repetition type A is applied;

- For PUSCH repetition type A, the selection of the time domain resource allocation table follows the rules for DCI format 0\_0 on UE specific search space, as defined in Clause 6.1.2.1.1.

- For PUSCH repetition type B, the selection of the time domain resource allocation table is as follows:

- If *pusch-RepTypeIndicatorDCI-0-1* in *pusch-Config* is configured and set to *'*pusch-RepTypeB*'*, *pusch-TimeDomainResourceAllocationListDCI-0-1* in *pusch-Config* is used;

- Otherwise, *pusch-TimeDomainResourceAllocationListDCI-0-2* in *pusch-Config* is used.

- It is not expected that *pusch-RepTypeIndicator* in *rrc-ConfiguredUplinkGrant* is configured with *'*pusch-RepTypeB*'* when none of *pusch-RepTypeIndicatorDCI-0-1* and *pusch-RepTypeIndicatorDCI-0-2* in *pusch-Config* is set to *'*pusch-RepTypeB*'*.

- The higher layer parameter *timeDomainAllocation* value *m* provides a row index *m*+1 pointing to the determined time domain resource allocation table, where the start symbol and length are determined following the procedure defined in Clause 6.1.2.1;

- Frequency domain resource allocation is determined by the *N* LSB bits in the higher layer parameter *frequencyDomainAllocation*, forming a bit sequence , where is the LSB, according to the procedure in Clause 6.1.2.2 and *N* is determined as the size of frequency domain resource assignment field in DCI format 0\_1 for a given resource allocation type indicated by *resourceAllocation,* except if *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated* is configured, in which case uplink type 2 resource allocation is used wherein the UE interprets the LSB bits in the higher layer parameter *frequencyDomainAllocation* as for the frequency domain resource assignment field of DCI 0\_1 according to the procedure in Clause 6.1.2.2.3*;*

- The *IMCS* is provided by higher layer parameter *mcsAndTBS;*

- Number of DM-RS CDM groups, DM-RS ports, SRS resource indication and DM-RS sequence initialization are determined as in Clause 7.3.1.1.2 of [5, TS 38.212], and the antenna port value, the bit value for DM-RS sequence initialization, precoding information and number of layers, SRS resource indicator are provided by *antennaPort, dmrs-SeqInitialization, precodingAndNumberOfLayers*, and *srs-ResourceIndicator* respectively;

- When frequency hopping is enabled, the frequency offset between two frequency hops can be configured by higher layer parameter *frequencyHoppingOffset.*

- For Type 2 PUSCH transmissions with a configured grant: the resource allocation follows the higher layer configuration according to [10, TS 38.321], and UL grant received on the DCI.

- The PUSCH repetition type and the time domain resource allocation table are determined by the PUSCH repetition type and the time domain resource allocation table associated with the UL grant received on the DCI, respectively, as defined in Clause 6.1.2.1. The value of Koffset, if configured, is applied when determining the first transmission opportunity.

For PUSCH transmissions with a Type 1 or Type 2 configured grant, the number of (nominal) repetitions *K* to be applied to the transmitted transport block is provided by the indexed row in the time domain resource allocation table if *numberOfRepetitions* is present in the table; otherwise *K* is provided by the higher layer configured parameters *repK.*

The UE shall not transmit anything on the resources configured by *configuredGrantConfig* if the higher layers did not deliver a transport block to transmit on the resources allocated for uplink transmission without grant.

A set of allowed periodicities *P* are defined in [12, TS 38.331]. The higher layer parameter *cg-nrofSlots*, provides the number of consecutive slots allocated within a configured grant period. The higher layer parameter *cg-nrofPUSCH-InSlot* provides the number of consecutive PUSCH allocations within a slot, where the first PUSCH allocation follows the higher layer parameter *timeDomainAllocation* for Type 1 PUSCH transmission or the higher layer configuration according to [10, TS 38.321], and UL grant received on the DCI for Type 2 PUSCH transmissions, and the remaining PUSCH allocations have the same length and PUSCH mapping type, and are appended following the previous allocations without any gaps. The same combination of start symbol and length and PUSCH mapping type repeats over the consecutively allocated slots.

For operation with shared spectrum channel access where a UE is performing uplink transmission with configured grants in contiguous OFDM symbols on all resource blocks of an RB set, for the first such UL transmission the UE determines a duration of a cyclic prefix extension *Text* to be applied for transmission according to [4, TS 38.211] where the index for [4, TS 38.211] is chosen randomly from a set of values configured by higher layers according to the following rule:

- If the first such UL transmission is within a channel occupancy initiated by the gNB (defined in Clause 4 of [16, TS 37.213]), the set of values is determined by *cg-StartingFullBW-InsideCOT*;

- otherwise, the set of values is determined by *cg-StartingFullBW-OutsideCOT*.

For operation with shared spectrum channel access where a UE is performing uplink transmission with configured grants in contiguous OFDM symbols on fewer than all resource blocks of an RB set, for the first such UL transmission the UE determines a duration of a cyclic prefix extension *Text* to be applied for transmission according to [4, TS 38.211] according to the following rule:

- If the first such UL transmission is within a channel occupancy initiated by the gNB (defined in Clause 4 of [16, TS 37.213]), the index for [4, TS 38.211] is equal to *cg-StartingPartialBW-InsideCOT*;

- otherwise, the index for [4, TS 38.211] is equal to *cg-StartingPartialBW-OutsideCOT.*

<omitted text>

## 6.2 UE reference signal (RS) procedure

### 6.2.1 UE sounding procedure

The UE may be configured with one or more Sounding Reference Signal (SRS) resource sets as configured by the higher layer parameter *SRS-ResourceSet* or *SRS-PosResourceSet*. For each SRS resource set configured by *SRS-ResourceSet*, a UE may be configured with SRS resources (higher layer parameter *SRS-Resource*), where the maximum value of K is indicated by UE capability[13, 38.306]. When SRS resource set is configured with the higher layer parameter *SRS-PosResourceSet,* a UE may be configured with *K* ≥1 SRS resources (higher layer parameter *SRS-PosResource*), where the maximum value of K is 16. The SRS resource set applicability is configured by the higher layer parameter *usage* in *SRS-ResourceSet.* When the higher layer parameter *usage* is set to 'beamManagement'*,* only one SRS resource in each of multiple SRS resource sets may be transmitted at a given time instant, but the SRS resources in different SRS resource sets with the same time domain behaviour in the same BWP may be transmitted simultaneously.

For aperiodic SRS at least one state of the DCI field is used to select at least one out of the configured SRS resource set(s).

The following SRS parameters are semi-statically configurable by higher layer parameter *SRS-Resource* or *SRS-PosResource*.

- *srs-ResourceId* or *SRS-PosResourceId* determines SRS resource configuration identity.

- Number of SRS ports, as defined by the higher layer parameter *nrofSRS-Ports* and described in Clause 6.4.1.4 of [4, TS 38.211]. If not configured, *nrofSRS-Ports* is 1.

*-* Time domain behaviour of SRS resource configuration as indicated by the higher layer parameter *resourceType*, which may be periodic, semi-persistent, aperiodic SRS transmission as defined in Clause 6.4.1.4 of [4, TS 38.211].

- Slot level periodicity and slot level offset as defined by the higher layer parameters *periodicityAndOffset-p* or *periodicityAndOffset-sp* for an SRS resource of type periodic or semi-persistent. The UE is not expected to be configured with SRS resources in the same SRS resource set *SRS-ResourceSet* or *SRS-PosResourceSet* with different slot level periodicities. For an *SRS-ResourceSet* configured with higher layer parameter *resourceType* set to 'aperiodic', a slot level offset is defined by the higher layer parameter *slotOffset.* For an *SRS-PosResourceSet* configured with higher layer parameter r*esourceType* set to 'aperiodic', the slot level offset is defined by the higher layer parameter *slotOffset* for each SRS resource.

- Number of OFDM symbols in the SRS resource, starting OFDM symbol of the SRS resource within a slot including repetition factor R as defined by the higher layer parameter *resourceMapping* and described in Clause 6.4.1.4 of [4, TS 38.211]. If *R* is not configured, then *R* is equal to the number of OFDM symbols in the SRS resource.

- SRS bandwidth and , as defined by the higher layer parameter *freqHopping* and described in Clause 6.4.1.4 of [4, TS 38.211]. If not configured, then= 0.

- Frequency hopping bandwidth , as defined by the higher layer parameter *freqHopping* and described in Clause 6.4.1.4 of [4, TS 38.211]. If not configured, then = 0.

- Defining frequency domain position and configurable shift, as defined by the higher layer parameters *freqDomainPosition* and *freqDomainShift*, respectively, and described in Clause 6.4.1.4 of [4, TS 38.211]. If *freqDomainPosition* is not configured, *freqDomainPosition* is zero.

- Cyclic shift, as defined by the higher layer parameter *cyclicShift-n2*, *cyclicShift-n4, or cyclicShift-n8* for transmission comb value 2, 4 or 8, and described in Clause 6.4.1.4 of [4, TS 38.211].

- Transmission comb value, as defined by the higher layer parameter *transmissionComb* described in Clause 6.4.1.4 of [4, TS 38.211].

- Transmission comb offset, as defined by the higher layer parameter *combOffset-n2*, *combOffset-n4,* and *combOffset-n8* for transmission comb value 2, 4, or 8, and described in Clause 6.4.1.4 of [4, TS 38.211].

- SRS sequence ID, as defined by the higher layer parameter *sequenceId* in Clause 6.4.1.4 of [4].

- The configuration of the spatial relation between a reference RS and the target SRS, where the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos*, if configured, contains the ID of the reference RS. The reference RS may be an SS/PBCH block, CSI-RS configured on serving cell indicated by higher layer parameter *servingCellId* if present, same serving cell as the target SRS otherwise, or an SRS configured on uplink BWP indicated by the higher layer parameter *uplinkBWP*, and serving cell indicated by the higher layer parameter *servingCellId* if present, same serving cell as the target SRS otherwise. When the target SRS is configured by the higher layer parameter *SRS-PosResourceSet*, the reference RS may also be a DL PRS configured on a serving cell or a non-serving cell indicated by the higher layer parameter *dl-PRS*, or an SS/PBCH block of a non-serving cell indicated by the higher layer parameter *ssb-Ncell*.

The UE may be configured by the higher layer parameter *resourceMapping* in *SRS-Resource* with an SRS resource occupying  adjacent OFDM symbols within the last 6 symbols of the slot, or at any symbol location within the slot if *resourceMapping-r16* is provided subject to UE capability, where all antenna ports of the SRS resources are mapped to each symbol of the resource. When the SRS is configured with the higher layer parameter *SRS-PosResourceSet* the higher layer parameter *resourceMapping-r16* in *SRS-PosResource* indicates an SRS resource occupying adjacent symbols anywhere within the slot.

If a PUSCH with a priority index 0 and SRS configured by *SRS-Resource* are transmitted in the same slot on a serving cell, the UE may only be configured to transmit SRS after the transmission of the PUSCH and the corresponding DM-RS.

If a PUSCH transmission with a priority index 1 or a PUCCH transmission with a priority index 1 would overlap in time with an SRS transmission on a serving cell, the UE does not transmit the SRS in the overlapping symbol(s).

For a UE configured with one or more SRS resource configuration(s), and when the higher layer parameter *resourceType* in *SRS-Resource* or *SRS-PosResource* is set to 'periodic':

- if the UE is configured with the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos* containing the ID of a reference'ssb-Index', 'ssb-IndexServing', or 'ssb-IndexNcell', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference SS/PBCH block, if the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos* contains the ID of a reference 'csi-RS-Index' or 'csi-RS-IndexServing', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference periodic CSI-RS or of the reference semi-persistent CSI-RS, if the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos* containing the ID of a reference 'srs' or 'srs-spatialRelation', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the transmission of the reference periodic SRS. When the SRS is configured by the higher layer parameter *SRS-PosResource* and if the higher layer parameter *spatialRelationInfoPos* contains the ID of a reference 'dl-PRS', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference DL PRS.

For a UE configured with one or more SRS resource configuration(s), and when the higher layer parameter *resourceType* in *SRS-Resource* or *SRS-PosResource* is set to 'semi-persistent':

- when a UE receives an activation command, as described in clause 6.1.3.17 or 6.1.3.36 of [10, TS 38.321], for an SRS resource, and when the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the activation command is transmitted in slot *n*, the corresponding actions in [10, TS 38.321] and the UE assumptions on SRS transmission corresponding to the configured SRS resource set shall be applied starting from the first slot that is after slot where ** is the SCS configuration for the PUCCH. The activation command also contains spatial relation assumptions provided by a list of references to reference signal IDs, one per element of the activated SRS resource set. When the SRS is configured with the higher layer parameter *SRS-ResourceSet*, each ID in the list refers to a reference SS/PBCH block, NZP CSI-RS resource configured on serving cell indicated by *Resource Serving Cell ID* field in the activation command if present, same serving cell as the SRS resource set otherwise, or SRS resource configured on serving cell and uplink bandwidth part indicated by Resource *Serving Cell ID* field and *Resource BWP ID* field in the activation command if present, same serving cell and bandwidth part as the SRS resource set otherwise. When the SRS is configured with the higher layer parameter *SRS-PosResourceSet*, each ID in the list of reference signal IDs may refer to a reference SS/PBCH block on a serving or non-serving cell indicated by *PCI* field in the activation command, NZP CSI-RS resource configured on serving cell indicated by *Resource Serving Cell ID* field in the activation command if present, same serving cell as the SRS resource set otherwise, SRS resource configured on serving cell and uplink bandwidth part indicated by Resource *Serving Cell ID* field and *Resource BWP ID* field in the activation command if present, same serving cell and bandwidth part as the SRS resource set otherwise, or DL PRS resource of a serving or non-serving cell associated with a *dl-PRS-ID* indicated by *DL-PRS ID* field in the activation command.

- if an SRS resource in the activated resource set is configured with the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos*, the UE shall assume that the ID of the reference signal in the activation command overrides the one configured in *spatialRelationInfo* or *spatialRelationInfoPos.*

- when a UE receives a deactivation command [10, TS 38.321] for an activated SRS resource set, and when the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the deactivation command, the corresponding actions in [10, TS 38.321] and UE assumption on cessation of SRS transmission corresponding to the deactivated SRS resource set shall apply starting from the first slot that is after slot where ** is the SCS configuration for the PUCCH.

- if the UE is configured with the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos* containing the ID of a reference 'ssb-Index', 'ssb-IndexServing', or 'ssb-IndexNcell' the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference SS/PBCH block, if the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos* contains the ID of a reference 'csi-RS-Index' or 'csi-RS-IndexServing', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference periodic CSI-RS or of the reference semi-persistent CSI-RS, if the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos* contains the ID of a reference 'srs' or 'srs-SpatialRelation', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the transmission of the reference periodic SRS or of the reference semi-persistent SRS. When the SRS is configured by the higher layer parameter *SRS-PosResourceSet* and if the higher layer parameter *spatialRelationInfoPos* contains the ID of a reference 'dl-PRS', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference DL PRS.

If the UE has an active semi-persistent SRS resource configuration and has not received a deactivation command, the semi-persistent SRS configuration is considered to be active in the UL BWP which is active, otherwise it is considered suspended.

For a UE configured with one or more SRS resource configuration(s), and when the higher layer parameter *resourceType* in *SRS-Resource* or *SRS-PosResource* is set to 'aperiodic':

- the UE receives a configuration of SRS resource sets,

- the UE receives a downlink DCI, a group common DCI, or an uplink DCI based command where a codepoint of the DCI may trigger one or more SRS resource set(s). For SRS in a resource set with usage set to 'codebook' or 'antennaSwitching', the minimal time interval between the last symbol of the PDCCH triggering the aperiodic SRS transmission and the first symbol of SRS resource is *N2*  symbols and an additional time duration *Tswitch*. Otherwise, the minimal time interval between the last symbol of the PDCCH triggering the aperiodic SRS transmission and the first symbol of SRS resource is *N2* +14 symbols and an additional time duration *Tswitch*. The minimal time interval unit of OFDM symbol is counted based on the minimum subcarrier spacing given by min(*µPDCCH, µUL*) where *µUL* is given by min(*µUL,carrier1, µUL,carrier2, µSRS*) when the UE is configured with the higher layer parameter *uplinkTxSwitchingOption* set to 'dualUL' for uplink carrier aggregation, and by *µSRS*otherwise. *µSRS* and *µPDCCH*are the subcarrier spacing configurations for triggered SRS and PDCCH carrying the triggering command respectively.

- *Tswitch*, *µUL,carrier1* and *µUL,carrier2* are defined in clause 6.4.

- If the UE receives the DCI triggering aperiodic SRS in slot *n* and except when SRS is configured with the higher layer parameter *SRS-PosResource*, the UE transmits aperiodic SRS in each of the triggered SRS resource set(s) in slot , if UE is configured with ca-SlotOffset for at least one of the triggered and triggering cell, , if the UE is configured with the higher layer parameter *CellSpecific\_Koffset*,*Ks* =, otherwise, and where

*- k* is configured via higher layer parameter *slotOffset* for each triggered SRS resources set and is based on the subcarrier spacing of the triggered SRS transmission, *µSRS* and *µPDCCH* are the subcarrier spacing configurations for triggered SRS and PDCCH carrying the triggering command respectively;

*-*  is provided with a value of ms for frequency range 1 and is equal to *UESpecific\_Koffset* if *UESpecific\_Koffset* is provided in MAC CE and *CellSpecific\_Koffset* otherwise.

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

- If the UE receives the DCI triggering aperiodic SRS in slot *n* and when SRS is configured with the higher layer parameter *SRS-PosResource*, the UE transmits every aperiodic SRS resource in each of the triggered SRS resource set(s) in slot , if UE is configured with ca-SlotOffset for at least one of the triggered and triggering cell, , if UE is configured with the higher layer parameter *CellSpecific\_Koffset*, *Ks* =, otherwise, and where

*- k* is configured via higher layer parameter *slotOffset* for each aperiodic SRS resource in each triggered SRS resources set and is based on the subcarrier spacing of the triggered SRS transmission, *µSRS* and *µPDCCH* are the subcarrier spacing configurations for triggered SRS and PDCCH carrying the triggering command respectively;

*-*  is provided with a value of ms for frequency range 1 and is equal to *UESpecific\_Koffset* if *UESpecific\_Koffset* is provided in MAC CE and *CellSpecific\_Koffset* otherwise.

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

- if the UE is configured with the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos* containing the ID of a reference 'ssb-Index', 'ssb-IndexServing' or 'ssb-IndexNcell', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference SS/PBCH block, if the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos* contains the ID of a reference 'csi-RS-Index' or 'csi-RS-IndexServing', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference periodic CSI-RS or of the reference semi-persistent CSI-RS, or of the latest reference aperiodic CSI-RS. If the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos* contains the ID of a reference 'srs' or 'srs-SpatialRelation', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the transmission of the reference periodic SRS or of the reference semi-persistent SRS or of the reference aperiodic SRS. When the SRS is configured by the higher layer parameter *SRS-PosResourceSet* and if the higher layer parameter *spatialRelationInfoPos* contains the ID of a reference 'dl-PRS', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference DL PRS.

- when a UE receives an spatial relation update command, as described in clause 6.1.3.26 of [10, TS 38.321], for an SRS resource configured with the higher layer parameter *SRS-Resource*, and when the HARQ-ACK corresponding to the PDSCH carrying the update command is transmitted in slot *n*, the corresponding actions in [10, TS 38.321] and the UE assumptions on updating spatial relation for the SRS resource shall be applied for SRS transmission starting from the first slot that is after slot The update command contains spatial relation assumptions provided by a list of references to reference signal IDs, one per element of the updated SRS resource set. Each ID in the list refers to a reference SS/PBCH block, NZP CSI-RS resource configured on serving cell indicated by *Resource Serving Cell ID* field in the update command if present, same serving cell as the SRS resource set otherwise, or SRS resource configured on serving cell and uplink bandwidth part indicated by *Resource* *Serving Cell ID* field and *Resource BWP ID* field in the update command if present, same serving cell and bandwidth part as the SRS resource set otherwise. When the UE is configured with the higher layer parameter *usage* in *SRS-ResourceSet* set to 'antennaSwitching', the UE shall not expect to be configured with different spatial relations for SRS resources in the same SRS resource set.

The UE is not expected to be configured with different time domain behavior for SRS resources in the same SRS resource set. The UE is also not expected to be configured with different time domain behavior between SRS resource and associated SRS resources set.

For operation in the same carrier, the UE is not expected to be configured on overlapping symbols with a SRS resource configured by the higher layer parameter *SRS-PosResource* and a SRS resource configured by the higher layer parameter *SRS-Resource* with *resourceType* of both SRS resources as 'periodic'.

For operation in the same carrier, the UE is not expected to be activated or triggered to transmit SRS on overlapping symbols with a SRS resource configured by the higher layer parameter *SRS-PosResource* and a SRS resource configured by the higher layer parameter *SRS-Resource* with *resourceType* of both SRS resources as 'semi-persistent' or 'aperiodic'.

For operations in the same carrier, the UE is not expected to be configured on overlapping symbols with more than one SRS resources configured by the higher layer parameter *SRS-PosResource* with *resourceType* of the SRS resources as 'periodic'.

For operations in the same carrier, the UE is not expected to be activated or triggered to transmit SRS on overlapping symbols with more than one SRS resources configured by the higher layer parameter *SRS-PosResource* with *resourceType* of the SRS resources as 'semi-persistent' or 'aperiodic'.

For intra-band and inter-band CA operations, a UE can simultaneously transmit more than one SRS resource configured by *SRS-PosResource* on different CCs, subject to UE's capability

For intra-band and inter-band CA operations, a UE can simultaneously transmit more than one SRS resource configured by *SRS-PosResource* and *SRS-Resource* on different CCs, subject to UE's capability.

The SRS request field [5, TS38.212] in DCI format 0\_1, 1\_1, 0\_2 (if SRS request field is present), 1\_2 (if SRS request field is present) indicates the triggered SRS resource set given in Table 7.3.1.1.2-24 of [5, TS 38.212]. The 2-bit SRS request field [5, TS38.212] in DCI format 2\_3 indicates the triggered SRS resource set given in Clause 7.3 of [5, TS 38.212] if the UE is configured with higher layer parameter *srs-TPC-PDCCH-Group* set to 'typeB', or indicates the SRS transmission on a set of serving cells configured by higher layers if the UE is configured with higher layer parameter *srs-TPC-PDCCH-Group* set to 'typeA'.

For PUCCH and SRS on the same carrier, a UE shall not transmit SRS when semi-persistent or periodic SRS is configured in the same symbol(s) with PUCCH carrying only CSI report(s), or only L1-RSRP report(s), or only L1-SINR report(s). A UE shall not transmit SRS when semi-persistent or periodic SRS is configured or aperiodic SRS is triggered to be transmitted in the same symbol(s) with PUCCH carrying HARQ-ACK, link recovery request (as defined in clause 9.2.4 of [6, 38.213]) and/or SR. In the case that SRS is not transmitted due to overlap with PUCCH, only the SRS symbol(s) that overlap with PUCCH symbol(s) are dropped. PUCCH shall not be transmitted when aperiodic SRS is triggered to be transmitted to overlap in the same symbol with PUCCH carrying semi-persistent/periodic CSI report(s) or semi-persistent/periodic L1-RSRP report(s) only, or only L1-SINR report(s).

In case of intra-band carrier aggregation or in inter-band CA band combination if simultaneous SRS and PUCCH/PUSCH transmissions are not supported by UE, the UE is not expected to be configured with SRS from a carrier and PUSCH/UL DM-RS/UL PT-RS/PUCCH formats from a different carrier in the same symbol.

In case of intra-band carrier aggregation or in inter-band CA band combination if simultaneous SRS and PRACH transmissions are not supported by UE, the UE shall not transmit simultaneously SRS resource(s) from a carrier and PRACH from a different carrier.

In case a SRS resource with *resourceType* set as 'aperiodic' is triggered on the OFDM symbol(s) configured with periodic/semi-persistent SRS transmission, the UE shall transmit the aperiodic SRS resource and only the periodic/semi-persistent SRS symbol(s) overlapping within the symbol(s) are dropped, while the periodic/semi-persistent SRS symbol(s) that are not overlapped with the aperiodic SRS resource are transmitted. In case a SRS resource with *resourceType* set as 'semi-persistent' is triggered on the OFDM symbol(s) configured with periodic SRS transmission, the UE shall transmit the semi-persistent SRS resource and only the periodic SRS symbol(s) overlapping within the symbol(s) are dropped, while the periodic SRS symbol(s) that are not overlapped with the semi-persistent SRS resource are transmitted.

When the UE is configured with the higher layer parameter *usage* in *SRS-ResourceSet* set to 'antennaSwitching', and a guard period of Y symbols is configured according to Clause 6.2.1.2, the UE shall use the same priority rules as defined above during the guard period as if SRS was configured.

When a *spatialRelationInfo* is activated/updated for a semi-persistent or aperiodic SRS resource configured by the higher layer parameter *SRS-Resource* by a MAC CE for a set of CCs/BWPs, where the applicable list of CCs provided by higher layer parameter *simultaneousSpatial-UpdatedList1* or *simultaneousSpatial-UpdatedList2* is determined by the indicated CC in the MAC CE, the *spatialRelationInfo* is applied for the semi-persistent or aperiodic SRS resource(s) with the same SRS resource ID for all the BWPs in the determined CCs.

When the higher layer parameter *enableDefaultBeamPL-ForSRS* is set 'enabled', and if the higher layer parameter *spatialRelationInfo* for the SRS resource, except for the SRS resource with the higher layer parameter *usage* in SRS-ResourceSet set to 'beamManagement' or for the SRS resource with the higher layer parameter *usage* in SRS-ResourceSet set to 'nonCodebook' with configuration of *associatedCSI-RS* or for the SRS resource configured by the higher layer parameter *SRS-PosResourceSet*, is not configured in FR2 and if the UE is not configured with higher layer parameter(s) *pathlossReferenceRS*, and if the UE is not configured with different values of coresetPoolIndex in ControlResourceSets, and is not provided at least one TCI codepoint mapped with two TCI states, the UE shall transmit the target SRS resource in an active UL BWP of a CC,

- according to the spatial relation, if applicable, with a reference to the RS configured with *qcl-Type* set to 'typeD' corresponding to the QCL assumption of the CORESET with the lowest *controlResourceSetId* in the active DL BWP in the CC.

- according to the spatial relation, if applicable, with a reference to the RS configured with *qcl-Type* set to 'typeD' in the activated TCI state with the lowest ID applicable to PDSCH in the active DL BWP of the CC if the UE is not configured with any CORESET in the active DL BWP of the CC

<omitted text>

## 6.4 UE PUSCH preparation procedure time

If the first uplink symbol in the PUSCH allocation for a transport block, including the DM-RS, as defined by the slot offset *K2* and Koffset, if configured, and the start *S* and length *L* of the PUSCH allocation indicated by '*Time domain resource assignment*' of the scheduling DCI and including the effect of the timing advance, is no earlier than at symbol *L2*, where *L2* is defined as the next uplink symbol with its CP starting after the end of the reception of the last symbol of the PDCCH carrying the DCI scheduling the PUSCH, then the UE shall transmit the transport block.

*- N2* is based on *µ* of Table 6.4-1 and Table 6.4-2 for UE processing capability 1 and 2 respectively, where *µ* corresponds to the one of (*µDL*, *µUL*) resulting with the largest *Tproc,2*, where the *µDL* corresponds to the subcarrier spacing of the downlink with which the PDCCH carrying the DCI scheduling the PUSCH was transmitted and *µUL* corresponds to the subcarrier spacing of the uplink channel with which the PUSCH is to be transmitted, and *κ* is defined in clause 4.1 of [4, TS 38.211].

*-* For operation with shared spectrum channel access, is calculated according to [4, TS 38.211], otherwise =0.

- If the first symbol of the PUSCH allocation consists of DM-RS only, then *d2,1* = 0*,* otherwise *d2,1* = 1.

- If the UE is configured with multiple active component carriers, the first uplink symbol in the PUSCH allocation further includes the effect of timing difference between component carriers as given in [11, TS 38.133].

- If the scheduling DCI triggered a switch of BWP, *d2,2* equals to the switching time as defined in [11, TS 38.133], otherwise *d2,2*=0.

- If a PUSCH of a larger priority index would overlap with PUCCH of a smaller priority index, *d2* for the PUSCH of a larger priority is set as reported by the UE; otherwise *d2 = 0.*

- For a UE that supports capability 2 on a given cell, the processing time according to UE processing capability 2 is applied if the high layer parameter *processingType2Enabled* in *PUSCH-ServingCellConfig* is configured for the cell and set to 'enable',

- If the PUSCH indicated by the DCI is overlapping with one or more PUCCH channels, then the transport block is multiplexed following the procedure in clause 9.2.5 of [6, TS 38.213], otherwise the transport block is transmitted on the PUSCH indicated by the DCI.

- If uplink switching gap is triggered as defined in clause 6.1.6, ** equals to the switching gap duration and for the UE configured with higher layer parameter *uplinkTxSwitchingOption* set to 'dualUL' for uplink carrier aggregation *µUL*=min(*µUL,carrier1, µUL,carrier2*), otherwise **.

- If the UE is configured with the higher layer parameter *CellSpecific\_Koffset*, the UL slot timing relative to the DL slot timing is offset by Koffset, where Koffset is provided in slots using a reference subcarrier spacing of 15 kHz for frequency range 1.

Otherwise the UE may ignore the scheduling DCI.

The value of  is used both in the case of normal and extended cyclic prefix.

Table 6.4-1: PUSCH preparation time for PUSCH timing capability 1

|  |  |
| --- | --- |
|  | PUSCH preparation time *N2* [symbols] |
| 0 | 10 |
| 1 | 12 |
| 2 | 23 |
| 3 | 36 |

Table 6.4-2: PUSCH preparation time for PUSCH timing capability 2

|  |  |
| --- | --- |
|  | PUSCH preparation time *N2* [symbols] |
| 0 | 5 |
| 1 | 5.5 |
| 2 | 11 for frequency range 1 |

<omitted text>