**3GPP TSG RAN WG1 #108-e** **R1-22xxxxx**

**e-Meeting, February 21st – March 3rd, 2022**

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| *CR-Form-v12.0* | | | | | | | | |
| **DRAFT CHANGE REQUEST** | | | | | | | | |
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|  | **38.213** | **CR** |  | **rev** |  | **Current version:** | **17.0.0** |  |
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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:*** | Corrections on further enhancements on MIMO for NR | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Samsung | | | | | | | | | |
| ***Source to TSG:*** | R1 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** |  | | | | |  | ***Date:*** | | | 2022-03-07 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | F |  | | | | | ***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-12 (Release 12)* *Rel-13 (Release 13) Rel-14 (Release 14) Rel-15 (Release 15) Rel-16 (Release 16)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Corrections on further MIMO enhancements. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | 1. Add missing sets for sets that include RS indexes configured with *qcl-Type* set to 'typeD' in clause 6. 2. Capture that an UL PC parameter setting for an SRS resource set is derived from the setting associated with the indicated TCI for the SRS resource with the lowest ID in the SRS resource set in clause 7. 3. Correct CLPC adjustement state determination in clause 7.1.1. 4. Correct the mapping of first and second RS resource indexes for pathloss measurement in clause 7.1.1. 5. Add determination of *p0-PUCCH-Value*, of *pathlossReferenceRSs*, and of *closedLoopIndex* when a UE is provided more than one sets of power control parameters for operation in FR1 in clause 7.2.1. 6. Capture determination of a PDCCH candidate in determining a first CCE and a PUCCH resource when there is ambiguity between a PDCCH candidate from a linked search space set and a PDCCH candidate from a non-linked search space set in clauses 9.2.1 and 9.2.3. 7. Capture determination of spatial setting for a PUCCH when a CORESET where an associated PDCCH is received has two activated TCI states in clause 9.2.2. 8. Capture a condition where a UE is not required to monitor PDCCH candidates for a Type2-PDCCH CSS set in clause10. 9. Capture that a UE does not expect a first PDCCH from a linked search space set and a second PDCCH from a non-linked search space set to have same {set of CCEs, scrambling, CORESET, sizes of DCI formats} in any span other than the first span in a slot in clause 10.1. 10. Capture that if a PUCCH/PUSCH/PRACH/SRS would overlap in symbols with an SS/PBCH block associated with an additional PCI, the UE does not transmit the PUCCH/PUSCH/PRACH and does not transmit the SRS in the symbols in clauses 11.1 and 11.1.1. 11. Other miscellaneous corrections/alignments | | | | | | | | |
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| ***Consequences if not approved:*** | | Incomplete support for MIMO enhancements. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 6, 7, 7.1.1, 7.2.1, 9.2.1, 9.2.2, 9.2.3, 9.2.6, 10, 10.1, 11.1, 11.1.1 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | TS 38.212, TS 38.214, TS 38.321, TS 38.331 | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

### \*\*\* Unchanged text is omitted \*\*\*

# 6 Link recovery procedures

A UE can be provided, for each BWP of a serving cell, a set of periodic CSI-RS resource configuration indexes by *failureDetectionResourcesToAddModList* and a set of periodic CSI-RS resource configuration indexes and/or SS/PBCH block indexes by *candidateBeamRSList* or *candidateBeamRSListExt* or *candidateBeamRSSCellList* for radio link quality measurements on the BWP of the serving cell. Instead of the sets and , for each BWP of a serving cell, the UE can be provided respective two sets and of periodic CSI-RS resource configuration indexes that can be activated by a MAC CE [11 TS 38.321] and corresponding two sets and of periodic CSI-RS resource configuration indexes and/or SS/PBCH block indexes by *candidateBeamRSList1* and *candidateBeamRSList2*, respectively, for radio link quality measurements on the BWP of the serving cell. The set is associated with the set and the set is associated with the set .

If the UE is not provided by *failureDetectionResourcesToAddModList* for a BWP of the serving cell, the UE determines the set to include periodic CSI-RS resource configuration indexes with same values as the RS indexes in the RS sets indicated by *TCI-State* for respective CORESETs that the UE uses for monitoring PDCCH. If the UE is not provided or for a BWP of the serving cell, the UE determines the set or to include periodic CSI-RS resource configuration indexes with same values as the RS indexes in the RS sets indicated by *TCI-State* for first and second CORESETs that the UE uses for monitoring PDCCH, where the UE is provided two coresetPoolIndex values 0 and 1 for the first and second CORESETs, or is not provided coresetPoolIndex value for the first CORESETs and is provided coresetPoolIndex value of 1 for the second CORESETs, respectively. If there are two RS indexes in a TCI state, the set or , or includes RS indexes configured with *qcl-Type* set to 'typeD' for the corresponding TCI states. If a CORESET that the UE uses for monitoring PDCCH includes two TCI states and the UE is provided *sfnSchemePdcch* set to 'sfnSchemeA' or 'sfnSchemeB', the set includes RS indexes in the RS sets associated with the two TCI states. The UE expects the set to include up to two RS indexes. If the UE is provided or , the UE expects the set or the set to include up to a number of RS indexes indicated by *capabilityparametername*. If the UE is not provided or , and if a number of active TCI states for PDCCH receptions in the first or second CORESETs is larger than , the UE determines the set or to include periodic CSI-RS resource configuration indexes with same values as the RS indexes in the RS sets associated with the active TCI states for PDCCH receptions in the first or second CORESETs corresponding to search space sets according to an ascending order for monitoring periodicity. If more than one first or second CORESETs correspond to search space sets with same monitoring periodicity, the UE determines the order of the first or second CORESETs according to a descending order of a CORESET index.

If a UE

- is not provided *coresetPoolIndex* or is provided *coresetPoolIndex* with a value of 0 for first CORESETs on an active DL BWP of a serving cell,

- is provided *coresetPoolIndex* with a value of 1 for second CORESETs on the active DL BWP of the serving cells, and

- is provided *SSB-MTCAdditionalPCI*

SS/PBCH block indexes associated with a physical cell identity other than the one provided by *physCellId* in *ServingCellConfigCommon* can be provided in either or set and the corresponding or set is associated with the physical cell identity.

The UE expects single port RS in the set , or , or . The UE expects single-port or two-port CSI-RS with frequency density equal to 1 or 3 REs per RB in the set , or , or .The thresholds Qout,LR and Qin,LR correspond to the default value of *rlmInSyncOutOfSyncThreshold*, as described in [10, TS 38.133] for Qout, and to the value provided by *rsrp-ThresholdSSB* or *rsrp-ThresholdBFR*, respectively.

The physical layer in the UE assesses the radio link quality according to the set , , or , of resource configurations against the threshold Qout,LR. For the set , the UE assesses the radio link quality only according to SS/PBCH blocks on the PCell or the PSCell or periodic CSI-RS resource configurations that are quasi co-located, as described in [6, TS 38.214], with the DM-RS of PDCCH receptions monitored by the UE. The UE applies the Qin,LR threshold to the L1-RSRP measurement obtained from a SS/PBCH block. The UE applies the Qin,LR threshold to the L1-RSRP measurement obtained for a CSI-RS resource after scaling a respective CSI-RS reception power with a value provided by *powerControlOffsetSS*.

In non-DRX mode operation, the physical layer in the UE provides an indication to higher layers when the radio link quality for all corresponding resource configurations in the set , or in the set or that the UE uses to assess the radio link quality is worse than the threshold Qout,LR. The physical layer informs the higher layers when the radio link quality is worse than the threshold Qout,LR with a periodicity determined by the maximum between the shortest periodicity among the SS/PBCH blocks on the PCell or the PSCell and/or the periodic CSI-RS configurations in the set , , or that the UE uses to assess the radio link quality and 2 msec. In DRX mode operation, the physical layer provides an indication to higher layers when the radio link quality is worse than the threshold Qout,LR with a periodicity determined as described in [10, TS 38.133].

### \*\*\* Unchanged text is omitted \*\*\*

# 7 Uplink Power control

### \*\*\* Unchanged text is omitted \*\*\*

In the remaining of this clause, if a UE is provided *DLorJoint-TCIState* or *UL-TCIstate* and for an indicated *DLorJoint-TCIState* or *UL-TCIstate* as described in [6, TS 38.214]

- in clauses 7.1.1, 7.2.1, and 7.3.1, the RS index for obtaining the downlink pathloss estimate for PUSCH, PUCCH, and SRS transmission is provided by *PL-RS* associated with or included in the indicated *DLorJoint-TCIState* or *UL-TCIstate* except for SRS transmission that is not provided *useIndicatedTCIState*

- in clause 7.1.1, if *p0-Alpha-CLID-PUSCH-Set* is provided, the values of , , and the PUSCH power control adjustment state are provided by *p0-Alpha-CLID-PUSCH-Set* associated with the indicated *DLorJoint-TCIState* or *UL-TCIstate*

- in clause 7.2.1, if *p0-Alpha-CLID-PUCCHSet* is provided, the values of and the PUCCH power control adjustment state are provided by *p0-Alpha-CLID-PUCCH-Set* associated with the indicated *DLorJoint-TCIState* or *UL-TCIstate*

- in clause 7.3.1, if *p0-Alpha-CLID-SRS-Set* is provided

- if *useIndicatedTCIState* is provided for a SRS resource set, the values of , , and SRS power control adjustment state are provided by *p0-Alpha-CLID-SRS-Set* associated with the indicated *DLorJoint-TCIState* or *UL-TCIState*

- else, if *useIndicatedTCIState* is not provided for a SRS resource set and for a first SRS resource from the SRS resource set, the values of , , and SRS power control adjustment state are provided by *p0-Alpha-CLID-SRS-Set* associated with *DLorJoint-TCIState* or *UL-TCIState* of an SRS resource with lowest *SRS-ResourceId* in the SRS resource set and a RS index for obtaining a pathloss estimate for the SRS transmission is provided by PL-RS associated with or included in the indicated *DLorJoint-TCIState* or *UL-TCIState* of an SRS resource with lowest *SRS-ResourceId* in the SRS resource set

In the remaining of this clause, if a PDCCH reception by a UE includes two PDCCH candidates from corresponding search space sets, as described in clause 10.1

- a PDCCH monitoring occasion is the union of the PDCCH monitoring occasions for the two PDCCH candidates

- the end of the PDCCH reception is the end of the PDCCH candidate that ends later

The PDCCH reception includes the two PDCCH candidates also when the UE is not required to monitor one of the two PDCCH candidates as described in clauses 10, 11.1, and 11.1.1.

### 7.1.1 UE behaviour

### \*\*\* Unchanged text is omitted \*\*\*

- If the UE is provided *enablePL-RS-UpdateForPUSCH-SRS*, a mapping between *sri-PUSCH-PowerControlId* and *PUSCH-PathlossReferenceRS-Id* values can be updated by a MAC CE as described in [11, TS 38.321]

- For a PUSCH transmission scheduled by a DCI format that does not include an SRI field, or for a PUSCH transmission configured by *ConfiguredGrantConfig* and activated, as described in clause 10.2, by a DCI format that does not include an SRI field, the UE determines a RS resource index from the *PUSCH-PathlossReferenceRS-Id* mapped to *sri-PUSCH-PowerControlId* = 0. If the UE is provided two SRS resource sets in *srs-ResourceSetToAddModList* or *srs-ResourceSetToAddModListDCI-0-2* with *usage* set to 'codebook' or 'nonCodebook', the UE determines first and second RS resource indexes from respective *PUSCH-PathlossReferenceRS-Id* mapped to *sri-PUSCH-PowerControlId* = 0 of *sri-PUSCH-MappingToAddModList* and *sri-PUSCH-PowerControlId* = 0 of *sri-PUSCH-MappingToAddModList2*, respectively.

- If the UE is not provided *enablePL-RS-UpdateForPUSCH-SRS*

- For a PUSCH transmission scheduled by a DCI format that does not include an SRI field, if the UE is provided two SRS resources in *srs-ResourceSetToAddModList* or *srs-ResourceSetToAddModListDCI-0-2* with *usage* set to 'codebook' or 'nonCodebook', the UE determines first and second RS resource indexes with respective first and second *PUSCH-PathlossReferenceRS-Id* values being equal to 0 and 1.

### \*\*\* Unchanged text is omitted \*\*\*

-  is the PUSCH power control adjustment state for active UL BWP of carrier of serving cell and PUSCH transmission occasion if the UE is not provided *tpc-Accumulation*, where

- The values are given in Table 7.1.1-1

- is a sum of TPC command values in a set of TPC command values with cardinality that the UE receives between symbols before PUSCH transmission occasion and symbols before PUSCH transmission occasion on active UL BWP of carrier of serving cell for PUSCH power control adjustment state , where is the smallest integer for which symbols before PUSCH transmission occasion is earlier than symbols before PUSCH transmission occasion

- If a PUSCH transmission is scheduled by a DCI format, is a number of symbols for active UL BWP of carrier of serving cell after a last symbol of a corresponding PDCCH reception and before a first symbol of the PUSCH transmission

- If a PUSCH transmission is configured by *ConfiguredGrantConfig*, is a number of symbols equal to the product of a number of symbols per slot, , and the minimum of the values provided by *k2* in *PUSCH-ConfigCommon* for active UL BWP of carrier of serving cell

- If the UE has reached maximum power for active UL BWP of carrier of serving cell at PUSCH transmission occasion and , then

- If UE has reached minimum power for active UL BWP of carrier of serving cell at PUSCH transmission occasion and , then

- A UE resets accumulation of a PUSCH power control adjustment state for active UL BWP of carrier of serving cell to

- If a configuration for a corresponding value is provided by higher layers

- If a configuration for a corresponding value is provided by higher layers

where is determined from the value of as

- If and the UE is provided higher *SRI-PUSCH-PowerControl*, is the *sri-PUSCH-ClosedLoopIndex* value(s) configured in any *SRI-PUSCH-PowerControl* with the *sri-P0-PUSCH-AlphaSetId* value corresponding to

- If and the UE is not provided *SRI-PUSCH-PowerControl* or , if and are provided by the second *P0-PUSCH-AlphaSet* in *p0-AlphaSets*; otherwise,

- If ,

- is provided by the value of *powerControlLoopToUse* if and are provided by *p0-PUSCH-Alpha* in *ConfiguredGrantConfig*

- is provided by the value of *powerControlLoopToUse2* if and are provided by *p0-PUSCH-Alpha2* in *ConfiguredGrantConfig*

- is the PUSCH power control adjustment state for active UL BWP of carrier of serving cell and PUSCH transmission occasion  if the UE is provided *tpc-Accumulation*, where

- absolute values are given in Table 7.1.1-1

### \*\*\* Unchanged text is omitted \*\*\*

### 7.2.1 UE behaviour

If a UE transmits a PUCCH on active UL BWP of carrier in the primary cell using PUCCH power control adjustment state with index , the UE determines the PUCCH transmission power in PUCCH transmission occasion as

 [dBm]

where

- is the UE configured maximum output power defined in [8-1, TS 38.101-1], [8-2, TS38.101-2] and [8-3, TS38.101-3] for carrier of primary cell in PUCCH transmission occasion

- is a parameter composed of the sum of a component , provided by *p0-nominal*, or dBm if *p0-nominal* is not provided, for carrier of primary cell and, if provided, a component provided by *p0-PUCCH-Value* in *P0-PUCCH* for active UL BWP of carrier of primary cell , where . is a size for a set of values provided by *maxNrofPUCCH-P0-PerSet*. The set of values is provided by *p0-Set*. If *p0-Set* is not provided to the UE, ,

- If the UE is provided *PUCCH-SpatialRelationInfo*, the UE obtains a mapping, by an index provided by *p0-PUCCH-Id*, between a set of *pucch-SpatialRelationInfoId* values and a set of *p0-PUCCH-Value* values. If the UE is provided more than one values for *pucch-SpatialRelationInfoId* and the UE receives an activation command [11, TS 38.321] indicating a value of *pucch-SpatialRelationInfoId*, the UE determines the *p0-PUCCH-Value* value through the link to a corresponding *p0-PUCCH-Id* index. The UE applies the activation command in the first slot that is after slot where is the slot where the UE would transmit a PUCCH with HARQ-ACK information for the PDSCH providing the activation command and is the SCS configuration for the PUCCH

* If the UE is provided more than one sets of power control parameters for operation in FR1, and the UE receives an activation command [11, TS 38.321] indicating one or two of the more than one sets of power control parameters, the UE determines *p0-PUCCH-Value* value according to the corresponding one or two sets of power control parameters. The UE applies the activation command in the first slot that is after slot where is the slot where the UE would transmit a PUCCH with HARQ-ACK information for the PDSCH providing the activation command and is the SCS configuration for the PUCCH.

- If the UE is not provided *PUCCH-SpatialRelationInfo* and is not provided more than one sets of power control parameters for operation in FR1, the UE obtains the *p0-PUCCH-Value* value from the *P0-PUCCH* with *p0-PUCCH-Id* value equal to the minimum *p0-PUCCH-Id* value in *p0-Set*

- is a bandwidth of the PUCCH resource assignment expressed in number of resource blocks for PUCCH transmission occasion on active UL BWP of carrier of primary cell and is a SCS configuration defined in [4, TS 38.211]

- is a downlink pathloss estimate in dB calculated by the UE using RS resource index as described in clause 7.1.1 for the active DL BWP of carrier of the primary cell as described in clause 12

- If the UE is not provided *pathlossReferenceRSs* or before the UE is provided dedicated higher layer parameters, the UE calculates using a RS resource obtained from an SS/PBCH block with same SS/PBCH block index as the one the UE uses to obtain *MIB*

- If the UE is provided a number of RS resource indexes, the UE calculates using RS resource with index , where . is a size for a set of RS resources provided by *maxNrofPUCCH-PathlossReferenceRSs*. The set of RS resources is provided by *pathlossReferenceRSs*. The set of RS resources can include one or both of a set of SS/PBCH block indexes, each provided by *ssb-Index* in *PUCCH-PathlossReferenceRS* when a value of a corresponding *pucch-PathlossReferenceRS-Id* maps to a SS/PBCH block index, and a set of CSI-RS resource indexes, each provided by *csi-RS-Index* when a value of a corresponding *pucch-PathlossReferenceRS-Id* maps to a CSI-RS resource index. The UE identifies a RS resource in the set of RS resources to correspond either to a SS/PBCH block index or to a CSI-RS resource index as provided by *pucch-PathlossReferenceRS-Id* in *PUCCH-PathlossReferenceRS*

- If the UE is provided *pathlossReferenceRSs* and *PUCCH-SpatialRelationInfo*, the UE obtains a mapping, by indexes provided by corresponding values of *pucch-PathlossReferenceRS-Id*, between a set of *pucch-SpatialRelationInfoId* values and a set of *referenceSignal* values provided by *PUCCH-PathlossReferenceRS*. If the UE is provided more than one values for *pucch-SpatialRelationInfoId* and the UE receives an activation command [11, TS 38.321] indicating a value of *pucch-SpatialRelationInfoId*, the UE determines the *referenceSignal* value in *PUCCH-PathlossReferenceRS* through the link to a corresponding *pucch-PathlossReferenceRS-Id* index. The UE applies the activation command in the first slot that is after slot where is the slot where the UE would transmit a PUCCH with HARQ-ACK information for the PDSCH providing the activation command and is the SCS configuration for the PUCCH

- If *PUCCH-SpatialRelationInfo* includes *servingCellId* indicating a serving cell, the UE receives the RS for resource index on the active DL BWP of the serving cell

- If the UE is provided *pathlossReferenceRSs* and more than one sets of power control parameters for operation in FR1, and the UE receives an activation command [11, TS 38.321] indicating one or two of the more than one sets of power control parameters, the UE determines the *referenceSignal* values in *PUCCH-PathlossReferenceRS* that are indicated in the one or two sets ofpower control parameter- If the UE is provided *pathlossReferenceRSs* and is not provided *PUCCH-SpatialRelationInfo* andis not provided more than one sets of power control parameters for operation in FR1, the UE obtains the *referenceSignal* value in *PUCCH-PathlossReferenceRS* from the *pucch-PathlossReferenceRS-Id* with index 0 in *PUCCH-PathlossReferenceRS* where the RS resource is either on the primary cell or, if provided, on a serving cell indicated by a value of *pathlossReferenceLinking*

- If the UE

- is not provided *pathlossReferenceRSs*, and

- is not provided *PUCCH-SpatialRelationInfo,* and

- is provided *enableDefaultBeamPL-ForPUCCH*, and

- is not provided coresetPoolIndex value of 1 for any CORESET, or is provided coresetPoolIndex value of 1 for all CORESETs, in ControlResourceSet and no codepoint of a TCI field, if any, in a DCI format of any search space set maps to two TCI states [5, TS 38.212]

the UE determines a RS resource index providing a periodic RS resource configured with *qcl-Type* set to 'typeD' in the TCI state or the QCL assumption of a CORESET with the lowest index in the active DL BWP of the primary cell. If the CORESET has two activated TCI states, as described in clause 10.1, the UE determines the RS resource index based on the first activated TCI state. For a PUCCH transmission over multiple slots, a same applies to the PUCCH transmission in each of the multiple slots.

- The parameter is a value of *deltaF-PUCCH-f0* for PUCCH format 0, *deltaF-PUCCH-f1* for PUCCH format 1, *deltaF-PUCCH-f2* for PUCCH format 2, *deltaF-PUCCH-f3* for PUCCH format 3, and *deltaF-PUCCH-f4* for PUCCH format 4, if provided; otherwise .

- is a PUCCH transmission power adjustment component on active UL BWP of carrier of primary cell

- For a PUCCH transmission using PUCCH format 0 or PUCCH format 1, where

- is a number of PUCCH format 0 symbols or PUCCH format 1 symbols for the PUCCH transmission as described in clause 9.2.

- for PUCCH format 0

- for PUCCH format 1

- for PUCCH format 0

- for PUCCH format 1, where is a number of UCI bits in PUCCH transmission occasion

- For a PUCCH transmission using PUCCH format 2 or PUCCH format 3 or PUCCH format 4 and for a number of UCI bits smaller than or equal to 11, , where

-

- is a number of HARQ-ACK information bits that the UE determines as described in clause 9.1.2.1 or 16.5.1.1 for Type-1 HARQ-ACK codebook and as described in clause 9.1.3.1 or 9.1.3.3 or 16.5.2.1 for Type-2 HARQ-ACK codebook.is the same as  as described in clause 9.1.4 for Type-3 HARQ-ACK codebook. If the UE is not provided any of *pdsch-HARQ-ACK-Codebook*, *pdsch-HARQ-ACK-Codebook-r16*, or *pdsch-HARQ-ACK-OneShotFeedback*, if the UE includes a HARQ-ACK information bit in the PUCCH transmission; otherwise,

- is a number of SR information bits that the UE determines as described in clause 9.2.5.1

- is a number of CSI information bits that the UE determines as described in clause 9.2.5.2

- is a number of resource elements determined as , where is a number of subcarriers per resource block excluding subcarriers used for DM-RS transmission, and is a number of symbols excluding symbols used for DM-RS transmission, as defined in clause 9.2.5.2, for PUCCH transmission occasion on active UL BWP of carrier of primary cell

- For a PUCCH transmission using PUCCH format 2 or PUCCH format 3 or PUCCH format 4 and for a number of UCI bits larger than 11, , where

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- is a number of HARQ-ACK information bits that the UE determines as described in clause 9.1.2.1 or 16.5.1.1 for Type-1 HARQ-ACK codebook and as described in clause 9.1.3.1 or 9.1.3.3 or 16.5.2.1 for Type-2 HARQ-ACK codebook, or as described in clause 9.1.4 for Type-3 HARQ-ACK codebook. If the UE is not provided any of *pdsch-HARQ-ACK-Codebook*, *pdsch-HARQ-ACK-Codebook-r16*, or *pdsch-HARQ-ACK-OneShotFeedback*, if the UE includes a HARQ-ACK information bit in the PUCCH transmission; otherwise,

- is a number of SR information bits that the UE determines as described in clause 9.2.5.1

- is a number of CSI information bits that the UE determines as described in clause 9.2.5.2

- is a number of CRC bits that the UE determines as described in clause 9.2

- is a number of resource elements that the UE determines as , where is a number of subcarriers per resource block excluding subcarriers used for DM-RS transmission, and is a number of symbols excluding symbols used for DM-RS transmission, as defined in clause 9.2.5.2, for PUCCH transmission occasion on active UL BWP of carrier of primary cell.

- For the PUCCH power control adjustment state for active UL BWP of carrier of primary cell and PUCCH transmission occasion

- is a TPC command value included in a DCI format associated with the PUCCH transmission for active UL BWP of carrier of the primary cell that the UE detects for PUCCH transmission occasion , or is jointly coded with other TPC commands in a DCI format 2\_2 with CRC scrambled by TPC-PUCCH-RNTI [5, TS 38.212], as described in clause 11.3

- if the UE is provided *twoPUCCH-PC-AdjustmentStates* and *PUCCH-SpatialRelationInfo*, or more than one sets of power control parameters for operation in FR1, and if the UE is not provided *twoPUCCH-PC-AdjustmentStates*, *PUCCH-SpatialRelationInfo*, and more than one sets of power control parameters

- If the UE obtains a TPC command value from a DCI format associated with the PUCCH transmission and if the UE is provided *PUCCH-SpatialRelationInfo*, the UE obtains a mapping, by an index provided by *p0-PUCCH-Id*, between a set of *pucch-SpatialRelationInfoId* values and a set of values for *closedLoopIndex* that provide the value(s). If the UE receives an activation command indicating a value of *pucch-SpatialRelationInfoId*, the UE determines the value *closedLoopIndex* that provides the value of through the link to a corresponding *p0-PUCCH-Id* index

- If the UE obtains a TPC command from a DCI format 2\_2 with CRC scrambled by a TPC-PUCCH-RNTI, the value is provided by the closed loop indicator field in DCI format 2\_2

- If the UE transmits the PUCCH with repetitions, as described in clause 9.2.6, and the UE is provided *twoPUCCH-PC-AdjustmentStates* by *pucch-PowerControl*

- If the DCI format includes two TPC command values and the PUCCH resource of the PUCCH transmission is associated with and , the UE applies the first TPC command value for and applies the second TPC command value for

- If the DCI format includes two TPC command values and the PUCCH resource of the PUCCH transmission is associated with , the UE applies the first TPC command value for and ignores the second TPC command value

- If the DCI format includes two TPC command values and the PUCCH resource of the PUCCH transmission is associated with , the UE applies the second TPC command value for and ignores the first TPC command value

- If the DCI format includes one TPC command value, the UE applies the TPC command value for all associated with the PUCCH resource of the PUCCH transmission

- is the current PUCCH power control adjustment state for active UL BWP of carrier of primary cell and PUCCH transmission occasion , where

- The values are given in Table 7.1.2-1

- is a sum of TPC command values in a set of TPC command values with cardinality that the UE receives between symbols before PUCCH transmission occasion and  symbols before PUCCH transmission occasion on active UL BWP of carrier of primary cell for PUCCH power control adjustment state, where is the smallest integer for which symbols before PUCCH transmission occasion is earlier than symbols before PUCCH transmission occasion

- If the PUCCH transmission is in response to a detection by the UE of a DCI format, is a number of symbols for active UL BWP of carrier of primary cell after a last symbol of a corresponding PDCCH reception and before a first symbol of the PUCCH transmission

- If the PUCCH transmission is not in response to a detection by the UE of a DCI format, is a number of symbols equal to the product of a number of symbols per slot, , and the minimum of the values provided by *k2* in *PUSCH-ConfigCommon* for active UL BWP of carrier of primary cell

- If the UE has reached maximum power for active UL BWP of carrier of primary cell at PUCCH transmission occasion and , then

- If UE has reached minimum power for active UL BWP of carrier of primary cell at PUCCH transmission occasion and , then

- If a configuration of a value for a corresponding PUCCH power control adjustment state for active UL BWP of carrier of primary cell is provided by higher layers,

-

- if the UE is provided *PUCCH-SpatialRelationInfo*, the UE determines the value of from the value of based on a *pucch-SpatialRelationInfoId* value associated with the *p0-PUCCH-Id* value corresponding to and with the *closedLoopIndex* value corresponding to ;

- else, if the UE is provided more than one sets of power control parameters for operation in FR1, and if the UE receives an activation command for a PUCCH resource that indicates one or two sets of the more than one sets of power control parameters, the UE determines the value of based on the *closedLoopIndex* value in the one or two sets of power control parameters;

- else,

- Else,

- , where , and is

- the TPC command value indicated in a random access response grant corresponding to a PRACH transmission according to Type-1 random access procedure, or in a random access response grant corresponding to MsgA transmissions according to Type-2 random access procedure with RAR message(s) for fallbackRAR, or

- the TPC command value indicated in a successRAR corresponding to MsgA transmissions for Type-2 random access procedure, or

- the TPC command value in a DCI format with CRC scrambled by C-RNTI or MCS-C-RNTI that the UE detects in a first PDCCH reception in a search space set provided by *recoverySearchSpaceId* if the PUCCH transmission is a first PUCCH transmission after 28 symbols from a last symbol of the first PDCCH reception,

and, if the UE transmits PUCCH on active UL BWP of carrier of primary cell ,

;

otherwise,

where is provided by higher layers and corresponds to the total power ramp-up requested by higher layers from the first to the last preamble for active UL BWP of carrier of primary cell , and corresponds to PUCCH format 0 or PUCCH format 1

Table 7.2.1-1: Mapping of TPC Command Field in a DCI format to accumulated values

|  |  |
| --- | --- |
| TPC Command Field | Accumulated [dB] |
| 0 | -1 |
| 1 | 0 |
| 2 | 1 |
| 3 | 3 |

### \*\*\* Unchanged text is omitted \*\*\*

### 9.2.1 PUCCH Resource Sets

If a UE does not have dedicated PUCCH resource configuration, provided by *PUCCH-ResourceSet* in *PUCCH-Config*, a PUCCH resource set is provided by *pucch-ResourceCommon* through an index to a row of Table 9.2.1-1 for transmission of HARQ-ACK information on PUCCH in an initial UL BWP of PRBs. For operation in FR2-2, *pucch-ResourceCommon* can also provide a number of RBs for the PUCCH resource set; otherwise .

The PUCCH resource set includes sixteen resources, each corresponding to a PUCCH format, a first symbol, a duration, a PRB offset , and a cyclic shift index set for a PUCCH transmission.

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

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

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

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

If the UE provides HARQ-ACK information in a PUCCH transmission in response to detecting a DCI format scheduling a PDSCH reception or having associated HARQ-ACK information without scheduling a PDSCH reception, the UE determines a PUCCH resource with index , , as , where is a number of CCEs in a CORESET of a PDCCH reception with the DCI format, as described in clause 10.1, is the index of a first CCE for the PDCCH reception, and is a value of the PUCCH resource indicator field in the DCI format.

When the PDCCH reception by a UE includes first and second PDCCH candidates from respective first and second search space sets, as described in clause 10.1, the CORESET and are associated with the search space set having the smaller index. If

* the first search space set has larger index than the second search space set and includes the first PDCCH candidate and a third PDCCH candidate that have same first CCE index and CCE aggregation levels 8 and 16, or 16 and 8, respectively,
* the second search space set includes the second PDCCH candidate that has same index and same CCE aggregation level as the first PDCCH candidate, and a fourth PDCCH candidate that has same index and same CCE aggregation level as the third PDCCH candidate,
* the CORESET associated with the first search space set has *cce-REG-MappingType* = '*nonInterleaved*' and has duration of one symbol, and
* the second PDCCH candidate has different first CCE index than the fourth PDCCH candidate

the UE determines from the PDCCH candidate with CCE aggregation level 16 among the second PDCCH candidate and the fourth PDCCH candidate.

If and a UE is provided a PUCCH resource by *pucch-ResourceCommon* and is not provided *useInterlacePUCCH-PUSCH* in *BWP-UplinkCommon*

- the UE determines the lowest PRB index of the PUCCH transmission in the first hop as and the lowest PRB index of the PUCCH transmission in the second hop as , where is the total number of initial cyclic shift indexes in the set of initial cyclic shift indexes

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

If and a UE is provided a PUCCH resource by *pucch-ResourceCommon* and is not provided *useInterlacePUCCH-PUSCH* in *BWP-UplinkCommon*

- the UE determines the lowest PRB index of the PUCCH transmission in the first hop as and the lowest PRB index of the PUCCH transmission in the second hop as

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

\*\*\* Unchanged text is omitted \*\*\*

### 9.2.2 PUCCH Formats for UCI transmission

If a UE is not transmitting PUSCH, and the UE is transmitting UCI, the UE transmits UCI in a PUCCH using

- PUCCH format 0 if

- the transmission is over 1 symbol or 2 symbols,

- the number of HARQ-ACK information bits with positive or negative SR (HARQ-ACK/SR bits) is 1 or 2

- PUCCH format 1 if

- the transmission is over 4 or more symbols,

- the number of HARQ-ACK/SR bits is 1 or 2

- PUCCH format 2 if

- the transmission is over 1 symbol or 2 symbols,

- the number of UCI bits is more than 2

- PUCCH format 3 if

- the transmission is over 4 or more symbols,

- the number of UCI bits is more than 2,

- the PUCCH resource does not include an orthogonal cover code, or the UE is provided *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated*

- PUCCH format 4 if

- the transmission is over 4 or more symbols,

- the number of UCI bits is more than 2,

- the PUCCH resource includes an orthogonal cover code and the UE is not provided *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated*

A spatial setting for a PUCCH transmission by a UE is provided by

- an indicated *DLorJoint-TCIState* or *UL-TCIstate*, if provided, as described in [6, TS 38.214];

- *PUCCH-SpatialRelationInfo* if the UE is configured with a single value for *pucch-SpatialRelationInfoId*;

- as described in [11, TS 38.321], if the UE is provided multiple values for *PUCCH-SpatialRelationInfo*. The UE applies corresponding actions in [11, TS 38.321] and a corresponding setting for a spatial domain filter to transmit PUCCH in the first slot that is after slot where is the slot where the UE would transmit a PUCCH with HARQ-ACK information with ACK value corresponding to a PDSCH reception providing the *PUCCH-SpatialRelationInfo*, each slot consists of symbols as defined in [4, TS 38.211],and is the SCS configuration for the PUCCH

- If *PUCCH-SpatialRelationInfo* or the indicated *UL-TCIstate* provides *ssb-Index*, the UE transmits the PUCCH using a same spatial domain filter as for a reception of a SS/PBCH block with index provided by *ssb-Index* for a same serving cell or, if *servingCellId* is provided, for a serving cell indicated by *servingCellId*

- else if *PUCCH-SpatialRelationInfo* or the indicated *UL-TCIstate* provides *csi-RS-Index*, or the indicated *DLorJoint-TCIState* provides *csi-rs* configured with *qcl-Type* set to ‘typeD’, the UE transmits the PUCCH using a same spatial domain filter as for a reception of a CSI-RS with resource index provided by *csi-RS-Index* or csi-rs for a same serving cell or, if *servingCellId* or *cell* is provided, for a serving cell indicated by *servingCellId* or *cell*

- else *PUCCH-SpatialRelationInfo* or the indicated *UL-TCIstate* provides *srs*, the UE transmits the PUCCH using a same spatial domain filter as for a transmission of a SRS with resource index provided by *resource* for a same serving cell and/or active UL BWP or, if *servingCellId* and/or *uplinkBWP* are provided, for a serving cell indicated by *servingCellId* and/or for an UL BWP indicated by *uplinkBWP*

If a UE

- is not provided *pathlossReferenceRSs* in *PUCCH-PowerControl*,

- is provided *enableDefaultBeamPL-ForPUCCH*, and

- is not provided *PUCCH-SpatialRelationInfo*, and

- is not provided coresetPoolIndex value of 1 for any CORESET, or is provided coresetPoolIndex value of 1 for all CORESETs, in ControlResourceSet and no codepoint of a TCI field, if any, in a DCI format of any search space set maps to two TCI states [5, TS 38.212]

a spatial setting for a PUCCH transmission from the UE is same as a spatial setting for PDCCH receptions by the UE in the CORESET with the lowest ID on the active DL BWP of the PCell and, if the CORESET has two activated TCI states as described in clause 10.1, the UE determines the spatial setting for the PUCCH transmission based on the first TCI state. For a PUCCH transmission over multiple slots, a same spatial setting applies to the PUCCH transmission in each of the multiple slots.

A number of DMRS symbols for a PUCCH transmission using PUCCH format 3 or 4 is provided by *additionalDMRS*.

Use of /2-BPSK, instead of QPSK, for a PUCCH transmission using PUCCH format 3 or 4 is indicated by *pi2BPSK*.

### 9.2.3 UE procedure for reporting HARQ-ACK

\*\*\* Unchanged text is omitted \*\*\*

The PUCCH resource indicator field values map to values of a set of PUCCH resource indexes, as defined in Table 9.2.3-2 for a PUCCH resource indicator field of 3 bits, provided by *resourceList* for PUCCH resources from a set of PUCCH resources provided by *PUCCH-ResourceSet* with a maximum of eight PUCCH resources. If the PUCCH resource indicator field includes 1 bit or 2 bits, the values map to the first two values or the first four values, respectively, of Table 9.2.3-2. If the last DCI format does not include a PUCCH resource indicator field, the first value of Table 9.2.3-2 is used.

For the first set of PUCCH resources and when the size of *resourceList* is larger than eight, when a UE provides HARQ-ACK information in a PUCCH transmission in response to detecting a last DCI format in a PDCCH reception, among DCI formats with a value of the PDSCH-to-HARQ\_feedback timing indicator field, if present, or a value of *dl-DataToUL-ACK*, or *dl-DataToUL-ACK-r16*, or *dl-DataToUL-ACKForDCIFormat1\_2*, or *dl-DataToUL-ACK-r17,* or *dl-DataToUL-ACK-MulticastDciFormat4\_1*, indicating a same slot for the PUCCH transmission, the UE determines a PUCCH resource with index , , as



where is a number of CCEs in CORESET of the PDCCH reception for the DCI format as described in clause 10.1, is the index of a first CCE for the PDCCH reception, and is a value of the PUCCH resource indicator field in the DCI format. When the PDCCH reception includes first and second PDCCH candidates from respective first and second search space sets, as described in clause 10.1, the CORESET is associated with the search space set having the smaller index. If

* the first search space set has larger index than the second search space set and includes the first PDCCH candidate and a third PDCCH candidate that have same first CCE index and CCE aggregation levels 8 and 16, or 16 and 8, respectively,
* the second search space set includes the second PDCCH candidate that has same index and same CCE aggregation level as the first PDCCH candidate, and a fourth PDCCH candidate that has same index and same CCE aggregation level as the third PDCCH candidate,
* the CORESET associated with the first search space set has *cce-REG-MappingType* = '*nonInterleaved*' and has duration of one symbol, and
* the second PDCCH candidate has different first CCE index than the fourth PDCCH candidate

the UE determines from the PDCCH candidate with CCE aggregation level 16 among the second PDCCH candidate and the fourth PDCCH candidate.

If the DCI format does not include a PUCCH resource indicator field, .

\*\*\* Unchanged text is omitted \*\*\*

### 9.2.6 PUCCH repetition procedure

If the UE determines that, for a PUCCH transmission in a slot, the number of symbols available for the PUCCH transmission is smaller than the value provided by *nrofSymbols* for the corresponding PUCCH format, the UE does not transmit the PUCCH in the slot.

A SS/PBCH block symbol is a symbol of an SS/PBCH block with candidate SS/PBCH block index corresponding to the SS/PBCH block index indicated to a UE by *ssb-PositionsInBurst* in *SIB1* or *ssb-PositionsInBurst* in *ServingCellConfigCommon* or, if the UE is not provided *DLorJoint-TCIState* or *followUnifiedTCIstate*, by *ssb-PositionsInBurst* in *SSB-MTCAdditionalPCI* associated to physical cell ID with active TCI states.

\*\*\* Unchanged text is omitted \*\*\*

# 10 UE procedure for receiving control information

\*\*\* Unchanged text is omitted \*\*\*

For monitoring of a PDCCH candidate by a UE, if the UE

- has received *ssb-PositionsInBurst* in *SIB1* and has not received *ssb-PositionsInBurst* in *ServingCellConfigCommon* for a serving cell, and

- does not monitor PDCCH candidates in a Type0-PDCCH CSS set, and

- at least one RE for a PDCCH candidate overlaps with at least one RE of a candidate SS/PBCH block corresponding to a SS/PBCH block index provided by *ssb-PositionsInBurst* in *SIB1*,

the UE is not required to monitor the PDCCH candidate.

For monitoring of a PDCCH candidate by a UE, if the UE

- has received *ssb-PositionsInBurst* in *ServingCellConfigCommon* for a serving cell, and

- does not monitor PDCCH candidates in a Type0-PDCCH CSS set, and

- at least one RE for a PDCCH candidate overlaps with at least one RE of a candidate SS/PBCH block corresponding to a SS/PBCH block index provided by *ssb-PositionsInBurst* in *ServingCellConfigCommon*,

the UE is not required to monitor the PDCCH candidate.

For monitoring of a PDCCH candidate by a UE, if the UE

- has received *ssb-PositionsInBurst* in *SSB-MTCAdditionalPCI* for a serving cell, and

- at least one RE for a PDCCH candidate overlaps with at least one RE of a candidate SS/PBCH block corresponding to a SS/PBCH block index provided by *ssb-PositionsInBurst* in *SSB-MTCAdditionalPCI* with same physical cell identity as the one associated with a RS having same quasi-collocation properties as a CORESET for the PDCCH candidate,

the UE is not required to monitor the PDCCH candidate.

A UE is not required to monitor PDCCH candidates for a Type0/0A/1/2-PDCCH CSS set when the active TCI state for a corresponding CORESET is not associated with *physCellId* in *ServingCellConfigCommon*.

If a UE monitors the PDCCH candidate for a Type0-PDCCH CSS set on the serving cell according to the procedure described in clause 13, the UE may assume that no SS/PBCH block is transmitted in REs used for monitoring the PDCCH candidate on the serving cell.

If at least one RE of a PDCCH candidate for a UE on the serving cell overlaps with at least one RE of *lte-CRS-ToMatchAround*, or of *LTE-CRS-PatternList*, the UE is not required to monitor the PDCCH candidate.

If a UE is provided *availableRB-SetsPerCell,* the UE is not required to monitor PDCCH candidates that overlap with any RB from RB sets that are indicated as unavailable for receptions by an available RB set indicator field in DCI format 2\_0 as described in clause 11.1.1. If the UE does not obtain the available RB set indicator for a symbol, the UE monitors PDCCH candidates on all RB sets in the symbol.

\*\*\* Unchanged text is omitted \*\*\*

## 10.1 UE procedure for determining physical downlink control channel assignment

\*\*\* Unchanged text is omitted \*\*\*

For a CORESET with index 0, the UE assumes that a DM-RS antenna port for PDCCH receptions in the CORESET is quasi co-located with

- if the UE is provided *DLorJoint-TCIState* and if *followUnifiedTCIstate* = ‘*enabled*’ for the CORESET, the UE assumes that a DM-RS antenna port for PDCCH receptions in the CORESET and a DM-RS antenna port for PDSCH receptions scheduled by DCI formats provided by PDCCH receptions in the CORESET are quasi co-located with the reference signals provided by the indicated *DLorJoint-TCIState* [6, TS 38.214]

- else, the UE assumes that a DM-RS antenna port for PDCCH receptions in the CORESET is quasi co-located with

- the one or more DL RS configured by a TCI state, where the TCI state is indicated by a MAC CE activation command for the CORESET, if any, or

- a SS/PBCH block the UE identified during a most recent random access procedure not initiated by a PDCCH order that triggers a contention-free random access procedure, if no MAC CE activation command indicating a TCI state for the CORESET is received after the most recent random access procedure, or a SS/PBCH block the UE identified during a most recent configured grant PUSCH transmission as described in clause 19.

For a CORESET other than a CORESET with index 0, if a UE is provided a single TCI state for a CORESET, or if the UE receives a MAC CE activation command for one or two of the provided TCI states for a CORESET, the UE assumes that the DM-RS antenna port associated with PDCCH receptions in the CORESET is quasi co-located with the one or more DL RS configured by the TCI states. For a CORESET with index 0, the UE expects that a CSI-RS configured with *qcl-Type* set to 'typeD' in a TCI state indicated by a MAC CE activation command for the CORESET is provided by a SS/PBCH block

- if the UE receives a MAC CE activation command for one of the TCI states, the UE applies the activation command in the first slot that is after slot where is the slot where the UE would transmit a PUCCH with HARQ-ACK information for the PDSCH providing the activation command, is the SCS configuration for the PUCCH in the slot when the activation command is applied, and is a number of slots for SCS configuration provided by *K-Mac* or if *K-Mac* is not provided.

If a UE is provided *DLorJoint-TCIState*, a DM-RS antenna port for PDCCH receptionsin a CORESET, other than a CORESET with index 0, associated only with USS sets and/or Type3-PDCCH CSS sets, and a DM-RS antenna port for PDSCH receptions scheduled by DCI formats provided by PDCCH receptions in the CORESET are quasi co-located with reference signals provided by the indicated *DLorJoint-TCIState* [6, TS 38.214].

If a UE is provided *followUnifiedTCIstate* for a CORESET, other than a CORESET with index 0, associated at least with CSS sets other than Type3-PDCCH CSS sets, and if *followUnifiedTCIstate* is set as enabled, a DM-RS antenna port for PDCCH receptions in the CORESET and a DM-RS antenna port for PDSCH receptions scheduled by DCI formats provided by PDCCH receptions in the CORESET are quasi co-located with reference signals provided by the indicated *DLorJoint-TCIState*.

If the UE is provided by *simultaneousTCI-UpdateList1* or *simultaneousTCI-UpdateList2* up to two lists of cells for simultaneous TCI state activation, the UE applies the antenna port quasi co-location provided by one or two *TCI-State* each with same activated *tci-StateID* value, to CORESETs with a same index in all configured DL BWPs of all configured cells in a list determined from a serving cell index, where one or two *tci-StateID*, the CORESET index, and the serving cell index are provided by a MAC CE command.

\*\*\* Unchanged text is omitted \*\*\*

For search space sets and that include *searchSpaceLinking* with value and , respectively, a UE monitors, in monitoring occasions with same index according to each of search space sets and in a slot, PDCCH candidates and , with , for detection of a DCI format with same information. The UE expects , , , and a same number of non-overlapping PDCCH monitoring occasions per slot based on corresponding *monitoringSymbolsWithinSlot*, for search space sets and . For CORESET associated with the search space set and for CORESET associated with the search space set , the UE is provided *tci-PresentInDCI* or tci-PresentDCI-1-2 for either none or both of CORESETs and . For CORESET associated with the search space set and for CORESET associated with the search space set , the UE is either not provided coresetPoolIndex value of 1 for any of the two CORESETs, or is provided coresetPoolIndex value of 1 for both CORESETs.

A UE can indicate by countLinkedCandidates a capability for counting PDCCH candidates and either as 2 PDCCH candidates or as 3 PDCCH candidates.

For search space sets , , , and , that include *searchSpaceLinking* with values , , , and , respectively, a UE expects to simultaneously monitor PDCCH candidates , and = only if a first CCE of or has different index than a first CCE of or in a CORESET configured with *cce-REG-MappingType* = '*nonInterleaved*' and with duration of one symbol.

If a UE

- is provided *monitoringCapabilityConfig* = *r16monitoringcapability* for a downlink cell,

- is provided, by *searchSpaceLinking*, for search space sets and on the downlink cell respective values and , and

- indicates *three-BDforSSsetLinking*

the UE counts each PDCCH candidate for the one of the search space sets and that the UE monitors PDCCH in the later span, as two PDCCH candidates. The UE does not expect a first PDCCH candidate from search space set or and a second PDCCH candidate from a search space set that does not include *searchSpaceLinking* to use a same set of CCEs and same scrambling in a same CORESET, and provide respective first and second DCI formats with same size, in any span other than the first span in a slot.

A UE does not expect to be provided *freqMonitorLocations* for a search space set in a serving cell if *intraCellGuardBandsDL-List* indicates that no intra-cell guard-bands are configured for the serving cell.

A UE that

- is configured for operation with carrier aggregation, and

- indicates support of search space sharing through *searchSpaceSharingCA-UL* or through *searchSpaceSharingCA-DL*, and

- has a PDCCH candidate with CCE aggregation level in CORESET associated with search space set for detection of a first DCI format, other than DCI format 0\_0 or DCI format 1\_0, having a first size and scheduling

- PUSCH transmission or configured grant Type 2 PUSCH release on serving cell , or

- PDSCH reception or having associated HARQ-ACK information without scheduling PDSCH reception on serving cell

can receive a corresponding PDCCH through a PDCCH candidate with CCE aggregation level in CORESET associated with search space set for detection of a second DCI format having a second size and associated with scheduling on serving cell if the first size and the second size are same and if neither of search space sets and includes *searchSpaceLinking*.

A UE expects to monitor PDCCH candidates for up to 4 sizes of DCI formats that include up to 3 sizes of DCI formats with CRC scrambled by C-RNTI per serving cell. The UE counts a number of sizes for DCI formats per serving cell based on a number of configured PDCCH candidates in respective search space sets for the corresponding active DL BWP.

A UE does not expect to detect, in a same PDCCH monitoring occasion, a DCI format with CRC scrambled by a SI-RNTI, RA-RNTI, MsgB-RNTI, TC-RNTI, P-RNTI, C-RNTI, CS-RNTI, or MCS-RNTI and a DCI format with CRC scrambled by a SL-RNTI or a SL-CS-RNTI for scheduling respective PDSCH reception and PSSCH transmission on a same serving cell.

A PDCCH candidate with index for a search space set using a set of CCEs in a CORESET on the active DL BWP for serving cell is not counted for monitoring if there is a PDCCH candidate with index for a search space set , or if there is a PDCCH candidate with index and , in the CORESET on the active DL BWP for serving cell using a same set of CCEs, the PDCCH candidates have identical scrambling, and the corresponding DCI formats for the PDCCH candidates have a same size; otherwise, the PDCCH candidate with index is counted for monitoring.

For search space sets and that include *searchSpaceLinking* with values and , and for search space set that does not include *searchSpaceLinking*, when a UE

- monitors PDCCH candidates for detection of a first DCI format,

- monitors PDCCH candidate for detection of a second DCI format having a same size as the first DCI format,

- the PDCCH candidate , or the PDCCH candidate , and the PDCCH candidate have identical scrambling and use a same set of CCEs over same symbols in a slot in a CORESET ,

the PDCCH candidate is not counted for monitoring and the UE assumes that a detected DCI format is the first DCI format. A UE may monitor PDCCH candidate depending on a corresponding capability [16, TS 38.306].

For search space sets and that include *searchSpaceLinking* with values and , and for search space set that does not include *searchSpaceLinking*, when a UE

- monitors PDCCH candidates for detection of a first DCI format and monitors PDCCH candidate for detection of a second DCI format, or monitors PDCCH candidates for detection of the first DCI format and monitors PDCCH candidate for detection of the second DCI format, and

- one of the PDCCH candidates and , and the PDCCH candidate , or one of the PDCCH candidates and , and the PDCCH candidate , have a first CCE with same index and are simultaneously monitored in a CORESET with *cce-REG-MappingType* = '*nonInterleaved*' and duration of one symbol,

the UE assumes that a detected DCI format is the first DCI format.

For search space sets , , , and that include *searchSpaceLinking* with values , , , and , respectively, and for detection of DCI formats with same size, a UE expects different CCEs or different scrambling in a CORESET for any of first PDCCH candidates and , with , and any of second PDCCH candidates and , with that the UE would simultaneously monitor.

Table 10.1-2 provides the maximum number of monitored PDCCH candidates, , per slot for a UE in a DL BWP with SCS configuration for operation with a single serving cell.

\*\*\* Unchanged text is omitted \*\*\*

## 11.1 Slot configuration

\*\*\* Unchanged text is omitted \*\*\*

For a set of symbols of a slot that are indicated to a UE as uplink by *tdd-UL-DL-ConfigurationCommon*, or *tdd-UL-DL-ConfigurationDedicated*, the UE does not receive DL PRS in the set of symbols of the slot, if the UE is not provided with a measurement gap.

For a set of symbols of a slot that are indicated to a UE as downlink by *tdd-UL-DL-ConfigurationCommon*, or *tdd-UL-DL-ConfigurationDedicated*, the UE does not transmit PUSCH, PUCCH, PRACH, or SRS when the PUSCH, PUCCH, PRACH, or SRS overlaps, even partially, with the set of symbols of the slot.

For a set of symbols of a slot that are indicated to a UE as flexible by *tdd-UL-DL-ConfigurationCommon*, and *tdd-UL-DL-ConfigurationDedicated* if provided, the UE does not expect to receive both dedicated higher layer parameters configuring transmission from the UE in the set of symbols of the slot and dedicated higher layer parameters configuring reception by the UE in the set of symbols of the slot.

For operation on a single carrier in unpaired spectrum, for a set of symbols of a slot indicated to a UE for reception of SS/PBCH blocks by *ssb-PositionsInBurst* in *SIB1* or by *ssb-PositionsInBurst* in *ServingCellConfigCommon* or, if the UE is not provided *DLorJoint-TCIState* or *followUnifiedTCIstate*,by *ssb-PositionsInBurst* in *SSB-MTCAdditionalPCI* associated to physical cell ID with active TCI states, the UE does not transmit PUSCH, PUCCH, PRACH in the slot if a transmission would overlap with any symbol from the set of symbols and the UE does not transmit SRS in the set of symbols of the slot. The UE does not expect the set of symbols of the slot to be indicated as uplink by *tdd-UL-DL-ConfigurationCommon*, or *tdd-UL-DL-ConfigurationDedicated*, when provided to the UE.

If a UE

- is configured with multiple serving cells and is provided with *directionalCollisionHandling-r16* = ‘enabled’ for a set of serving cell(s) among the multiple serving cells, and

- indicates support of *half-DuplexTDD-CA-SameSCS-r16* capability, and

- is not configured to monitor PDCCH for detection of DCI format 2\_0 on any of the multiple serving cells,

For a set of symbols of a slot that are indicated to the UE for reception of SS/PBCH blocks in a first cell of the multiple serving cells by *ssb-PositionsInBurst* in *SystemInformationBlockType1* or by *ssb-PositionsInBurst* in *ServingCellConfigCommon* or, if the UE is not provided *DLorJoint-TCIState* or *followUnifiedTCIstate*, by *ssb-PositionsInBurst* in *SSB-MTCAdditionalPCI* associated to physical cell ID with active TCI states, the UE does not transmit PUSCH, PUCCH, or PRACH in the slot if a transmission would overlap with any symbol from the set of symbols, and the UE does not transmit SRS in the set of symbols of the slot in

- any of the multiple serving cells if the UE is not capable of simultaneous transmission and reception as indicated by *simultaneousRxTxInterBandCA* among the multiple serving cells, and

- any one of the cells corresponding to the same band as the first cell, irrespective of any capability indicated by *simultaneousRxTxInterBandCA*.

For a set of symbols of a slot corresponding to a valid PRACH occasion and  symbols before the valid PRACH occasion, as described in clause 8.1, the UE does not receive PDCCH, PDSCH, or CSI-RS in the slot if a reception would overlap with any symbol from the set of symbols. The UE does not expect the set of symbols of the slot to be indicated as downlink by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated*.

\*\*\* Unchanged text is omitted \*\*\*

### 11.1.1 UE procedure for determining slot format

\*\*\* Unchanged text is omitted \*\*\*

For a set of symbols of a slot that are indicated as downlink/uplink by *tdd-UL-DL-ConfigurationCommon*, or *tdd-UL-DL-ConfigurationDedicated*, the UE does not expect to detect a DCI format 2\_0 with an SFI-index field value indicating the set of symbols of the slotas uplink/downlink, respectively, or as flexible.

For a set of symbols of a slot corresponding to SS/PBCH blocks with candidate SS/PBCH block indices corresponding to the SS/PBCH block indexes indicated to a UE by *ssb-PositionsInBurst* in *SIB1,* or by *ssb-PositionsInBurst* in *ServingCellConfigCommon*, as described in clause 4.1 or, if the UE is not provided *DLorJoint-TCIState* or *followUnifiedTCIstate*, by *ssb-PositionsInBurst* in *SSB-MTCAdditionalPCI* associated to physical cell ID with active TCI states, the UE does not expect to detect a DCI format 2\_0 with an SFI-index field value indicating the set of symbols of the slotas uplink.

For a set of symbols of a slot corresponding to a valid PRACH occasion and symbols before the valid PRACH occasion, as described in clause 8.1, the UE does not expect to detect a DCI format 2\_0 with an SFI-index field value indicating the set of symbols of the slotas downlink.

\*\*\* Unchanged text is omitted \*\*\*