**3GPP TSG- Meeting #**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  |  | **CR** |  | **rev** |  | **Current version:** |  |  |
|  | | | | | | | | |
| *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 |  | Core Network |  |

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|  | | | | | | | | | | |
| ***Title:*** | enance (Rel-16, CAT F) | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** |  | | | | | | | | | |
| ***Source to TSG:*** |  | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_newRAT-Perf  NR\_eMIMO-Perf  NR\_L1enh\_URLLC-perf  5G\_V2X\_NRSL-Perf  NR\_HST-Perf  NR\_perf\_enh-Perf | | | | |  | ***Date:*** | | |  |
|  |  | | | |  | |  | | |  |
| ***Category:*** |  |  | | | | | ***Release:*** | | |  |
|  | *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-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | This big CR merges endorsed draf CR to TS38.101-4 in RAN4#103-e. The reason for change in endorsed draft CR is copied below:  - R4-2210896:   1. There is wrong csi-ReportingBand configuration for Multiple PMI with 16TX Enhanced Type II Codebook. The csi-ReportingBand should be “1111111111111” for FDD 15kHz case and “11111111111111” for TDD 30kHz case. 2. The propagation condition for test case 7.2.2.2.3-3 is still within brackets. 3. In table 11.1.7.1.1-1, the number of transmitted UE should be n as Note 1. However, the parameter” 0 ≤ i ≤ n” indicate that there is n+1 transmitted UEs.   -R4-2210893:  RAN4 received reply LS from RAN1 (R4-2206150) on UE capability for supporting single DCI transmission schemes for multi-TRP. RAN1 clarified that for UE supporting single DCI TDM Scheme A, FDM or SDM transmission schemes in any CC/band the UE is required to support at least 2 active TCI states in the corresponding CC/band. RAN1 or RAN2 doesn’t define a pre-requisite that UE supporting single DCI transmission schemes are required to support at least 2 active TCI states. Clarification in RAN4 requirements applicability is needed that UE needs to support at least 2 active TCI states. For Inter-Slot TDM, the IE *maxNumberTCI-states-r16* is part of *supportInter-slotTDM-r16*. It need not be in a separate row.  -R4-2208532:  PDSCH requirements for HST-972 and TDLC300-600 are in square brackets, which is a leftover issue and the square brackets need to be removed.  -R4-2210895:  Currently there’s no difference between the CSI Report settings for PCell and SCell, so the reports will be scheduled on the same slots and using the same PUCCH resource. However, with this setting the UE may not be able to send both CSI Reports as per TS 38.213 cl. 9.2.5. If a UE is not provided with multi-CSI-PUCCH-ResourceList; it may not transmit PUCCH with the CSI report having lower priority.  Also for FDD-TDD/TDD-FDD CA combination, the number of CQI of Pcell and Scell will not be matched using current CSI-Report Periodicity and Offset setting. Hence purpose of the test of taking difference of PCC and SCC CQI report per time will not be achieved.  So, to prevent overlapping scheduling of the CSI Reports (or unmatched number of CQI), separate CSI Report offset settings for the PCell and SCell were specified.  And in order to ensure UE processing time for periodic CSI Report is achieved, NZP-CSI-RS periodicity and offset were also adjusted accordingly depending on test/CA combination.  Also clarification is needed with the way how NZP CSI-RS periodicity/offset slots and CSI reporting periodicity/offset slots are based on.  -R4-2210894  LTE UL-DL configuration is added in TDD LTE-NR coexistence tests  -R4-2208575  The CA requirements defined in Rel-16 required the configuration of PUCCH ressource groups. This is however a Rel-16 feature and since the CA tests also do apply in a release independent manner to Rel-15 devices, it is not possible to configure PUCCH ressource groups for those devices. Therefor this element needs to be removed from the configuration tables.  -R4-2209854  FR2 bands are only applicable for 2RX. But the antenna configuration in Table 7.5A.1-1 shows this test is applicable for both 1T4R and 2T4R | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | The summary of change in endorsed draft CR is copied as below:  -R4-2210896:   1. Update the csi-ReportingBand configuration for Multiple PMI with 16TX Enhanced Type II Codebook. 2. Removing the brackets from propagation condition. 3. Modify the paramter “0 ≤ i ≤ n” to “0 ≤ i < n”   -R4-2210893:  Added applicability notes that UE is required to support at least 2 active states for the requirement to be applicable for FDM and FDM scheme  Deleted additional row for applicability based on *maxNumberTCI-states-r16* and added it in applicability notes.  -R4-2208532:  Remove the [ ] from PDSCH requirements for HST-972 and TDLC300-600 .  -R4-2210895  Separated CSI Report offset settings for the CSI reports for the PCell and SCell. Updated NZP-CSI-RS periodicity and offset settings depending on test/CA combination. With condition based on CA band combinations stated for the tests.  Added notes in Table 6.2A.3.1.1-2 and Table 6.2A.3.1.1-3 to clarify the SCS which NZP-CSI-RS periodicity and offset slots and CSI reporting periodicity/offsets are based on.  -R4-220894  LTE UL-DL configuration is added in TDD LTE-NR coexistence tests  -R4-2208575  Remove Number of PUCCH RessourceGroups element.  -R4-2209854  Delete the paramter “1T4R” and “2T4R” in Table 7.5A.1-1 | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | The consequences if not approved for endorsed draft CR are coppied as below.  -R4-2210896  There will be inconsistence between the specification 38.101-4 and RAN 4  -R4-2210893:  Single DCI multi TRxP requirements applicability is incomplete.  -R4-2208532  The requirments are not completed  -R4-2210895  A conformant UE may fail.  -R4-2210894  Requirements for TDD LTE-NR coexistence will be incomplete.  agreements.  -R4-2208575  Rel-15 devices may fail the Test Cases.  -R4-2209854  The antenna configuration will still be wrong in the specification. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 5.1.1.3,  5.2.2.1.1, 5.2.3.1.1,  5.2.2.2.4, 5.2.3.2.4  5.2A  6.2A.3.1.1  6.3.2.1.6, 6.3.2.2.6, 6.3.3.1.6, 6.3.3.2.6  7.2.2.2.3,  7.5A.1  11.1.7.1.1 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | | **x** |  | Test specifications | | | | TS 38.521-4 | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

## 5.1 General

### 5.1.1 Applicability of requirements

#### 5.1.1.1 General

#### 5.1.1.2 Applicability of requirements for different number of RX antenna ports

<Start of Change R4-2210893>

#### 5.1.1.3 Applicability of requirements for optional UE features

The performance requirements in Table 5.1.1.3-1 shall apply for UEs which support optional UE features only.

Table 5.1.1.3-1: Requirements applicability for optional UE features

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| UE feature/capability [14] | Test type | | Test list | Applicability notes |
| SU-MIMO Interference Mitigation advanced receiver | FR1 FDD | PDSCH | Clause 5.2.2.1.1 (Test 3-1)  Clause 5.2.3.1.1 (Test 5-1) |  |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.1 (Test 3-1)  Clause 5.2.3.2.1 (Test 5-1) |  |
| Alternative additional DMRS position for co-existence with LTE CRS *(additionalDMRS-DL-Alt)* | FR1 FDD | PDSCH | Clause 5.2.2.1.4 (Test 1-2)  Clause 5.2.3.1.4 (Test 1-2) |  |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.4 (Test 1-2)  Clause 5.2.3.2.4 (Test 1-2) |  |
| Basic DL NR-NR CA operation (*supportedBandCombinationList*) | NR CA | SDR | Clause 5.5A.1 | 1)Up to 16 DL carriers  2)Same numerology across carrier for data/control channel at a given time |
| Enhanced demodulation processing for HST-SFN joint transmission scheme with velocity up to 500km/h | FR1 FDD | PDSCH | Clause 5.2.2.1.9 (Test 1-1)  Clause 5.2.3.1.9 (Test 1-1) |  |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.9 (Test 1-1)  Clause 5.2.3.2.9 (Test 1-1) |  |
| Alternative 64QAM MCS table for PDSCHNew 64QAM MCS table for PDSCH (*dl-64QAM-MCS-TableAlt*) | FR1 FDD | PDSCH | Clause 5.2.2.1.5  Clause 5.2.3.1.5  Clause 5.2.2.1.6  Clause 5.2.3.1.6 |  |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.5  Clause 5.2.3.2.5  Clause 5.2.2.2.6  Clause 5.2.3.2.6 |  |
| CQI table with target BLER of 10^-5New CQI table (cqi-TableAlt) | FR1 FDD | PDSCH | Clause 5.2.2.1.5  Clause 5.2.3.1.5 |  |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.5  Clause 5.2.3.2.5 |  |
| PDSCH repetitions over multiple slots *(pdsch-RepetitionMultiSlots)* | FR1 FDD | PDSCH | Clause 5.2.2.1.6  Clause 5.2.3.1.6 |  |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.6  Clause 5.2.3.2.6 |  |
| UE PDSCH processing capability #2 *(pdsch-ProcessingType2)* | FR1 FDD | PDSCH | Clause 5.2.2.1.7  Clause 5.2.3.1.7 |  |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.7  Clause 5.2.3.2.7 |  |
| Pre-emption indication for DL *(pre-EmptIndication-DL)* | FR1 FDD | PDSCH | Clause 5.2.2.1.8  Clause 5.2.3.1.8 |  |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.8  Clause 5.2.3.2.8 |  |
| Single DCI based SDM transmission for multi-TRxP (singleDCI-SDM-scheme-r16) | FR1 FDD | PDSCH | Clause 5.2.2.1.11  Clause 5.2.3.1.11 | The requirements apply when UE supports at least 2 active TCI states |
| FR1 TDD | PDSCH | Clause 5.2.2.2.11  Clause 5.2.3.2.11 |
| Multi DCI based multi-TRxP support (multiDCI-MultiTRP-r16) | FR1 FDD | PDSCH | Clause 5.2.2.1.12  Clause 5.2.3.1.12 |  |
| FR1 TDD | PDSCH | Clause 5.2.2.2.12  Clause 5.2.3.2.12 |  |
| Single DCI based FDM Scheme-A for multi-TRxP(supportFDM-SchemeA-r16) | FR1 FDD | PDSCH | Clause 5.2.2.1.13  Clause 5.2.3.1.13 | The requirements apply when UE supports at least 2 active TCI states |
| FR1 TDD | PDSCH | Clause 5.2.2.2.13  Clause 5.2.3.2.13 |
| Single DCI based inter-slot TDM for multi-TRxP (supportInter-slotTDM-r16) | FR1 FDD | PDSCH | Clause 5.2.2.1.14  Clause 5.2.3.1.14 | The requirements apply only when maxNumberTCI-states-r16 = 2. |
| FR1 TDD | PDSCH | Clause 5.2.2.2.14  Clause 5.2.3.2.14 |
| DRX Adaptation (*drx-Adaptation-r16*) | FR1 FDD | PDCCH | Clause 5.3.2.1.3 | If the Test 1 in Clause 5.3.2.1.3 is passed, the test coverage can be considered fulfilled without executing Test 3 in clause 5.3.2.1.1. |
| FR1 TDD | PDCCH | Clause 5.3.2.2.3 | If the Test 1 in Clause 5.3.2.2.3 is passed, the test coverage can be considered fulfilled without executing Test 2 in clause 5.3.2.2.1. |
| FR1 FDD | PDCCH | Clause 5.3.3.1.3 | If the Test 1 in Clause 5.3.3.1.3 is passed, the test coverage can be considered fulfilled without executing Test 3 in clause 5.3.3.1.1. |
| FR1 TDD | PDCCH | Clause 5.3.3.2.3 | If the Test 1 in Clause 5.3.3.2.3 is passed, the test coverage can be considered fulfilled without executing Test 2 in clause 5.3.3.2.1. |
| Validating P/SP-CSI-RS reception (*periodicAndSemi-PersistentCSI-RS-r16*) | FR1 TDD | PDSCH | Clause 5.2.2.2.15  Clause 5.2.3.2.15  Clause 5.2A.2.3  Clause 5.2A.3.3 | The requirements apply only in case tested UE supporting operations in shared spectrum access and validation of P/SP-CSI-RS reception based on DCI |
| Supported UL channels for dynamic channel access mode (*ul-DynamicChAccess-r16*) or UL channel access for semi-static channel access mode (ul-Semi-StaticChAccess-r16) or both | FR1 TDD | PDSCH | Clause 5.2.2.2.15  Clause 5.2.3.2.15 | The requirements apply only in case tested UE supports one of UL channels for dynamic channel access mode and UL channel access for semi-static channel access mode |

<End of Change R4-2210893>

<Unchanged sections skipped>

## 5.2 PDSCH demodulation requirements

### 5.2.1 1RX requirements

(Void)

### 5.2.2 2RX requirements

#### 5.2.2.1 FDD

<Start of Change R4-2208532>

##### 5.2.2.1.1 Minimum requirements for PDSCH Mapping Type A

The performance requirements are specified in Table 5.2.2.1.1-3 and Table 5.2.2.1.1-4, with the addition of test parameters in Table 5.2.2.1.1-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.1-1.

Table 5.2.2.1.1-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions and with different channel models, MCSs and number of MIMO layers | 1-1, 1-2, 1-3, 1-5, 1-6, 1-7, 2-1, 2-2 |
| Verify the PDSCH mapping Type A HARQ soft combining performance under 2 receive antenna conditions. | 1-4 |
| Verify the PDSCH mapping Type A performance requirements for Enhanced Receiver Type 1 under 2 receive antenna conditions. | 3-1 |

Table 5.2.2.1.1-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex mode | |  | FDD |
| Active DL BWP index | |  | 1 |
| PDSCH configuration | Mapping type |  | Type A |
|  | k0 |  | 0 |
|  | Starting symbol (S) |  | 2 |
|  | Length (L) |  | 12 |
|  | PDSCH aggregation factor |  | 1 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 4 for Test 1-1  2 for other tests |
|  | Resource allocation type |  | Test 1-2: Type 1 with start RB = 23, LRBs = 6  Other tests: Type 0 |
|  | RBG size |  | Test 1-2: N/A  Other tests: Config2 |
|  | VRB-to-PRB mapping type |  | Non-interleaved |
|  | VRB-to-PRB mapping interleaver bundle size |  | N/A |
| PDSCH DMRS configuration | DMRS Type |  | Type 1 |
|  | Number of additional DMRS |  | 2 for Tests 1-1, 1-5, 1-6, 1-7 1 for other tests |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CSI-RS for tracking | CSI-RS periodicity | Slots | Test 1-5, 1-6, 1-7: 10 for CSI-RS resource 1,2,3,4.  Other tests: Table 5.2-1. |
|  | CSI-RS offset | Slots | Test 1-5, 1-6, 1-7: 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4.  Other tests: Table 5.2-1. |
| Number of HARQ Processes | |  | 8 for Test 1-4  4 for other tests |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |

Table 5.2.2.1.1-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
|  |  |  |  |  |  | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.1-1.1 FDD | 10 / 15 | QPSK, 0.30 | TDLB100-400 | 2x2, ULA Low | 70 | -0.8 |
| 1-2 | R.PDSCH.1-1.2 FDD | 10 / 15 | QPSK, 0.30 | TDLC300-100 | 2x2, ULA Low | 70 | 0.2 |
| 1-3 | R.PDSCH.1-4.1 FDD | 10 / 15 | 256QAM, 0.82 | TDLA30-10 | 2x2, ULA Low | 70 | 24.6 |
| 1-4 | R.PDSCH.1-2.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-100 | 2x2, ULA Low | 30 | 1.1 |
| 1-5 | R.PDSCH.1-8.1 FDD | 10 / 15 | 16QAM, 0.48 | HST-750 | 1x2 | 70 | 6.2 |
| 1-6 | R.PDSCH.1-8.2 FDD | 10 / 15 | 64QAM, 0.43 | HST-972 | 1x2 | 70 | 9.9 |
| 1-7 | R.PDSCH.1-8.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-600 | 2x2 | 70 | 8.6 |

Table 5.2.2.1.1-4: Minimum performance for Rank 2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 2-1 | R.PDSCH.1-3.1 FDD | 10 / 15 | 64QAM, 0.50 | TDLA30-10 | 2x2, ULA Low | 70 | 19.4 |
| 2-2 | R.PDSCH.2-1.1 FDD | 20 / 30 | 64QAM, 0.50 | TDLA30-10 | 2x2, ULA Low | 70 | 19.7 |

Table 5.2.2.1.1-5: Minimum performance for Rank 2 and Enhanced Receiver Type 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
|  |  |  |  |  |  | Fraction of maximum throughput (%) | SNR (dB) |
| 3-1 | R.PDSCH.1-2.2 FDD | 10 / 15 | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Medium | 70 | 17.6 |

<End of Change R4-2208532>

<Unchanged sections skipped>

<Start of Change R4-2208532>

##### 5.2.3.1.1 Minimum requirements for PDSCH Mapping Type A

The performance requirements are specified in Table 5.2.3.1.1-3, Table 5.2.3.1.1-4, Table 5.2.3.1.1-5 and Table 5.2.3.1.1-6, with the addition of test parameters in Table 5.2.3.1.1-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.1-1.

Table 5.2.3.1.1-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH mapping Type A normal performance under 4 receive antenna conditions and with different channel models, MCSs and number of MIMO layers | 1-1, 1-2, 1-3, 1-5, 1-6, 1-7, 2-1, 2-2, 3-1, 4-1 |
| Verify the PDSCH mapping Type A HARQ soft combining performance under 4 receive antenna conditions. | 1-4 |
| Verify the PDSCH mapping Type A performance requirements for Enhanced Receiver Type 1 under 4 receive antenna conditions. | 5-1 |

Table 5.2.3.1.1-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex mode | |  | FDD |
| Active DL BWP index | |  | 1 |
| PDSCH configuration | Mapping type |  | Type A |
| k0 |  | 0 |
| Starting symbol (S) |  | 2 |
| Length (L) |  | 12 |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 4 for Test 1-1 wideband for Test 3-1  2 for other tests |
| Resource allocation type |  | Test 1-2: Type 1 with start RB = 23, LRBs = 6  Other test: Type 0 |
| RBG size |  | Test 1-2: N/A  Other tests: Config2 |
| VRB-to-PRB mapping type |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size |  | N/A |
| PDSCH DMRS configuration | DMRS Type |  | Type 1 |
| Number of additional DMRS |  | 2 for Test 1-1, 1-5, 1-6, 1-7  1 for other tests |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CSI-RS for tracking | CSI-RS periodicity | Slots | Test 1-5, 1-6, 1-7: 10 for CSI-RS resource 1,2,3,4.  Other tests: Table 5.2-1. |
| CSI-RS offset | Slots | Test 1-5, 1-6, 1-7: 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4.  Other tests: Table 5.2-1. |
| Number of HARQ Processes | |  | 8 for Test 1-4, 2-1  4 for other tests |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |

Table 5.2.3.1.1-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.1-1.1 FDD | 10 / 15 | QPSK, 0.30 | TDLB100-400 | 2x4, ULA Low | 70 | -3.5 |
| 1-2 | R.PDSCH.1-1.2 FDD | 10 / 15 | QPSK, 0.30 | TDLC300-100 | 2x4, ULA Low | 70 | -2.9 |
| 1-3 | R.PDSCH.1-4.1 FDD | 10 / 15 | 256QAM, 0.82 | TDLA30-10 | 2x4, ULA Low | 70 | 21.0 |
| 1-4 | R.PDSCH.1-2.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-100 | 2x4, ULA Low | 30 | -1.5 |
| 1-5 | R.PDSCH.1-8.1 FDD | 10 / 15 | 16QAM, 0.48 | HST-750 | 1x4 | 70 | 3.3 |
| 1-6 | R.PDSCH.1-8.2 FDD | 10 / 15 | 64QAM, 0.43 | HST-972 | 1x4 | 70 | 7.0 |
| 1-7 | R.PDSCH.1-8.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-600 | 2x4 | 70 | 5.0 |

Table 5.2.3.1.1-4: Minimum performance for Rank 2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Modulation format and code rate** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** | |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 2-1 | R.PDSCH.1-3.1 FDD | 10 / 15 | 64QAM, 0.50 | TDLA30-10 | 2x4, ULA Low | 70 | 13.5 |
| 2-2 | R.PDSCH.2-1.1 FDD | 20 / 30 | 64QAM, 0.50 | TDLA30-10 | 2x4, ULA Low | 70 | 13.7 |

Table 5.2.3.1.1-5: Minimum performance for Rank 3

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Modulation format and code rate** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** | |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 3-1 | R.PDSCH.1-2.3 FDD | 10 / 15 | 16QAM, 0.48 | TDLA30-10 | 4x4, ULA Low | 70 | 11.0 |

Table 5.2.3.1.1-6: Minimum performance for Rank 4

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | Bandwidth (MHz) / Subcarrier spacing (kHz) | **Modulation format and code rate** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** | |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 4-1 | R.PDSCH.1-2.4 FDD | 10 / 15 | 16QAM, 0.48 | TDLA30-10 | 4x4, ULA Low | 70 | 15.6 |

Table 5.2.3.1.1-7: Minimum performance for Rank 3 and Enhanced Receiver Type 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 5-1 | R.PDSCH.1-2.3 FDD | 10 / 15 | 16QAM, 0.48 | TDLA30-10 | 4x4, ULA Medium A | 70 | 22.3 |

<End of Change R4-2208532>

<Unchanged sections skipped>

#### 5.2.2.2 TDD

##### 5.2.2.2.1 Minimum requirements for PDSCH Mapping Type A

##### 5.2.2.2.2 Minimum requirements for PDSCH Mapping Type A and CSI-RS overlapped with PDSCH

##### 5.2.2.2.3 Minimum requirements for PDSCH Mapping Type B

##### 5.2.2.2.4 Minimum requirements for PDSCH Mapping Type A and LTE-NR coexistence

The performance requirements are specified in Table 5.2.2.2.4-3, with the addition of test parameters in Table 5.2.2.2.4-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.4-1.

Table 5.2.2.2.4-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions with CRS rate matching configured | 1-1, 1-2 |

<Start of Change R4-2210894>

**Table 5.2.2.2.4-2: Test parameters**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | TDD |
| Active DL BWP index | |  | 1 |
| NR UL transmission with a 7.5 kHz shift to the LTE raster | |  | true |
| PDSCH configuration | Mapping type |  | Type A |
|  | k0 |  | 0 |
|  | Starting symbol (S) |  | 3 |
|  | Length (L) |  | 9 for Test 1-1 11 for Test 1-2 |
|  | PDSCH aggregation factor |  | 1 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 2 |
|  | Resource allocation type |  | Type 0 |
|  | RBG size |  | Config2 |
|  | VRB-to-PRB mapping type |  | Non-interleaved |
|  | VRB-to-PRB mapping interleaver bundle size |  | N/A |
| PDSCH DMRS configuration | DMRS Type |  | Type 1 |
|  | Position of the first DM-RS for downlink |  | 3 |
|  | Number of additional DMRS |  | 1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CRS for rate matching (Note 1) | LTE carrier centre subcarrier location |  | Same as NR carrier centre subcarrier location |
|  | LTE carrier BW | MHz | 10 |
|  | Number of antenna ports |  | 4 |
|  | v-shift |  | 0 |
| Number of HARQ Processes | |  | 8 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | Specific to each TDD UL-DL pattern and as defined in Annex A.1.2 |
| Note 1: No MBSFN is configured on LTE carrier  Note 2: LTE carrier is configured with Uplink-downlink configuration 2 [Table 4.2-2, TS 36.211] and Special subframe configuration 7 [Table 4.2-1, TS 36.211]. The start of transmission of LTE frame is delayed by 2 LTE subframes with respect to the start of transmission of NR frame. | | | |

<End of Change R4-2210894 >

<Unchanged sections skipped>

#### 5.2.3.2 TDD

##### 5.2.3.2.1 Minimum requirements for PDSCH Mapping Type A

##### 5.2.3.2.2 Minimum requirements for PDSCH Mapping Type A and CSI-RS overlapped with PDSCH

##### 5.2.3.2.3 Minimum requirements for PDSCH Mapping Type B

##### 5.2.3.2.4 Minimum requirements for PDSCH Mapping Type A and LTE-NR coexistence

<Start of Change R4-2210894>

**Table 5.2.3.2.4-2: Test parameters**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | TDD |
| Active DL BWP index | |  | 1 |
| NR UL transmission with a 7.5 kHz shift to the LTE raster | |  | true |
| PDSCH configuration | Mapping type |  | Type A |
| k0 |  | 0 |
| Starting symbol (S) |  | 3 |
| Length (L) |  | 9 for Test 1-1 11 for Test 1-2 |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| Resource allocation type |  | Type 0 |
| RBG size |  | Config2 |
| VRB-to-PRB mapping type |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size |  | N/A |
| PDSCH DMRS configuration | DMRS Type |  | Type 1 |
| Position of the first DM-RS for downlink |  | 3 |
| Number of additional DMRS |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CRS for rate matching (Note 1) | LTE carrier centre subcarrier location |  | Same as NR carrier centre subcarrier location |
| LTE carrier BW | MHz | 10 |
| Number of antenna ports |  | 4 |
| v-shift |  | 0 |
| Number of HARQ Processes | |  | 8 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | Specific to each TDD UL-DL pattern and as defined in Annex A.1.2 |
| Note 1: No MBSFN is configured on LTE carrier  Note 2: LTE carrier is configured with Uplink-downlink configuration 2 [Table 4.2-2, TS 36.211] and Special subframe configuration 7 [Table 4.2-1, TS 36.211]. The start of transmission of LTE frame is delayed by 2 LTE subframes with respect to the start of transmission of NR frame. | | | |

<End of Change R4-2210894>

<Unchanged sections skipped>

<Start of Change R4-2208575>

## 5.2A PDSCH demodulation requirements for CA

The parameters specified in Table 5.2-1 for PDSCH single carrier tests are reused for PDSCH CA tests unless otherwise stated.

**Table 5.2A-1: Common test parameters for CA**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | FDD and TDD |
| Active DL BWP index | |  | 1 |
| PDSCH configuration | Mapping type |  | Type A |
| k0 |  | 0 |
| Starting symbol (S) |  | 2 |
| Length (L) |  | FDD: 12TDD: Specific to each Reference channel |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| Resource allocation type |  | Type 0 |
| RBG size |  | Config2 |
| VRB-to-PRB mapping type |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size |  | N/A |
| PDSCH DMRS configuration | DMRS Type |  | Type 1 |
| Number of additional DMRS |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Number of HARQ Processes | |  | As defined in Table 5.2A-2 |
| TDD UL-DL pattern | |  | 15kHz SCS: FR1.15-1  30kHz SCS: FR1.30-1 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | As defined in Table 5.2A-3 |
| PUCCH format for HARQ-ACK feedback | |  | PUCCH format 1 for cases with no more chan 2 DL CCs  PUCCH format 3 for cases with more than 2 DL CCs |

**Table 5.2A-2: Test parameters for number of HARQ processes**

|  |  |  |  |
| --- | --- | --- | --- |
| **HARQ process number** | | **CCs with the same duplex mode & SCS with Pcell** | **CCs with different duplex mode / SCS with Pcell** |
| FDD 15 kHz +  TDD 30 kHz CA | FDD PCell | 4 | 8 |
| TDD PCell | 8 | 8 |
| FDD 15 kHz +  TDD 15 kHz CA | FDD PCell | 4 | 4 |
| TDD PCell | 8 | 8 |
| TDD 15 kHz +  TDD 30 kHz CA | 15kHz PCell | 8 | 12 |
| 30kHz PCell | 8 | 8 |
| FDD 15 kHz +  FDD 15 kHz CA | FDD PCell | 4 | N/A |
| TDD 30 kHz +  TDD 30 kHz CA | TDD PCell | 8 | N/A |

**Table 5.2A-3: Test parameters for K1 values**

|  |  |  |  |
| --- | --- | --- | --- |
| **The number of slots between PDSCH and corresponding HARQ-ACK information** | | **CCs with the same duplex mode and SCS with Pcell** | **CCs with different duplex mode and/or SCS with Pcell** |
| FDD 15 kHz +  TDD 30 kHz CA | FDD PCell | {2} | {2} |
| TDD PCell | {8,7,6,5,5,4,3,2} | {7,5,4,11,9} |
| FDD 15 kHz +  TDD 15 kHz CA | FDD PCell | {2} | {2} |
| TDD PCell | {4,3,2,6} | {4,3,2,6,5} |
| TDD 15 kHz +  TDD 30 kHz CA | 15kHz PCell | {4,3,2,6} | {4,4,3,3,2,2,6,6} |
| 30kHz PCell | {8,7,6,5,5,4,3,2} | {7,5,4,11} |
| FDD 15 kHz +  FDD 15 kHz CA | FDD PCell | {2} | N/A |
| TDD 30 kHz +  TDD 30 kHz CA | TDD PCell | {8,7,6,5,5,4,3,2} | N/A |

<End of Change R4-2208575>

<Unchanged sections skipped>

<Start of Change R4-2210895>

## 6.2A Reporting of Channel Quality Indicator (CQI) for CA

### 6.2A.1 General

This clause includes the requirements for the reporting of channel quality indicator (CQI) with the UE configured for CA. The purpose is to verify that the CQI is correctly reported in accordance with the CQI definition given in TS 38.214 [12] for each CC with multiple cells configured for periodic reporting.

### 6.2A.2 1RX requirements

(Void)

### 6.2A.3 2RX requirements

#### 6.2A.3.1 CQI reporting definition under AWGN conditions

##### 6.2A.3.1.1 Minimum requirement for periodic CQI reporting

For each CA CQI reporting test defined in Table 6.2A.3.1.1-6, the test requirements and the test parameters are defined as below.

For each CC, the test parameters are specified in Table 6.2A.3.1.1-1. The additional parameters specified in Table 6.2A.3.1.1-2 are applicable for tests on FDD CC. The additional parameters specified in Table 6.2A.3.1.1-3 are applicable for tests on TDD CC.

For CA with 2 DL CC, for the SNR configuration specified in Table 6.2A.3.1.1-4, and using the downlink physical channels specified in Annex C.3.1 on each CC, the difference between the wideband CQI indices of PCell and SCell reported shall be such that

wideband CQIPCell – wideband CQISCell ≥ 2

for more than 90% of the time.

For CA with 3 or more DL CC, for the SNR configuration specified in Table 6.2A.3.1.1-5, and using the downlink physical channels specified in Annex C.3.1 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell1 and SCell2, 3… reported shall be such that

wideband CQIPCell – wideband CQISCell1 ≥ 2

wideband CQISCell1 – wideband CQISCell2, 3… ≥ 2

for more than 90% of the time.

Table 6.2A.3.1.1-1: CA CQI reporting test parameters for FDD and TDD CC

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Propagation channel | |  | AWGN |
| Antenna configuration | |  | 1×2 with static channel specified in Annex B.1 |
| ZP CSI-RS configuration | CSI-RS resource Type |  | Periodic |
| Number of CSI-RS ports (*X*) |  | 4 |
| CDM Type |  | FD-CDM2 |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0) |  | Row 5, 4 |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | 9 |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type |  | Periodic |
| Number of CSI-RS ports (*X*) |  | 1 |
| CDM Type |  | No CDM |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0) |  | Row 2, 6 |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | 13 |
| CSI-IM configuration | CSI-IM resource Type |  | Periodic |
| CSI-IM RE pattern |  | 0 |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) |  | (4, 9) |
| ReportConfigType | |  | Periodic |
| CQI-table | |  | Table 2 |
| reportQuantity | |  | cri-RI-PMI-CQI |
| timeRestrictionForChannelMeasurements | |  | Not configured |
| timeRestrictionForInterferenceMeasurements | |  | Not configured |
| cqi-FormatIndicator | |  | Wideband |
| pmi-FormatIndicator | |  | Wideband |
| Csi-ReportingBand | |  | 1111111 |
| aperiodicTriggeringOffset | |  | Not configured |
| Physical channel for CSI report | |  | PUCCH |
| Maximum number of HARQ transmission | |  | 1 |
| Measurement channel | |  | Derived as per section 5.1.3.2 of TS 38.214 [12] |

Table 6.2A.3.1.1-2: Additional test parameters for FDD CC

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex Mode | |  | FDD |
| Subcarrier spacing | | kHz | 15 |
| ZP CSI-RS configuration | CSI-RS  periodicity and offset | slot | 5/1 |
| NZP CSI-RS for CSI acquisition | NZP CSI-RS-timeConfig  periodicity and offset | slot | 5/1 |
| 10/1 if configured as SCell with TDD PCell (Test1) |
| CSI-IM configuration | CSI-IM timeConfig  periodicity and offset | slot | 5/1 |
| CSI-Report periodicity and offset | | slot | 5/0 if configured as PCell |
| 5/1 if configured as SCell with FDD PCell (Test2) |
| 20/18 if configured as SCell with TDD PCell (Test1) |
| CQI/RI/PMI delay | | ms | 8 |
| Sub-band Size | | RB | 8 for 5MHz and 10MHz,  16 for 15MHz, 20MHz and 25MHz, 32 for 30MHz, 40MHz and 50MHz |
| Note 1: NZP CSI-RS periodicity/offset slots are based on the carrier SCS and CSI reporting periodicity/offset slots are based on the PCell SCS. | | | |

Table 6.2A.3.1.1-3: Additional test parameters for TDD CC

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex Mode | |  | TDD |
| Subcarrier spacing | | kHz | 30 |
| TDD UL-DL pattern | |  | FR1.30-1 |
| ZP CSI-RS configuration | CSI-RS  periodicity and offset | slot | 10/1 |
| NZP CSI-RS for CSI acquisition | NZP CSI-RS-timeConfig  periodicity and offset | slot | 10/1 if configured as SCell with FDD PCell (Test1) |
| 20/1 |
| CSI-IM configuration | CSI-IM timeConfig  periodicity and offset | slot | 10/1 |
| CSI-Report periodicity and offset | | slot | 20/19 if configured as PCell |
| 20/18 if configured as SCell with TDD PCell (Test3) |
| 5/1 if configured as SCell with FDD PCell (Test1) |
| CQI/RI/PMI delay | | ms | 9.5 |
| Sub-band Size | | RB | 8 for 10MHz, 15MHz, 20MHz and 25MHz,  16 for 30MHz, 40MHz and 50MHz, 32 for 60MHz, 80MHz, 90MHz and 100MHz |
| Note 1: NZP CSI-RS periodicity/offset slots are based on the carrier SCS and CSI reporting periodicity/offset slots are based on the PCell SCS. | | | |

Table 6.2A.3.1.1-4: SNR configurations for 2 DL CA

|  |  |  |
| --- | --- | --- |
| Parameter | PCell | SCell |
| SNR (dB) | 10.0 | 4.0 |

Table 6.2A.3.1.1-5: SNR configurations for 3 or more DL CA

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | PCell | SCell1 | SCell2, 3… |
| SNR (dB) | 12.0 | 6.0 | 0.0 |

Table 6.2A.3.1.1-6: List of CA CQI reporting test

|  |  |
| --- | --- |
| Test number | CA duplex mode and SCS combination |
| 1 | FDD 15 kHz + TDD 30 kHz |
| 2 | FDD 15 kHz + FDD 15 kHz |
| 3 | TDD 30 kHz + TDD 30 kHz |
| Note 1: The applicability of requirements for different CA duplex modes, SCSs, is defined in 6.1.1.5.1.  Note 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 6.1.1.5.2. | |

<End of change R4-2210895>

<Unchanged sections skipped>

## 6.3 Reporting of Precoding Matrix Indicator (PMI)

### 6.3.1 1RX requirements

(Void)

### 6.3.2 2RX requirements

#### 6.3.2.1 FDD

<Start of change R4-2210896>

6.3.2.1.6 Multiple PMI with 16TX Enhanced Type II Codebook

For the parameters specified in Table 6.3.2.1.6-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.1.6-2.

**Table 6.3.2.1.6-1: Test parameters (dual-layer)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Test 1** |
| Bandwidth | | MHz | 10 |
| Subcarrier spacing | | kHz | 15 |
| Duplex Mode | |  | FDD |
| Propagation channel | |  | TDLA30-5 |
| Antenna configuration | |  | XP Medium 16 x 2  (N1,N2) = (4,2) |
| Beamforming Model | |  | As specified in Annex B.4.1 |
| ZP CSI-RS configuration | CSI-RS resource Type |  | Aperiodic |
| Number of CSI-RS ports (*X*) |  | 4 |
| CDM Type |  | FD-CDM2 |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1) |  | Row 5, (4,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (9,-) |
| CSI-RS  interval and offset | slot | Not configured |
| ZP CSI-RS trigger |  | 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0 |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type |  | Aperiodic |
| Number of CSI-RS ports (*X*) |  | 16 |
| CDM Type |  | CDM4 (FD2, TD2) |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1, k2, k3) |  | Row 12, (2, 4, 6, 8) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (5, -) |
| CSI-RS  interval and offset | slot | Not configured |
| aperiodicTriggeringOffset |  | 0 |
| CSI-IM configuration | CSI-IM resource Type |  | Aperiodic |
| CSI-IM RE pattern |  | Pattern 0 |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) |  | (4,9) |
| CSI-IM timeConfig  interval and offset | slot | Not configured |
| ReportConfigType | |  | Aperiodic |
| CQI-table | |  | Table 1 |
| reportQuantity | |  | cri-RI-PMI-CQI |
| timeRestrictionForChannelMeasurements | |  | Not configured |
| timeRestrictionForInterferenceMeasurements | |  | Not configured |
| cqi-FormatIndicator | |  | Wideband |
| pmi-FormatIndicator | |  | Not configured |
| Sub-band Size | | RB | 4 |
| csi-ReportingBand | |  | 1111111111111 |
| CSI-Report interval and offset | | slot | Not configured |
| Aperiodic Report Slot Offset | |  | 5 |
| CSI request | |  | 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0 |
| reportTriggerSize | |  | 1 |
| CSI-AperiodicTriggerStateList | |  | One State with one Associated Report Configuration  Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
| Codebook configuration | Codebook Type |  | typeII-r16 |
| *paramCombination-r16* |  | 6  (L =4, *pν* =1/2, β=1/2 ) |
| R*(numberOfPMISubbandsPerCQISubband-r16)* |  | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | (4,2) |
| (CodebookConfig-O1,CodebookConfig-O2) |  | (4,4) |
| CodebookSubsetRestriction |  | 0x 7FF  FFFF FFFF FFFF FFFF |
| RI Restriction (typeII-RI-Restriction-r16) |  | 0010 |
| Physical channel for CSI report | |  | PUSCH |
| CQI/RI/PMI delay | | ms | 8 |
| Maximum number of HARQ transmission | |  | 4 |
| Measurement channel | |  | R.PDSCH.1-6.3 |
| Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i1, i2 combination. The random precoder generation shall follow 'typeI-SinglePanel' codebook configuration as specified in table 6.3.2.1.3-1.  Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the gNB downlink before slot#(n+4).  Note 3: Randomization of the dual-cluster beam directions shall be used as specified in AnnexB.2.3.2.3A. The value of relative power ratio (p) shall be fixed as 1 during the test. | | | |

**Table 6.3.2.1.6-2: Minimum requirement**

|  |  |
| --- | --- |
| **Parameter** | **Test 1** |
| ** | 2.2 |

<End of change R4-2210896>

<Unchanged sections skipped>

#### 6.3.2.2 TDD

< Start of change R4-2210896>

6.3.2.2.6 Multiple PMI with 16Tx Enhanced Type II Codebook

For the parameters specified in Table 6.3.2.2.6-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.2.6-2.

**Table 6.3.2.2.6-1: Test parameters (dual-layer)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Test 1** |
| Bandwidth | | MHz | 40 |
| Subcarrier spacing | | kHz | 30 |
| Duplex Mode | |  | TDD |
| TDD DL-UL configurations | |  | FR1.30-1 as specified in Annex A |
| Propagation channel | |  | TDLA30-5 |
| Antenna configuration | |  | XP Medium 16 x 2  (N1,N2) = (4,2) |
| Beamforming Model | |  | As specified in Annex B.4.1 |
| ZP CSI-RS configuration | CSI-RS resource Type |  | Aperiodic |
| Number of CSI-RS ports (*X*) |  | 4 |
| CDM Type |  | FD-CDM2 |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1) |  | Row 5, (4,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (9,-) |
| CSI-RS  interval and offset | slot | Not configured |
| ZP CSI-RS trigger |  | 1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0 |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type |  | Aperiodic |
| Number of CSI-RS ports (*X*) |  | 16 |
| CDM Type |  | CDM4 (FD2, TD2) |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1, k2, k3) |  | Row 12, (2, 4, 6, 8) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (5, -) |
| CSI-RS  interval and offset | slot | Not configured |
| aperiodicTriggeringOffset |  | 0 |
| CSI-IM configuration | CSI-IM resource Type |  | Aperiodic |
| CSI-IM RE pattern |  | Pattern 0 |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) |  | (4,9) |
| CSI-IM timeConfig  interval and offset | slot | Not configured |
| ReportConfigType | |  | Aperiodic |
| CQI-table | |  | Table 1 |
| reportQuantity | |  | cri-RI-PMI-CQI |
| timeRestrictionForIChannelMeasurements | |  | Not configured |
| timeRestrictionForInterferenceMeasurements | |  | Not configured |
| cqi-FormatIndicator | |  | Wideband |
| pmi-FormatIndicator | |  | Not configured |
| Sub-band Size | | RB | 8 |
| csi-ReportingBand | |  | 11111111111111 |
| CSI-Report interval and offset | | slot | Not configured |
| Aperiodic Report Slot Offset | |  | 8 |
| CSI request | |  | 1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0 |
| reportTriggerSize | |  | 1 |
| CSI-AperiodicTriggerStateList | |  | One State with one Associated Report Configuration  Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
| Codebook configuration | Codebook Type |  | typeII-r16 |
| *paramCombination-r16* |  | 6  (L =4, *pν* =1/2, β=1/2 ) |
| R*(numberOfPMISubbandsPerCQISubband-r16)* |  | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | (4,2) |
| (CodebookConfig-O1,CodebookConfig-O2) |  | (4,4) |
| CodebookSubsetRestriction |  | 0x 7FF  FFFF FFFF FFFF FFFF |
| RI Restriction (typeII-RI-Restriction-r16) |  | 0010 |
| Physical channel for CSI report | |  | PUSCH |
| CQI/RI/PMI delay | | ms | 6.5 |
| Maximum number of HARQ transmission | |  | 4 |
| Measurement channel | |  | R.PDSCH.2-8.3 TDD |
| Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i1, i2 combination. The random precoder generation shall follow 'typeI-SinglePanel' codebook configuration as specified in table 6.3.2.2.3-1.  Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-6), this reported PMI cannot be applied at the gNB downlink before slot#(n+6).  Note 3: Randomization of the dual-cluster beam directions shall be used as specified in Annex B.2.3.2.3A. The value of relative power ratio (p) shall be fixed as 1 during the test. | | | |

**Table 6.3.2.2.6-2: Minimum requirement**

|  |  |
| --- | --- |
| **Parameter** | **Test 1** |
| ** | 2.2 |

<End of change R4-2210896>

<Unchanged sections skipped>

### 6.3.3 4RX requirements

#### 6.3.3.1 FDD

<Start of change R4-2210896>

6.3.3.1.6 Multiple PMI with 16Tx Enhanced Type II Codebook

For the parameters specified in Table 6.3.3.1.6-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.1.6-2.

**Table 6.3.3.1.6-1: Test parameters (dual-layer)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Test 1** |
| Bandwidth | | MHz | 10 |
| Subcarrier spacing | | kHz | 15 |
| Duplex Mode | |  | FDD |
| Propagation channel | |  | TDLA30-5 |
| Antenna configuration | |  | XP Medium 16 x 4  (N1,N2) = (4,2) |
| Beamforming Model | |  | As specified in Annex B.4.1 |
| ZP CSI-RS configuration | CSI-RS resource Type |  | Aperiodic |
| Number of CSI-RS ports (*X*) |  | 4 |
| CDM Type |  | FD-CDM2 |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1) |  | Row 5, (4,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (9,-) |
| CSI-RS  interval and offset | slot | Not configured |
| ZP CSI-RS trigger |  | 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0 |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type |  | Aperiodic |
| Number of CSI-RS ports (*X*) |  | 16 |
| CDM Type |  | CDM4 (FD2, TD2) |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1, k2, k3) |  | Row 12, (2, 4, 6, 8) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (5, -) |
| CSI-RS  interval and offset | slot | Not configured |
| aperiodicTriggeringOffset |  | 0 |
| CSI-IM configuration | CSI-IM resource Type |  | Aperiodic |
| CSI-IM RE pattern |  | Pattern 0 |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) |  | (4,9) |
| CSI-IM timeConfig  interval and offset | slot | Not configured |
| ReportConfigType | |  | Aperiodic |
| CQI-table | |  | Table 1 |
| reportQuantity | |  | cri-RI-PMI-CQI |
| timeRestrictionForChannelMeasurements | |  | Not configured |
| timeRestrictionForInterferenceMeasurements | |  | Not configured |
| cqi-FormatIndicator | |  | Wideband |
| pmi-FormatIndicator | |  | Not configured |
| Sub-band Size | | RB | 4 |
| csi-ReportingBand | |  | 1111111111111 |
| CSI-Report interval and offset | | slot | Not configured |
| Aperiodic Report Slot Offset | |  | 5 |
| CSI request | |  | 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0 |
| reportTriggerSize | |  | 1 |
| CSI-AperiodicTriggerStateList | |  | One State with one Associated Report Configuration  Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
| Codebook configuration | Codebook Type |  | typeII-r16 |
| *paramCombination-r16* |  | 6  (L =4, *pν* =1/2, β=1/2 ) |
| R*(numberOfPMISubbandsPerCQISubband-r16)* |  | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | (4,2) |
| (CodebookConfig-O1,CodebookConfig-O2) |  | (4,4) |
| CodebookSubsetRestriction |  | 0x 7FF  FFFF FFFF FFFF FFFF |
| RI Restriction (typeII-RI-Restriction-r16) |  | 0010 |
| Physical channel for CSI report | |  | PUSCH |
| CQI/RI/PMI delay | | ms | 8 |
| Maximum number of HARQ transmission | |  | 4 |
| Measurement channel | |  | R.PDSCH.1-6.3 |
| Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i1, i2 combination. The random precoder generation shall follow 'typeI-SinglePanel' codebook configuration as specified in table 6.3.3.1.3-1.  Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the gNB downlink before slot#(n+4).  Note 3: Randomization of the dual-cluster beam directions shall be used as specified in Annex B.2.3.2.3A. The value of relative power ratio (p) shall be fixed as 1 during the test. | | | |

**Table 6.3.3.1.6-2: Minimum requirement**

|  |  |
| --- | --- |
| **Parameter** | **Test 1** |
| ** | 2.2 |

<End of change R4-2210896>

<Unchanged sections skipped>

#### 6.3.3.2 TDD

<Start of change R4-2210896>

6.3.3.2.6 Multiple PMI with 16Tx Enhanced Type II Codebook

For the parameters specified in Table 6.3.3.2.6-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.2.6-2.

**Table 6.3.3.2.6-1: Test parameters (dual-layer)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Test 1** |
| Bandwidth | | MHz | 40 |
| Subcarrier spacing | | kHz | 30 |
| Duplex Mode | |  | TDD |
| TDD DL-UL configurations | |  | FR1.30-1 as specified in Annex A |
| Propagation channel | |  | TDLA30-5 |
| Antenna configuration | |  | XP Medium 16 x 4  (N1,N2) = (4,2) |
| Beamforming Model | |  | As specified in Annex B.4.1 |
| ZP CSI-RS configuration | CSI-RS resource Type |  | Aperiodic |
| Number of CSI-RS ports (*X*) |  | 4 |
| CDM Type |  | FD-CDM2 |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1) |  | Row 5, (4,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (9,-) |
| CSI-RS  interval and offset | slot | Not configured |
| ZP CSI-RS trigger |  | 1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0 |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type |  | Aperiodic |
| Number of CSI-RS ports (*X*) |  | 16 |
| CDM Type |  | CDM4 (FD2, TD2) |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1, k2, k3) |  | Row 12, (2, 4, 6, 8) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (5, -) |
| CSI-RS  interval and offset | slot | Not configured |
| aperiodicTriggeringOffset |  | 0 |
| CSI-IM configuration | CSI-IM resource Type |  | Aperiodic |
| CSI-IM RE pattern |  | Pattern 0 |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) |  | (4,9) |
| CSI-IM timeConfig  interval and offset | slot | Not configured |
| ReportConfigType | |  | Aperiodic |
| CQI-table | |  | Table 1 |
| reportQuantity | |  | cri-RI-PMI-CQI |
| timeRestrictionForIChannelMeasurements | |  | Not configured |
| timeRestrictionForInterferenceMeasurements | |  | Not configured |
| cqi-FormatIndicator | |  | Wideband |
| pmi-FormatIndicator | |  | Not configured |
| Sub-band Size | | RB | 8 |
| csi-ReportingBand | |  | 11111111111111 |
| CSI-Report interval and offset | | slot | Not configured |
| Aperiodic Report Slot Offset | |  | 8 |
| CSI request | |  | 1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0 |
| reportTriggerSize | |  | 1 |
| CSI-AperiodicTriggerStateList | |  | One State with one Associated Report Configuration  Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
| Codebook configuration | Codebook Type |  | typeII-r16 |
| *paramCombination-r16* |  | 6  (L =4, *pν* =1/2, β=1/2 ) |
| R*(numberOfPMISubbandsPerCQISubband-r16)* |  | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | (4,2) |
| (CodebookConfig-O1,CodebookConfig-O2) |  | (4,4) |
| CodebookSubsetRestriction |  | 0x 7FF  FFFF FFFF FFFF FFFF |
| RI Restriction (typeII-RI-Restriction-r16) |  | 0010 |
| Physical channel for CSI report | |  | PUSCH |
| CQI/RI/PMI delay | | ms | 6.5 |
| Maximum number of HARQ transmission | |  | 4 |
| Measurement channel | |  | R.PDSCH.2-8.3 TDD |
| Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i1, i2 combination. The random precoder generation shall follow 'typeI-SinglePanel' codebook configuration as specified in table 6.3.3.2.3-1.  Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-6), this reported PMI cannot be applied at the gNB downlink before slot#(n+6).  Note 3: Randomization of the dual-cluster beam directions shall be used as specified in Annex B.2.3.2.3A. The value of relative power ratio (p) shall be fixed as 1 during the test. | | | |

**Table 6.3.3.2.6-2: Minimum requirement**

|  |  |
| --- | --- |
| **Parameter** | **Test 1** |
| ** | 2.2 |

<End of change R4-2210896>

<Unchanged sections skipped>

## 7.2 PDSCH demodulation requirements

### 7.2.1 1RX requirements

(Void)

### 7.2.2 2RX requirements

#### 7.2.2.1 FDD

(Void)

#### 7.2.2.2 TDD

##### 7.2.2.2.1 Minimum requirements for PDSCH Mapping Type-A

##### 7.2.2.2.2 Minimum requirements for PDSCH repetitions over multiple slots

<Start of Change R4-2210896 >

7.2.2.2.3 Minimum requirements for PDSCH Mapping Type B

The performance requirements are specified in Table 7.2.2.2.3-3, with the addition of test parameters in Table 7.2.2.2. 3-2 and the downlink physical channel setup according to Annex C.5.1. The purpose is to verify the performance of PDSCH Type B scheduling.

The test purposes are specified in Table 7.2.2.2.3-1.

**Table 7.2.2.2.3-1: Test purpose**

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify PDSCH mapping Type B performance under 2 receive antenna conditions | 1-1 |

**Table 7.2.2.2.3-2: Test parameters**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | TDD |
| Active DL BWP index | |  | 1 |
| PDCCH configuration | Number of PDCCH candidates and aggregation levels |  | 1/AL8 |
| PDSCH configuration | Mapping type |  | Type B |
| k0 |  | 0 |
| Starting symbol (S) |  | 1 |
| Length (L) |  | 2 |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| Resource allocation type |  | Type 0 |
| RBG size |  | Config2 |
| VRB-to-PRB mapping type |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size |  | N/A |
| PDSCH DMRS configuration | DMRS Type |  | Type 1 |
| Number of additional DMRS |  | 0 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Number of HARQ Processes | |  | 8 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | Specific to each TDD UL-DL pattern and as defined in Annex A.1.3 |

**Table 7.2.2.2.3-3: Minimum performance for Rank 1**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Modulation format and code rate** | **TDD UL-DL pattern** | **Propagation**  **condition** | **Correlation matrix and antenna configuration** | **Reference value** | |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 1-1 | R.PDSCH. 5-1.2 TDD | 100 / 120 | QPSK, 0.30 | FR2.120-1 | TDLA30-75 | 2x2, ULA Low | 70 | 1.3 |

<End of change R4-2210896>

<Unchanged sections skipped>

<Start of Change R4-2209854>

## 7.5A Sustained downlink data rate provided by lower layers

### 7.5A.1 FR2 CA requirements

The Sustained Data Rate (SDR) requirements in this clause are applicable to the FR2 CA.

The purpose of the test is to verify that the Layer 1 and Layer 2 correctly process in a sustained manner the received packets corresponding to the maximum data rate indicated by UE capabilities*.* The sustained downlink data rate shall be verified in terms of the success rate of delivered PDCP SDU(s) by Layer 2. The test case below specifies the RF conditions and the required success rate of delivered TB by Layer 1 to meet the sustained data rate requirement.

The test parameters are determined by the following procedure:

- Step 1: Calculate the date rate for all supported CA configurations and set of per component carrier (CC) UE capabilities among all supported UE capabilities:

- Use Table 7.5A.1-3 to determine the MCS (=MCS1) achieving the largest data rate [clause 4.1.2 of TS 38.306 [14]] based on UE capabilities.

- Use Table 7.5A.1-4 to determine the largest MCS (=MCS2) requiring SNR below test equipment maximum achievable SNR for that CA configuration.

- Compute the data rate for CA configuration using the MCS = min(MCS1,MCS2) and the following equation for each CC in CA bandwidth combination.

where

J is the number of aggregated component carriers in CA bandwidth combination

TBSj is the total number of DL-SCH transport block bits calculated based on methodology in Clause 5.1.3.2 of TS 38.214 [12] and using parameters from Table 7.5A.1-1

µj is provided in Clause 4.2 of TS 38.211 for different subcarrier spacing values

- Step 2: Choose the CA bandwidth combination among all supported CA configurations that achieves maximum data rate in step 1 among all UE capabilities.

- Set of per CC UE capabilities includes channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor in accordance with clause 4.1.2 of TS 38.306 [14].

- When there are multiple sets of CA bandwidth combinations and UE capabilities (channel bandwidth, subcarrier spacing, number of MIMO layer, modulation format, scaling factor) with same data rate, select one among sets with the smallest aggregated channel bandwidth.

- Step 3: For each CC in chosen CA bandwidth combination, use determined MCS for each CC in step 1 for that CA configuration based on test parameters and indicated UE capabilities.

The TB success rate shall be higher than 85% when PDSCH is scheduled with MCS defined for the selected CA bandwidth combination and with the downlink physical channel setup according to Annex C.3.1.

The TB success rate is defined as 100%\*NDL\_correct\_rx/ (NDL\_newtx + NDL\_retx), where NDL\_newtx is the number of newly transmitted DL transport blocks, NDL\_retx is the number of retransmitted DL transport blocks, and NDL\_correct\_rx is the number of correctly received DL transport blocks.

The test parameters are specified in Table 7.5A.1-1.

Unless otherwise stated, no user data is scheduled on slot #0, 40 and 41 within 20 ms for SCS 60 kHz.

Unless otherwise stated, no user data is scheduled on slot #0, 80 and 81 within 20 ms for SCS 120 kHz.

Table 7.5A.1-1: Test parameters for FR2 TDD

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | | Unit | Value |
| PDSCH transmission scheme | | |  | Transmission scheme 1 |
| PTRS epre-Ratio | | |  | 0 |
| Channel bandwidth | | | MHz | Channel bandwidth from selected CA bandwidth combination |
| Common serving cell parameters | Physical Cell ID | |  | 0 |
| SSB position in burst | |  | First SSB in Slot #0 |
| SSB periodicity | | ms | 20 |
| First DMRS position for Type A PDSCH mapping | |  | 2 |
| Cross carrier scheduling | | |  | Not configured |
| Active DL BWP index | | |  | 1 |
| Actual carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 3) | | RBs | 0 |
| Subcarrier spacing | | kHz | 60 or 120 |
| DL BWP configuration #1 | RB Offset | |  | 0 |
| Number of contiguous PRB | |  | Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing |
| Subcarrier spacing | | kHz | 60 or 120 |
| Cyclic prefix | |  | Normal |
| PDCCH configuration | Slots for PDCCH monitoring | |  | Each slot |
| Symbols with PDCCH | |  | Symbols #0 |
| Number of PRBs in CORESET | |  | Table 7.5A.1-2 |
| Number of PDCCH candidates and aggregation levels | |  | 1/8 |
| CCE-to-REG mapping type | |  | Non-interleaved |
| DCI format | |  | 1-1 |
| TCI State | |  | TCI state #1 |
| PDCCH &PDCCH DMRS Precoding configuration | |  | Single Panel Type I, Random per slot with equal probability of precoder index 0 and 2, and with REG bundling granularity for number of Tx larger than 1 |
| PDSCH configuration | Mapping type | |  | Type A |
| k0 | |  | 0 |
| PDSCH aggregation factor | |  | 1 |
| PRB bundling type | |  | Static |
| PRB bundling size | |  | wideband |
| Resource allocation type | |  | Type 0 |
| RBG size | |  | Config2 |
| VRB-to-PRB mapping type | |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size | |  | N/A |
| Starting symbol (S) | |  | 1 |
| Length (L) | |  | 13 |
| PDSCH DMRS configuration | DMRS Type | |  | Type 1 |
| Number of additional DMRS | |  | 1 |
| Length | |  | 1 |
| Antenna ports indexes | |  | {1000} for 1 Layer CCs {1000, 1001} for 2 Layers CCs |
| Number of PDSCH DMRS CDM group(s) without data | |  | 1 |
| PTRS configuration | Frequency density (*KPT-RS*) | |  | 2 |
| Time density (*LPT-RS*) | |  | 1 |
| CSI-RS for tracking | Subcarrier indexes in the PRB used for CSI-RS | |  | k0 = 3 for CSI-RS resource 1,2,3,4 |
| OFDM symbols in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resource 1 and 3  l0 = 10 for CSI-RS resource 2 and 4 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 |
| CDM Type | |  | 'No CDM' for CSI-RS resource 1,2,3,4 |
| Density (ρ) | |  | 3 for CSI-RS resource 1,2,3,4 |
| CSI-RS periodicity | | Slots | 60 kHz SCS: 80 for CSI-RS resource 1,2,3,4  120 kHz SCS: 160 for CSI-RS resource 1,2,3,4 |
| CSI-RS offset | | Slots | 60 kHz SCS:  40 for CSI-RS resource 1 and 2  41 for CSI-RS resource 3 and 4  120 kHz SCS:  80 for CSI-RS resource 1 and 2  81 for CSI-RS resource 3 and 4 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = ceil(BWP size/4)\*4 |
| QCL info | |  | TCI state #0 |
| NZP CSI-RS for CSI acquisition | Subcarrier indexes in the PRB used for CSI-RS | |  | k0 = 4 |
| OFDM symbols in the PRB used for CSI-RS | |  | l0 = 13 |
| Number of CSI-RS ports (X) | |  | Same as number of transmit antenna |
| CDM Type | |  | 'FD-CDM2' |
| Density (ρ) | |  | 1 |
| CSI-RS periodicity | | Slots | 60 kHz SCS: 80  120 kHz SCS: 160 |
| CSI-RS offset | |  | 0 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = ceil(BWP size/4)\*4 |
| QCL info | |  | TCI state #1 |
| ZP CSI-RS for CSI acquisition | Subcarrier indexes in the PRB used for CSI-RS | |  | k0 = 0 |
| OFDM symbols in the PRB used for CSI-RS | |  | l0 = 12 |
| Number of CSI-RS ports (X) | |  | 4 |
| CDM Type | |  | 'FD-CDM2' |
| Density (ρ) | |  | 1 |
| CSI-RS periodicity | | Slots | 60 kHz SCS: 80  120 kHz SCS: 160 |
| CSI-RS offset | |  | 0 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = ceil(BWP size/4)\*4 |
| CSI-RS for beam refinement | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resource 1,2 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 8 for CSI-RS resource 1  l0 = 9 for CSI-RS resource 2 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2 |
| CDM Type | |  | 'No CDM' for CSI-RS resource 1,2 |
| Density (ρ) | |  | 3 for CSI-RS resource 1,2 |
| CSI-RS periodicity | | Slots | 60 kHz SCS: 80 for CSI-RS resource 1,2  120 kHz SCS: 160 for CSI-RS resource 1,2 |
| CSI-RS offset | | Slots | 0 for CSI-RS resource 1,2 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = ceil(BWP size/4)\*4 |
| Repetition | |  | ON |
| QCL info | |  | TCI state #1 |
| TCI state #0 | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type D |
| TCI state #1 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
| QCL Type |  | Type D |
| Maximum number of code block groups for ACK/NACK feedback | | |  | 1 |
| Number of HARQ Processes | | |  | 10 for FR2.60-1 and 8 for FR2.120-1 |
| K1 value | | |  | Specific to each UL-DL pattern |
| Maximum number of HARQ transmission | | |  | 4 |
| HARQ ACK/NACK bundling | | |  | Multiplexed |
| Redundancy version coding sequence | | |  | {0,2,3,1} |
| TDD UL-DL pattern | | |  | 60 kHz SCS: FR2.60-1  120 kHz SCS: FR2.120-1 |
| PDSCH & PDSCH DMRS Precoding configuration | | |  | Single Panel Type I, Precoder index 0 per slot with Wideband granularity for Rank 2 |
| Symbols for all unused REs | | |  | OP.1 FDD as defined in Annex A.5.1.1  OP.1 TDD as defined in Annex A.5.2.1 |
| Propagation condition | | |  | Static propagation condition  No external noise sources are applied |
| Antenna configuration | 1 layer CCs | |  | 1x2 |
| 2 layers CCs | |  | 2x2 |
| Physical signals, channels mapping and precoding | | |  | As specified in Annex B.4.1 |
| Note 1: PDSCH is scheduled only on full DL slots not containing SSB or TRS.  Note 2: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission.  Note 3: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing. | | | | |

Table 7.5A.1-2: Number of PRBs in CORESET

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SCS (kHz) | 50 MHz | 100 MHz | 200 MHz | 400 MHz |
| 60 | 66 | 132 | 264 | N.A |
| 120 | 30 | 66 | 132 | 264 |

Table 7.5A.1-3: MCS indexes for indicated UE capabilities

|  |  |  |  |
| --- | --- | --- | --- |
| Maximum number of PDSCH MIMO layers | Maximum modulation format (Note 1) | Scaling factor | MCS (Note 2) |
| 1 | 6 | 1 | 27 |
| 1 | 6 | 0.8 | 23 |
| 1 | 6 | 0.75 | 22 |
| 1 | 6 | 0.4 | 14 |
| 1 | 4 | 1 | 16 |
| 1 | 4 | 0.8 | 16 |
| 1 | 4 | 0.75 | 16 |
| 1 | 4 | 0.4 | 10 |
| 1 | 2 | 1 | 9 |
| 1 | 2 | 0.8 | 9 |
| 1 | 2 | 0.75 | 9 |
| 1 | 2 | 0.4 | 4 |
| 2 | 6 | 1 | 27 |
| 2 | 6 | 0.8 | 23 |
| 2 | 6 | 0.75 | 22 |
| 2 | 6 | 0.4 | 14 |
| 2 | 4 | 1 | 16 |
| 2 | 4 | 0.8 | 16 |
| 2 | 4 | 0.75 | 16 |
| 2 | 4 | 0.4 | 10 |
| 2 | 2 | 1 | 9 |
| 2 | 2 | 0.8 | 9 |
| 2 | 2 | 0.75 | 9 |
| 2 | 2 | 0.4 | 4 |
| Note 1: For the band(s) on which UE supporting “Maximum modulation format” of 8, the MCS index is derived from the rows with “Maximum modulation format” of 6.  Note 2: MCS Index is based on MCS index Table 1 defined in clause 5.1.3.1 of TS 38.214 [12]. | | | |

Table 7.5A.1-4: SNR required to achieve 85% of peak throughput under AWGN conditions

|  |  |  |
| --- | --- | --- |
| MCS Index (Note 1) | SNRBB(dB) for maximum number of PDSCH MIMO Layers = 1 | SNRBB(dB) for maximum number of PDSCH MIMO Layers = 2 |
| 13 | 6.2 | 9.0 |
| 14 | 7.2 | 9.9 |
| 15 | 8.2 | 10.9 |
| 16 | 8.7 | 11.6 |
| 17 | 10.1 | 13.2 |
| 18 | 10.7 | 13.7 |
| 19 | 11.7 | 14.7 |
| 20 | 12.7 | 15.6 |
| 21 | 13.6 | 16.5 |
| 22 | 14.8 | 17.6 |
| 23 | 15.6 | 18.6 |
| 24 | 16.9 | 19.7 |
| 25 | 18.3 | 21.2 |
| 26 | 19.3 | 22.3 |
| 27 | 20.5 | 23.3 |
| Note 1: MCS Index is based on MCS index Table 1 defined in clause 5.1.3.1 of TS 38.214 [12]. | | |

<End of Change R4-2209854>

<Unchanged sections skipped>

11 V2X requirements

This clause contains the performance requirements for the sidelink physical channels specified for V2X Sidelink Communication.

## 11.1 Demodulation performance requirements (Conducted requirements)

11.1.1 General

### 11.1.7 HARQ buffer soft combining test

#### 11.1.7.1 2Rx requirement

<Start of Change R4-22108896>

11.1.7.1.1 Minimum requirement

The purpose of this test is to verify the maximum number of HARQ processes per TTI supported by the V2X UE.

The minimum requirement is specified in Table 11.1.7.1.1-2 with the test parameters specified in Table 11.1.7.1.1-1.

**Table 11.1.7.1.1-1: Test Parameters**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Test 1** |
| Active cell(s) | |  | None |
| Active Sidelink UE(s) | |  | Sidelink UE i, 0 ≤ i < *n* (Note 1,2) |
| Sidelink UE i,  0 ≤ i < *n* | Sidelink Transmissions |  | PSCCH + PSSCH |
| PSSCH DMRS pattern |  | {2} |
| Time gap between initial transmission and retransmission | Slots | [*n* (Note 3)] |
| Timing offset (Note 4) | μs | 0 |
| Frequency offset (Note 5) | Hz | 0 |
| Synchronization source |  | GNSS or GNSS-equivalent |
| Antenna configuration |  | 1x2 Low |
| Redundancy version coding sequence |  | {0,2} |
| PSFCH resource period | | Slots | 1 |
| Note 1: *n* is the number of HARQ process UE can support (based on IE harq-RxProcessSidelink)  Note 2: When *n* = 16 or 24, sidelink UEs transmit one by one circularly for every slot;  When *n*=32, the first 31 UEs transmit signal one by one circularly for every slot and in the first subchannel, and the 32nd UE transmits signal in the first slot but in the second subchannel;  When *n*=48, the first 31 UEs transmit signal one by one circularly for every slot and in the first subchannel, the next 17 UEs transmit signal in the same slot as the first 17 UEs but in the second subchannel;  When *n*=64, first 31 UEs transmit signal one by one circularly for every slot and in the first subchannel, the next 31 UEs transmit signal one by one circularly for every slot and in the second subchannel, the last 2 UEs transmit signal in the same slot as the first 2 UEs in the third subchannel  Note 3: *k* = *n* if *n* < 32, otherwise *k* = 31  Note 4: Time offset of transmitted Sidelink UE signal is with respect to GNSS reference timing.  Note 5: Frequency offset of transmitted Sidelink UE signal with respect to GNSS reference frequency. | | | |

**Table 11.1.7.1.1-2: Minimum performance**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test num.** | **Bandwidth (MHz) / Subcarrier spacing(kHz)** | **PSSCH Reference channel** | **Propagation condition** | **Reference value** | |
| **PSSCH BLER (%)** | **SNR (dB) of PSSCH** |
| 1 | 20 / 30 | R.PSSCH.2-1.5 | AWGN | 5 | 10.9 |

<End of Change R4-2210896>