**3GPP TSG-RAN WG4 Meeting # 106-e *R4-23xxxxx***

**Athens, Greece, Februray 27th- March 3rd, 2023**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.101-4** | **CR** |  | **rev** |  | **Current version:** | **17.7.0** |  |
|  | | | | | | | | |
| *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:*** | BigCR on FR2-2 UE demodulation performance requirements in TS 38.101-4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Huawei,HiSilicon | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_ext\_to\_71GHz-Perf | | | | |  | ***Date:*** | | | 2023-03-07 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | B |  | | | | | ***Release:*** | | | Rel-17 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | RAN4 should submit BigCR for FR2-2 UE demodualtion and CSI requirements after RAN4 106 meeting | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Merge following draft CR into this BigCR  R4-2302973\_General and PBCH Demodulation requirements (QC) (Agreed in RAN4#106)  R4-2302855 draft CR on PDSCH requirements for 52.6 - 71 GHz band (Ericsson) (Agreed in RAN4#106)  R4-2220186\_DraftCR 71GHz CQI (Apple) (Agreed in RAN4#105)  R4-2302862 - DraftCR on PDCCH requirements for ext71GHz (Nokia) (Agreed in RAN4#106)  R4-2302856 Draft CR Introduction of FR2-2 PDSCH performance requirements for FR1+FR2-2 CA in TS 38.101-4 (Huawei) (Agreed in RAN4#106)  R4-2302974\_draftCR\_CA\_PDCCH\_CQI\_upto\_71Ghz (Apple) (Agreed in RAN4#106)  R4-2302854 Draft CR Updated simplification step for FR2-2 channel model in 38.101-4 (Huawei) (Agreed in RAN4#106)  R4-2215586\_DraftCR\_FRCs\_upto\_71GHz (Apple) (Agreed in RAN4 104# bis-e) (Only capture Table A.1.3-3, section A.3.3.2.6 and section A.3.4.2)  R4-2220183 (Apple) (Agreed in RAN4#105) (Only capture section A.3.2.2.8)  R4-2302928 Draft CR on FRC and Applicability for FR2-2 (Apple) (Agreed in RAN4#106)  R4-2215585\_DraftCR\_ChanModels\_upto\_71GHz (Apple) (Agreed in RAN4 #104bis-e) | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | The requirements will be missing | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 7.1, 7.2.2, 7.3.1, 7.3.2, 7.4.2, 8.1.1, 8.2.2.2.1, 9.1.1.1, 9.1.1.3, 9.2A.1.1, 9.3A.1,10.2A.1, A.1.3, A.3.2.2.8, A.3.3.2.6, A.3.4.2, B.2.1 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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:*** | |  | | | | | | | | |

<Start of R4-2302973 Part1>

7 Demodulation performance requirements (Radiated requirements)

7.1 General

7.1.1 Applicability of requirements

*<Unchanged skipped>*

7.1.1.3 Applicability of requirements for optional UE features

The performance requirements in Table 7.1.1.3-1 shall apply for UEs which support optional UE features only.

**Table 7.1.1.3-1: Requirements applicability for optional UE features**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE feature/capability [14]** | **Test type** | | **Test list** | **Applicability notes** |
| SU-MIMO Interference Mitigation advanced receiver | FR2-1 TDD | PDSCH | Clause 7.2.2.2.1 (Test 3-1) |  |
| Basic DL NR-NR CA operation (*supportedBandCombinationList*) | NR CA | SDR | Clause 7.5A.1 | 1) Up to 16 DL carriers  2) Same numerology across carrier for data/control channel at a given time |
| PDSCH repetitions over multiple slots *(pdsch-RepetitionMultiSlots)* | FR2-1 TDD | PDSCH | Clause 7.2.2.2.2 |  |
| DRX Adaptation (*drx-Adaptation-r16*) | FR2-1 TDD | PDCCH | Clause 7.3.2.2.3 | If the Test 3-1 in Clause 7.3.2.2.3 is passed, the test coverage can be considered fulfilled without executing Test 1-2 in clause 7.3.2.2.1. |
| 256QAM for PDSCH  (*pdsch-256QAM-FR2*) | FR2-1 TDD | PDSCH | Clause 7.2.2.2.1 (Test 1-4) |  |
| 256QAM for PDSCH (*pdsch-256QAM-FR2*) | FR2-1TDD | SDR | Clause 7.5A.1 | For UE capable of *pdsch-256QAM-FR2* for certain band(s), *mcs-Table* is configured to ‘64QAM’ for SDR test. |
| Support of FR2 HST operation [(FR2 UE power class PC6 signalling is used to indicate support of feature group)] | FR2-1 TDD | PDSCH | [Clause 7.2.2.2.4] |  |
| Support of Single Carrier operations with 120kHz SCS for FR2-2  (*initialAccessSSB-120kHz-r17)* | FR2-2 TDD | PDSCH | Clause 7.2.2.2.1  (Table 7.2.2.2.1-6: Test 4-1, 4-2, 4-3, 4-4) |  |
| PDCCH | Clause 7.3.2.2  (Table 7.3.2.2.1-2: Test 1a-1, 1a-2, 1a-3)  (Table 7.3.2.2.2-2, Test 3-1, 3-2) |  |
| PBCH | Clause 7.4.2.2  (Table 7.4.2.2-2: Test 3) |  |
| Support of 480kHz SCS for FR2-2  (*ul-FR2-2-SCS-480kHz-r17* and *initialAccessSSB-480kHz-r17)* | FR2-2 TDD | PDSCH | Clause 7.2.2.2.1  (Table 7.2.2.2.1-6: Test 4-5, 4-6) |  |
| PDCCH | Clause 7.3.2.2  (Table 7.3.2.2.1-2: Test 1a-4) (Table 7.3.2.2.2-2, Test 3-3) |  |
| PBCH | Clause 7.4.2.2  (Table 7.4.2.2-2: Test 4) |  |

*<Unchanged skipped>*

7.1.1.6 Applicability of requirements for operating bands in FR2-1

The applicability rules for FR2 operating bands are specified in Table 7.1.1.6-1.

**Table 7.1.1.6-1: Requirements applicability for operating bands in FR2-1**

|  |  |  |  |
| --- | --- | --- | --- |
| **Test type** | | **Test list** | **Applicability notes** |
| FR2-1 TDD | PDSCH | Clause 7.2.2.2.1 (Test 1-4) | The requirements are applicable for bands with FDL\_high higher than 40000 MHz and lower than 48200 MHz with additional margin as 1.5 dB. |
| PDSCH | Clause 7.2.2.2.1 (Test 2-6)  Clause 7.2.2.2.1 (Test 3-1) | The requirements are applicable for bands with FDL\_high higher than 40000 MHz and lower than 48200 MHz with additional margin as 0.5 dB. |

*<Unchanged skipped>*

7.1.1.8 Applicability of requirements for operating bands in FR2-2

The requirements in Table 7.1.1.8-1 are applicable for bands with FDL\_high higher than 52600 MHz and lower than 71000 MHz;

Other performance requirements mandatory for UE supporting NR operation defined in Section 7 but not included in Table 7.1.1.8-1 should not be considered applicable to FR2-2 bands;

**Table 7.1.1.8-1: Requirements applicability for operating bands in FR2-2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test type** | | **Test list** | **Applicability notes** | |
| FR2-2 TDD | PDSCH | Clause 7.2.2.2.1  (All Tests in Table 7.2.2.2.1-6) |  | The requirements apply if the device supports initial access on FR2-2 frequencies, or if it supports both Single Carrier and CA\_AX (FR1+FR2-2) operations; |
| ( | T |
| PDCCH | Clause 7.3.2.2  (All Tests in Table 7.3.2.2.1-2) (All tests in Table 7.3.2.2.2-2) |  |
| PBCH | Clause 7.4.2.2  (Table 7.4.2.2-2: Tests 3, 4) |  | |

<End of R4-2302973 Part1>

<Start of R4-2302855>

7.2 PDSCH demodulation requirements

The parameters specified in Table 7.2-1 are valid for all PDSCH demodulation tests unless otherwise stated.

**Table 7.2-1: Common Test Parameters**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Value** |
| PDSCH transmission scheme | | |  | Transmission scheme 1 |
| PTRS *epre-Ratio* | | |  | 0 |
| Actual carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 2) | | RBs | 0 |
| Subcarrier spacing | | kHz | 60 or 120 or 480 |
| DL BWP configuration #1 | Cyclic prefix | |  | Normal |
| RB offset | | RBs | 0 |
| Number of contiguous PRB | | PRBs | Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing |
| Common serving cell parameters | Physical Cell ID | |  | 0 |
| SSB position in burst | |  | First SSB in Slot #0 |
| SSB periodicity | | Ms | 20 |
| PDCCH configuration | Slots for PDCCH monitoring | |  | Each slot for 120 KHz SCS  (Xs, Ys) = (4, 1) for 480 KHz SCS |
| Symbols with PDCCH | |  | 0 |
| Number of PRBs in CORESET | |  | Table 7.2-2 for tested channel bandwidth and subcarrier spacing |
| Number of PDCCH candidates and aggregation levels | |  | 1/AL8 |
| 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 each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1 |
| Cross carrier scheduling | | |  | Not configured |
| CSI-RS for tracking | First subcarrier index in the PRB used for CSI-RS (*k0*) | |  | 0 for CSI-RS resource 1,2,3,4 |
| First OFDM symbol in the PRB used for CSI-RS (*l0*) | |  | 6 for CSI-RS resource 1 and 3 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  480 kHz SCS: [640] 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  480 kHz SCS:  320 for CSI-RS resource 1 and 2  321 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 | First subcarrier index in the PRB used for CSI-RS (*k0*) | |  | 0 |
| First OFDM symbol in the PRB used for CSI-RS (*l0*) | |  | 12 |
| Number of CSI-RS ports (*X*) | |  | 2 |
| CDM Type | |  | FD-CDM2 |
| Density (*ρ*) | |  | 1 |
| CSI-RS periodicity | | Slots | 60 kHz SCS: 80  120 kHz SCS: 160  480 kHz SCS: 640 |
| 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 | First subcarrier index in the PRB used for CSI-RS (k0) | |  | 4 |
| First OFDM symbol 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  480 kHz SCS: 640 |
| 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  480 kHz SCS: 640 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 |
| PDSCH DMRS configuration | Antenna ports indexes | |  | {1000} for Rank 1 tests {1000, 1001} for Rank 2 tests |
| Position of the first DMRS for PDSCH mapping type A | |  | 2 |
| Number of PDSCH DMRS CDM group(s) without data | |  | 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 |
| PTRS configuration | Frequency density (*KPT-RS*) | |  | 2 |
| Time density (*LPT-RS*) | |  | 1 |
| Resource Element Offset | |  | 2 |
| Maximum number of code block groups for ACK/NACK feedback | | |  | 1 |
| Maximum number of HARQ transmission | | |  | 120 KHz SCS: 4  480 KHz SCS: 16 |
| HARQ ACK/NACK bundling | | |  | Multiplexed |
| Redundancy version coding sequence | | |  | {0,2,3,1} |
| PDSCH & PDSCH DMRS Precoding configuration | | |  | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, andwith Wideband granularity |
| Symbols for all unused REs | | |  | OP.1 FDD as defined in Annex A.5.1.1 for FR2-1 tests  OP.1 TDD as defined in Annex A.5.2.1 for FR2-1 tests  No OCNG symbols on unused REs for FR2-2 |
| Physical signals, channels mapping and precoding | | |  | As specified in Annex B.4.1 |
| Note 1: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission.  Note 2: 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 7.2-2: 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 |
| 480 | N.A | N.A | N.A | 66 |

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

For PDSCH Type-A scheduling, the requirements are specified in Table 7.2.2.2.1-3, 7.2.2.2.1-4, 7.2.2.2.1-5, and 7.2.2.2.1-6 with the addition of the parameters in Table 7.2.2.2.1-2 and the downlink physical channel setup according to Annex C.5.1. The purpose is to verify the performance of PDSCH Type-A scheduling.

The test purposes are specified in Table 7.2.2.1.1-1.

**Table 7.2.2.1.1-1: Tests purpose**

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH mapping Type A normal performance in FR2-1 under 2 receive antenna conditions and with different channel models, MCSs andnumber of MIMO layers in FR2-1. | 1-1, 1-3, 1-4, 2-1, 2-2, 2-3, 2-4, 2-5, 2-6 |
| Verify the PDSCH mapping Type A HARQ soft combining performance in FR2-1 under 2 receive antenna conditions. | 1-2 |
| Verify the PDSCH mapping Type A performance requirements for Enhanced Receiver Type 1 in FR2-1 under 2 receive antenna conditions. | 3-1 |
| Verify the PDSCH mapping Type A normal performance in FR2-2 under 2 receive antenna conditions and with different channel models, MCSs and number of MIMO layers | 4-1, 4-2, 4-3, 4-4, 4-5, 4-6 |

**Table 7.2.2.2.1-2: Test Parameters**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | TDD |
| Active DL BWP index | |  | 1 |
| CSI-RS for tracking | First OFDM symbol in the PRB used for CSI-RS (*l0*) |  | For Test 1-1 and 1-2:  3 for CSI-RS resource 1 and 3 7 for CSI-RS resource 2 and 4 |
| CSI-RS offset | Slots | For Test 1-2:  82 for CSI-RS resource 1 and 2  83 for CSI-RS resource 3 and 4 |
| PDCCH configuration | Number of PDCCH candidates and aggregation levels |  | 1/AL4 for Test 1-4, 2-3, and 4-6  1/AL8 for other tests |
| Symbols with PDCCH |  | 0,1 for Test 4-6  0 for other tests |
| Number of PRBs in CORESET |  | 18 for Test 4-6  Table 7.2-2 for other tests |
| PDSCH configuration | Mapping type |  | Type A |
| *k0* |  | 0 |
| Starting symbol (S) |  | 1 for other Tests |
| Length (L) |  | Specific to each Reference channel as defined in A.3.2.2 |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | wideband for Test 1-1,  2 for other tests |
| Resource allocation type |  | est 2-1: Type 1 with start RB = 30, LRBs = 64  Test 4-6: Type 1 with start RB = 24, LRBs = 20  Other tests: Type 0 |
| RBG size |  | Test 2-1: 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 |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Number of HARQ Processes | |  | 8 for Test 1-1, 1-3, 1-4, 2-2, 2-4, 4-1, 4-2, 4-4,  10 for Test 2-1, 2-3, 2-5, 2-6, 3-1  16 for Test 1-2, 4-3, 4-5, 4-6 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | As defined in Annex A.1.3 |

**Table 7.2.2.2.1-3: Minimum performance for Rank 1 (FRC) for FR2-1**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Modulation and code rate** | **TDD UL-DL pattern** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** | |
| **Fraction of maximum throughput (%)** | **SNRBB (dB)** |
| 1-1 | R.PDSCH.5-1.1 TDD | 100 / 120 | QPSK, 0.30 | FR2.120-1A | TDLC60-300 | 2x2 ULA Low | 70 | -0.4 |
| 1-2 | R.PDSCH.5-2.1 TDD | 100 / 120 | 16QAM, 0.48 | FR2.120-1 | TDLA30-300 | 2x2 ULA Low | 30 | 1.7 |
| 1-3 | R.PDSCH.5-3.1 TDD | 100 / 120 | 64QAM, 0.46 | FR2.120-1 | TDLA30-300 | 2x2 XPL Medium | 70 | 12.4 |
| 1-4 | R.PDSCH.5-10.1 TDD | 50 / 120 | 256QAM  0.67 | FR2.120-1 | TDLD30-75 | 2x2 ULA Low | 70 | 20.2 |

**Table 7.2.2.2.1-4: Minimum performance for Rank 2 (FRC) for FR2-1**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Modulation and code rate** | **TDD UL-DL pattern** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** | |
| **Fraction of maximum throughput (%)** | **SNRBB (dB)** |
| 2-1 | R.PDSCH.5-4.1 TDD | 100 / 120 | QPSK, 0.30 | FR2.120-2 | TDLA30-75 | 2x2 ULA Low | 70 | 4.1 |
| 2-2 | R.PDSCH.5-2.2 TDD | 100 / 120 | 16QAM, 0.48 | FR2.120-1 | TDLA30-300 | 2x2 ULA Low | 70 | 14.4 |
| 2-3 | R.PDSCH.5-5.2 TDD | 50 / 120 | 16QAM,0.48 | FR2.120-2 | TDLA30-75 | 2x2 ULA Low | 70 | 14.0 |
| 2-4 | R.PDSCH.5-2.3 TDD | 200 / 120 | 16QAM, 0.48 | FR2.120-1 | TDLA30-300 | 2x2 ULA Low | 70 | 14.2 |
| 2-5 | R.PDSCH.4-1.1 TDD | 50 / 60 | 16QAM, 0.48 | FR2.60-1 | TDLA30-75 | 2x2 ULA Low | 70 | 14.3 |
| 2-6 | R.PDSCH.5-6.1 TDD | 100 / 120 | 64QAM, 0.43 | FR2.120-2 | TDLA30-75 | 2x2 ULA Low | 70 | 18.6 |

**Table 7.2.2.2.1-5: Minimum performance for Rank 2 (FRC) for Enhanced Receiver Type 1 for FR2-1**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Modulation and code rate** | **TDD UL-DL pattern** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** | |
| **Fraction of maximum throughput (%)** | **SNRBB (dB)** |
| 3-1 | R.PDSCH.5-5.1 TDD | 100 / 120 | 16QAM, 0.48 | FR2.120-2 | TDLA30-75 | 2x2 ULA Medium | 70 | 19.0 |

**Table 7.2.2.2.1-6: Minimum performance for Rank 1 (FRC) for FR2-2**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num** | **Reference channel** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Modulation and code rate** | **TDD UL-DL pattern** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** | |
| **Fraction of max through-put (%)** | **SNRBB (dB)** |
| 4-1 | R.PDSCH.5-1.1 TDD | 100 / 120 | QPSK, 0.30 | FR2.120-1 | TDLA30-650 | 2x2 ULA Low | 70 | [0.9] |
| 4-2 | R.PDSCH.5-2.1 TDD | 100 / 120 | 16QAM, 0.48 | FR2.120-1 | TDLA30-200 | 2x2 ULA Low | 70 | [9.0] |
| 4-3 | R.PDSCH.5-2.1 TDD | 100 / 120 | 16QAM, 0.48 | FR2.120-1 | TDLA30-650 | 2x2 ULA Low | 30 | [2.7] |
| 4-4 | R.PDSCH.5-3.2 TDD | 100 / 120 | 64QAM, 0.43 | FR2.120-1 | TDLD30-200 | 2x2 ULA Low | 70 | [11.6] |
| 4-5 | R.PDSCH.8-1.1 TDD | 400 / 480 | QPSK, 0.30 | FR2.480-1 | TDLA10-200 | 2x2 ULA Low | 70 | [1.0] |
| 4-6 | R.PDSCH.8-2.1 TDD | 400 / 480 | 16QAM  0.48 | FR2.480-1 | TDLD10-200 | 2x2 ULA Low | 70 | [8.3] |

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7.3 PDCCH demodulation requirements

The receiver characteristics of the PDCCH are determined by the probability of miss-detection of the Downlink Scheduling Grant (Pm-dsg).

The parameters specified in Table 7.3-1 are valid for all PDCCH tests unless otherwise stated.

**Table 7.3-1: Common test Parameters**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Value** |
| Carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 1) | |  | 0 |
| DL BWP configuration #1 | Cyclic prefix | |  | Normal |
| Common serving cell parameters | Physical Cell ID | |  | 0 |
| SSB position in burst | |  | First SSB in Slot #0 |
| SSB periodicity | | ms | 20 |
| PDCCH configuration | Slots for PDCCH monitoring | |  | Each slot |
| Number of PDCCH candidates | |  | 1 |
| Frequency domain resource allocation for CORESET | |  | Start from RB = 0 with contiguous RB allocation |
| TCI state | |  | TCI state #1 |
| CSI-RS for tracking | First subcarrier index in the PRB used for CSI-RS (k0) | |  | 0 |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | CSI-RS resource 1: 4 CSI-RS resource 2: 8 CSI-RS resource 3: 4 CSI-RS resource 4: 8 |
| Number of CSI-RS ports (X) | |  | 1 |
| CDM Type | |  | No CDM |
| Density (ρ) | |  | 3 |
| CSI-RS periodicity | | Slots | 160 |
| CSI-RS offset | | Slots | 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 beam refinement | First subcarrier index in the PRB used for CSI-RS (k0) | |  | 0 |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | CSI-RS resource 1: 8  CSI-RS resource 2: 9 |
| Number of CSI-RS ports (X) | |  | 1 |
| CDM Type | |  | No CDM |
| Density (ρ) | |  | 3 |
| CSI-RS periodicity | | Slots | 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 |
| PDCCH & PDCCH DMRS Precoding configuration | | |  | Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 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 |
| 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 |
| 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. |
| Note 1: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing.  Note 2: The high layer parameter *precoderGranularity* equals to *sameAsREG-bundle* as defined in clause 7.4.1.3 of TS 38.211 [9] | | | | |

7.3.1 1RX requirements

(Void)

7.3.2 2RX requirements

7.3.2.1 FDD

(Void)

7.3.2.2 TDD

The parameters specified in Table 7.3.2.2-1 and 7.3.2.2-2 are valid for all TDD tests unless otherwise stated.

**Table 7.3.2.2-1: Test Parameters with 120kHz for FR2**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Unit** | **1 Tx Antenna** | **2 Tx Antenna** |
| TDD UL-DL pattern |  | FR2.120-1 | |
| CCE to REG mapping type |  | Interleaved | |
| REG bundle size |  | 2 for test 1-1  6 for test 1-2 | 2 |
| Interleaver size |  | 3 for test 1-1  2 for test 1-2 | 3 |
| Shift index |  | 0 | |

**Table 7.3.2.2-2: Test Parameters with 480kHz for FR2-2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | | **Unit** | **1 Tx Antenna** | **2 Tx Antenna** |
| TDD UL-DL pattern | |  | FR2.480-1 | |
| CCE to REG mapping type | |  | Interleaved | |
| REG bundle size | |  | 6 | 2 |
| Interleaver size | |  | 2 | 3 |
| Shift index | |  | 0 | |
| PDCCH configuration | Slots for PDCCH monitoring |  | Every 4th slot | |
| CSI-RS for tracking | CSI Periodicity | Slots | 640 | |
| CSI-RS offset | Slots | 320 for CSI-RS resource 1 and 2  321 for CSI-RS resource 3 and 4 | |
| NZP CSI-RS for beam refinement | CSI-RS periodicity | Slots | 640 for CSI-RS resource 1,2 | |

7.3.2.2.1 1 Tx Antenna performances

For the parameters specified in Table 7.3.2.2-1 and 7.3.2.2-2, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 7.3.2.2.1-1 and 7.3.2.2.1-2. The downlink physical setup is in accordance with Annex C.5.1.

**Table 7.3.2.2.1-1: Minimum performance requirements with 120 kHz SCS for FR2-1**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth (MHz)** | **CORESET RB** | **CORESET duration** | **Aggregation level** | **Reference Channel** | **Propagation Condition** | **Antenna configuration and correlation Matrix** | **Reference value** | |
| **Pm-dsg (%)** | **SNRBB (dB)** |
| 1-1 | 100 | 60 | 1 | 2 | R.PDCCH. 5-1.1 TDD | TDLA30-75 | 1x2 Low | 1 | 6.4 |
| 1-2 | 100 | 60 | 1 | 4 | R.PDCCH. 5-1.2 TDD | TDLA30-300 | 1x2 Low | 1 | 3.0 |

**Table 7.3.2.2.1-2: Minimum performance requirements for FR2-2**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **CORESET RB** | **CORESET duration** | **Aggregation level** | **Reference Channel** | **Propagation Condition** | **Antenna configuration and correlation Matrix** | **Reference value** | |
| **Pm-dsg (%)** | **SNRBB (dB)** |
| 1a-1 | 100/120 | 60 | 1 | 2 | R.PDCCH.5-1.1 TDD | TDLA30-200 | 1x2 Low | 1 | [6.6] |
| 1a-2 | 100/120 | 60 | 1 | 4 | R.PDCCH.5-1.2 TDD | TDLA30-650 | 1x2 Low | 1 | [3.9] |
| 1a-3 | 400/480 | 60 | 1 | 8 | R.PDCCH.6-1.1 TDD | TDLA10-200 | 1x2 Low | 1 | [1.2] |

7.3.2.2.2 2 Tx Antenna performances

For the parameters specified in Table 7.3.2.2-1 and 7.3.2.2-2, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 7.3.2.2.2-1 and 7.3.2.2.2-2. The downlink physical setup is in accordance with Annex C.5.1.

**Table 7.3.2.2.2-1: Minimum performance requirements with 120 kHz SCS for FR2-1**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth (MHz)** | **CORESET RB** | **CORESET duration** | **Aggregation level** | **Reference Channel** | **Propagation Condition** | **Antenna configuration and correlation Matrix** | **Reference value** | |
| **Pm-dsg (%)** | **SNRBB (dB)** |
| 2-1 | 100 | 60 | 1 | 8 | R.PDCCH. 5-1.3 TDD | TDLA30-75 | 2x2 Low | 1 | 0.1 |
| 2-2 | 100 | 60 | 2 | 16 | R.PDCCH. 5-2.1 TDD | TDLA30-75 | 2x2 Low | 1 | -3.0 |

**Table 7.3.2.2.2-2: Minimum performance requirements for FR2-2**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **CORESET RB** | **CORESET duration** | **Aggregation level** | **Reference Channel** | **Propagation Condition** | **Antenna configuration and correlation Matrix** | **Reference value** | |
| **Pm-dsg (%)** | **SNRBB (dB)** |
| 3-1 | 100/120 | 60 | 1 | 8 | R.PDCCH.5-1.3 TDD | TDLA30-200 | 2x2 Low | 1 | [0.1] |
| 3-2 | 100/120 | 60 | 2 | 16 | R.PDCCH.5-2.1 TDD | TDLA30-650 | 2x2 Low | 1 | [-3.1] |
| 3-3 | 400/480 | 60 | 2 | 16 | R.PDCCH.6-2.1 TDD | TDLA10-200 | 2x2 Low | 1 | [-2.9] |

7.3.2.2.3 Minimum requirements for power saving

During the test the UE shall monitor the *DCI format 2\_6* PDCCH in DRX off state and decide whether to receive the following PDCCH in DRX on period.

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7.4 PBCH demodulation requirements

*<Unchanged skipped>*

7.4.2 2RX requirements

7.4.2.2 TDD

**Table 7.4.2.2-1: Test parameters for PBCH**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Single antenna port** |
| Physical Cell ID |  | 0 |
| Cyclic prefix |  | Normal |
| Number of SS/PBCH blocks within an SS burst set periodicity |  | 1 |
| SS/PBCH block index Note1 |  | 0 |
| SS/PBCH block periodicity | ms | 20 |
| TDD UL-DL pattern |  | FR2.120-1 for Tests 1,2,3 in Table 7.4.2.2-2  and Tests 1, 2 in Table 7.4.2.2.3  FR2.480-1 for Test 4 in Table 7.4.2.2-2 |
| Note 1: as specified in clause 4.1 of TS 38.213 [11]  Note 2: as specified in clause 11.1 of TS 38.213 [11] | | |

For the parameters specified in Table 7.4.2.2-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 7.4.2.2-2 in case SS/PBCH block index is not known and below the specified values in Table.7.4.2.2-3 in case SS/PBCH block index is known. The downlink physical setup is in accordance with Annex C.5.1.

**Table 7.4.2.2-2: Minimum performance PBCH in case SS/PBCH block index is not known**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Reference channel** | **Propagation condition** | **Antenna configuration and correlation matrix** | **Reference value** | |
| **Pm-bch (%)** | **SNRBB (dB)** |
| 1 | 100 / 120 | R.PBCH.5 | TDLA30-300 | 1 x 2 Low | 1 | -6.3 |
| 2 | 100 / 240 | R.PBCH.6 | TDLA30-75 | 1 x 2 Low | 1 | -6.1 |
| 3 | 100 / 120 | R.PBCH.5 | TDLA30-650 | 1 x 2 Low | 1 | [-4.5] |
| 4 | 400 / 480 | R.PBCH.7 | TDLA10-200 | 1 x 2 Low | 1 | [-3.9] |

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*<Unchanged skipped>*

8.2.2.2.1 CQI reporting under AWGN conditions

The reporting accuracy of the channel quality indicator (CQI) under frequency non-selective conditions is determined by the reporting variance and the BLER performance using the transport format indicated by the reported CQI median. The purpose is to verify that the reported CQI values are in accordance with the CQI definition given in TS 38.214 [12]. To account for sensitivity of the input SNR the reporting definition is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

8.2.2.2.1.1 Minimum requirement for periodic CQI reporting

For the parameters specified in Table 8.2.2.2.1.1-1 and Table 8.2.2.2.1.1-2, and using the downlink physical channels specified in Annex C.5.1, the minimum requirements are specified by the following:

a) the reported CQI value shall be in the range of ±1 of the reported median more than 90% of the time;

b) if the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

**Table 8.2.2.2.1.1-1 Test parameters for FR2-1**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Test 1** | | **Test 2** | |
| Bandwidth | | | MHz | 100 | | | |
| Subcarrier spacing | | | kHz | 120 | | | |
| Duplex Mode | | |  | TDD | | | |
| TDD Slot Configuration | | |  | FR2.120-2 Annex A.1.3 | | | |
| SNRBB | | | dB | 8 | 9 | 14 | 15 |
| Propagation channel | | |  | AWGN | | | |
| Antenna configuration | | |  | 2×2 with static channel specified in Annex B.1 | | | |
| Beamforming Model | | |  | As specified in Annex B.4.1 | | | |
| 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, k1 ) | |  | 8 | | | |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) | |  | 13 | | | |
| CSI-RS  periodicity and offset | | slot | 8/1 | | | |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | *Periodic* | | | |
| Number of CSI-RS ports (*X*) | |  | 2 | | | |
| CDM Type | |  | *fd-CDM2* | | | |
| Density (ρ) | |  | 1 | | | |
| First subcarrier index in the PRB used for CSI-RS (k0, k1 ) | |  | 6 | | | |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) | |  | 13 | | | |
| NZP CSI-RS-timeConfig  periodicity and offset | | slot | 8/1 | | | |
| CSI-IM configuration | CSI-IM resource Type | |  | Periodic | | | |
| CSI-IM RE pattern | |  | 1 | | | |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) | |  | (8, 13) | | | |
| CSI-IM timeConfig  periodicity and offset | | slot | 8/1 | | | |
| ReportConfigType | | |  | *Periodic* | | | |
| CQI-table | | |  | Table 1 | | | |
| reportQuantity | | |  | *cri-RI-PMI-CQI* | | | |
| timeRestrictionForChannelMeasurements | | |  | *Not configured* | | | |
| timeRestrictionForInterferenceMeasurements | | |  | *Not configured* | | | |
| cqi-FormatIndicator | | |  | *Wideband* | | | |
| pmi-FormatIndicator | | |  | *Wideband* | | | |
| Sub-band Size | | | RB | 8 | | | |
| csi-ReportingBand | | |  | 111111111 | | | |
| CSI-Report periodicity and offset | | | slot | 8/3 | | | |
| aperiodicTriggeringOffset | | |  | *Not configured* | | | |
| Codebook configuration | | Codebook Type |  | *typeI-SinglePanel* | | | |
| Codebook Mode |  | 1 | | | |
| (CodebookConfig-N1,CodebookConfig-N2) |  | *Not configured* | | | |
| CodebookSubsetRestriction |  | 010000 | | | |
| RI Restriction |  | N/A | | | |
| Physical channel for CSI report | | |  | PUCCH | | | |
| CQI/RI/PMI delay | | | ms | 8.375 | | | |
| Maximum number of HARQ transmission | | |  | 1 | | | |
| Measurement channel | | |  | As specified in Table A.4-1, TBS.1-2 | | | |

**Table 8.2.2.2.1.1-2 Test parameters for FR2-2**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Test 1** | | **Test 2** | |
| Bandwidth | | | MHz | 100 | | | |
| Subcarrier spacing | | | kHz | 120 | | | |
| Duplex Mode | | |  | TDD | | | |
| TDD Slot Configuration | | |  | FR2.120-2 Annex A.1.3 | | | |
| SNRBB | | | dB | [0 | [1 | 7 | 8 |
| Propagation channel | | |  | AWGN | | | |
| Antenna configuration | | |  | 2×2 with static channel specified in Annex B.1 | | | |
| Beamforming Model | | |  | As specified in Annex B.4.1 | | | |
| 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, k1 ) | |  | 8 | | | |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) | |  | 13 | | | |
| CSI-RS  periodicity and offset | | slot | 8/1 | | | |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | *Periodic* | | | |
| Number of CSI-RS ports (*X*) | |  | 2 | | | |
| CDM Type | |  | *fd-CDM2* | | | |
| Density (ρ) | |  | 1 | | | |
| First subcarrier index in the PRB used for CSI-RS (k0, k1 ) | |  | 6 | | | |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) | |  | 13 | | | |
| NZP CSI-RS-timeConfig  periodicity and offset | | slot | 8/1 | | | |
| CSI-IM configuration | CSI-IM resource Type | |  | Periodic | | | |
| CSI-IM RE pattern | |  | 1 | | | |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) | |  | (8, 13) | | | |
| CSI-IM timeConfig  periodicity and offset | | slot | 8/1 | | | |
| ReportConfigType | | |  | *Periodic* | | | |
| CQI-table | | |  | Table 1 | | | |
| reportQuantity | | |  | *cri-RI-PMI-CQI* | | | |
| timeRestrictionForChannelMeasurements | | |  | *Not configured* | | | |
| timeRestrictionForInterferenceMeasurements | | |  | *Not configured* | | | |
| cqi-FormatIndicator | | |  | *Wideband* | | | |
| pmi-FormatIndicator | | |  | *Wideband* | | | |
| Sub-band Size | | | RB | 8 | | | |
| csi-ReportingBand | | |  | 111111111 | | | |
| CSI-Report periodicity and offset | | | slot | 8/3 | | | |
| aperiodicTriggeringOffset | | |  | *Not configured* | | | |
| Codebook configuration | | Codebook Type |  | *typeI-SinglePanel* | | | |
| Codebook Mode |  | 1 | | | |
| (CodebookConfig-N1,CodebookConfig-N2) |  | *Not configured* | | | |
| CodebookSubsetRestriction |  | [000001 | | | |
| RI Restriction |  | N/A | | | |
| Physical channel for CSI report | | |  | PUCCH | | | |
| CQI/RI/PMI delay | | | ms | 8.375 | | | |
| Maximum number of HARQ transmission | | |  | 1 | | | |
| Measurement channel | | |  | As specified in Table A.4-1, TBS.1-1 | | | |

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9.1.1 Applicability of requirements

The following applicability rules are specified for demodulation performance requirements for interworking:

- For UEs supporting both SA and NSA,

- The performance requirements specified in Clause 5 will be verified only for SA except for the sustained downlink data rate test specified in Clause 5.5 and 5.5A.

- The performance requirements specified in Clause 7 will be verified only for SA except for the sustained downlink data rate test specified in Clause 7.5 and 7.5A.

- The sustained downlink data rate tests specified in Clauses 5.5, 5.5A and 7.5, 7.5A for SA and in Clause 9.4B for NSA are verified separately.

- The FR1 EN-DC test cases with the NR TDD DL-UL configurations which are not aligned with LTE's can be tested on the corresponding EN-DC band combinations where UE supports simultaneous transmission and reception.

- For UEs supporting NR FR1 CA and/or NR CA including FR1 and FR2, the requirements applicability is specified in Table 9.1.1-1.

**Table 9.1.1-1: Requirements applicability for UEs supporting NR FR2 CA and NR CA including FR1 and FR2**

|  |  |
| --- | --- |
| **Supported scenarios** | **Requirements** |
| NR FR2 CA | Clause 7.5A |
| NR CA including FR1 and FR2 | Clause 9.4A.1, 9.3A.1 |
| Both NR FR2 CA and NR CA including FR1 and FR2 | Clause 7.5A |

- For UEs supporting EN-DC including FR2 and/or EN-DC including FR1 and FR2, the requirements applicability is specified in Table 9.1.1-2.

**Table 9.1.1-2: Requirements applicability for UEs supporting EN-DC including FR2 and EN-DC including FR1 and FR2**

|  |  |  |  |
| --- | --- | --- | --- |
| **Supported scenarios** | **SDR requirements** | **PDSCH requirements** | **PDCCH requirements** |
| EN-DC including FR2 | Clause 9.4B.1.2 | Clause 9.2B.1.2 | Clause 9.3B.1.2 |
| EN-DC including FR1 and FR2 | Clause 9.4B.1.3 | Clause 9.2B.1.3 | Clause 9.3B.1.3 |
| Both EN-DC including FR2 and EN-DC including FR1 and FR2 | Clause 9.4B.1.2 | Clause 9.2B.1.2 | Clause 9.3B.1.2 |

- For UEs supporting NR-DC including FR1 and FR2, if the FR2 requirements in Clause 7.2 and Clause 7.3 are tested, the test coverage can be considered fulfilled without executing requirements in Clause 9.2B.2 and Clause 9.3B.2.

- For UEs supporting NR-DC between FR1 and FR2, if requirements in Clause 9.4A.1 are tested under same or higher data rate as in Clause 9.4B.2, the test coverage can be considered fulfilled without executing the requirements in Clause 9.4B.2.

- For UEs supporting NE-DC and EN-DC, the test coverage of demodulation performance requirements can be considered fulfilled, if the demodulation requirements in Clause 5 and Clause 9.4B.1 are executed for UE under test in the standalone mode.

- For UEs supporting NE-DC and not supporting EN-DC, the test coverage of demodulation performance requirements can be considered fulfilled, if the demodulation requirements in Clause 5 and Clause 9.4B.3 are executed for UE under test.

- For UEs supporting NGEN-DC, the test coverage of demodulation performance requirements can be considered fulfilled, if the demodulation requirements in Clause 5 and Clause 9.4B.1 are executed for UE under test.

- For UEs supporting FR1 intra-band contiguous and non-contiguous EN-DC, the requirements applicability is specified in Table 9.1.1-3.

**Table 9.1.1-3: Requirements applicability for UE supporting FR1 intra-band and inter-band EN-DC**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Inter-band scenarios are not supported | UE indicates “interBandContiguousMRDC” (Note 1, Note 2) | UE does not indicate “interBandContiguousMRDC” (Note 1, Note 3) |
| Intra-band scenarios are not supported | N/A | Clause 9.5B.1.1 is executed for inter-band EN-DC scenarios | Clause 9.5B.1.2 is executed for inter-band EN-DC scenarios |
| UE does not indicate “intraBandENDC-Support” or UE indicates “both” in “intraBandENDC-Support” (Note 4) | Clause 9.5B.1.1 is only executed for intra-band EN-DC scenarios | Clause 9.5B.1.1 is executed for both intra-band and inter-band EN-DC scenarios | Clause 9.5B.1.1 is only executed for intra-band EN-DC scenarios |
| UE indicates “non-contiguous” in “intraBandENDC-Support” (Note 5) | Clause 9.5B.1.2 is only executed for intra-band EN-DC scenarios | Clause 9.5B.1.1 is executed for inter-band EN-DC scenarios | Clause 9.5B.1.2 is executed for both intra-band and inter-band EN-DC scenarios |
| Note 1: Requirements are applicable to intra-band scenarios and only inter-band scenarios from Table 5.5B.4.1-1 of TS 38.101-3 [8] for which Note 4 is applied.  Note 2: UE supports both intra-band contiguous and non-contiguous EN-DC requirements for supported inter-band EN-DC combinations.  Note 3: UE supports intra-band non-contiguous EN-DC requirements for supported inter-band EN-DC combinations.  Note 4: UE supports intra-band contiguous EN-DC, or both intra-band contiguous and non-contiguous EN-DC for supported intra-band EN-DC combinations.  Note 5: UE supports only intra-band non-contiguous EN-DC for supported intra-band EN-DC combinations. | | | |

<End of R4-2302974 Part 1>

<Start of R4-2302973 Part3>

9.1.1.1 Applicability of requirements for optional UE features

**Table 9.1.1.1-1: Void**

The applicability rule defined in Clause 5.1.1.3 shall be applied for performance requirements in Clauses 9.2B.1.1 and 9.4B.1.1.

The applicability rule defined in Clause 7.1.1.3 shall be applied for performance requirements in Clauses 9.2B.1.2, 9.4A.1, 9.4B.1.2 and 9.4B.1.3.

he performance requirements in Table 9.1.1.1-2 shall apply for UEs which support optional UE features only.**Table 9.1.1.1-2 Requirements applicability for optional UE features**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE feature/capability [14]** | **Test type** | | **Test list** | **Applicability notes** |
| Support of 480kHz SCS for FR2-2  (*ul-FR2-2-SCS-480kHz-r17)* | FR2-2 TDD | PDSCH | Clause 9.2A.1.1  (Table 9.2A.1-5: Test 1-5, 1-6) |  |
| PDCCH | Clause 9.3A.1.1  ( |  |

*<Unchanged skipped>*

9.1.1.3 Applicability of requirements for operating bands in FR2-2

The requirements in Table 9.1.1.3-1 are applicable for bands with FDL\_high higher than 52600 MHz and lower than 71000 MHz;

Other performance requirements mandatory for UE supporting NR operation defined in Section 9 but not included in Table 9.1.1.3-1 should not be considered applicable to FR2-2 bands;

**Table 9.1.1.3-1: Requirements applicability for operating bands in FR2-2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test type** | | **Test list** | **Applicability notes** | |
| FR2-2 TDD | PDSCH | Clause 9.2A.1.1  (Table 9.2A.1-5: Test 1-2) | The requirements apply if the device supports initial access on FR2-2 frequencies, or if it supports both Single Carrier and CA\_AX (FR1+FR2-2) operations; | |
| Clause 9.2A.1.1  (All Tests in Table 9.2A.1-5, except for Test 1-2) |  | The requirements apply if the device supports CA\_AX (FR1+FR2-2) operations in FR2-2 and not initial access on FR2-2 frequencies. |
| (Test | T |
| PDCCH | Clause 9.3A.1.1  ( |  |

<End of R4-2302973 Part3>

<Start of R4-2302856 >

## 9.2A PDSCH demodulation for CA

### 9.2A.1 NR CA between FR1 and FR2

### 9.2A.1.1 NR CA between FR1 and FR2-2

The performance requirements for SCell on FR2-2 band are specified in Table 9.2A.1-5. The test parameters for SCell are specified in Table 7.2.2.2.1-2 with additional change of PDSCH resource allocation type specified in Table 9.2A.1-1:

Table 9.2A.1-1: PDSCH resource allocation type

|  |  |  |  |
| --- | --- | --- | --- |
| Test numer | Allocation Type | Start RB | LRBs |
| 1-1 | Type 1 | 98 | 66 |
| 1-2 |  |  |  |
| 1-3 |  |  |  |
| 1-4 |  |  |  |
| 1-5 |  | 116 | 32 |
| 1-7 | ` | 24 | 20 |
| 1-6Note1 | Type 0 | N/A | N/A |
| Note 1: Full BWP is allocated for PDSCH | | | |

The test parameters for PCell in Table 9.2A.1-3 and the downlink physical channel setup according to Annex C.3.1. In this test, Pcell is in FR1 and Scell is in FR2-2 and only requirements for Scell should be verified.

The test purposes are specified in Table 9.2A.1-2.

Table 9.2A.1-2: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH mapping Type A normal performance in FR2-2 Scell CC in CA between FR1 and FR2-2 under 2 receive antenna conditions and with different channel models, MCSs and number of MIMO layers | 1-1,1-2,1-3,1-4,1-5,1-6 |

Table 9.2A.1-3: Test parameters for PCell

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | TDD |
| Bandwidth | | MHz | 40 |
| Subcarrier spacing | | kHz | 30 |
| TDD pattern | |  | FR1.30-1 |
| 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 |  | 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 |
|  | Dmrs-AdditionalPosition |  | pos1 |
|  | 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.1.2 |
| PUCCH format for HARQ-ACK feedback | |  | PUCCH format 3 |

Table 9.2A.1-4: K1 values for each CC

|  |  |
| --- | --- |
| **Cells** | **K1 values** |
| Pcell CC | {8,7,6,5,4,3,2} |
| SCell CC with 120kHz | {8,8,8,8,7,7,7,7} |
| SCell CC with 480kHz (Note 1) | {8,8,8,7} |
| Note 1: One k1 value applies for 4 TBs scheuled by one DCI | |

Table 9.2A.1-5: Minimum performance for Rank 1 (FRC) in Scell CC

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num** | **Reference channel** | Bandwidth (MHz) / Subcarrier spacing (kHz) | **Modulation and code rate** | **TDD UL-DL pattern** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** | |
| **Fraction of max through-put (%)** | **SNRBB (dB)** |
| 1-1 | TBD | 400 / 120 | QPSK, 0.30 | FR2.120-1 | TDLA30-650 | 2x2 ULA Low | 70 | [0.9] |
| 1-2 | TBD | 400 / 120 | 16QAM, 0.48 | FR2.120-1 | TDLA30-200 | 2x2 ULA Low | 70 | [9.0] |
| 1-3 | TBD | 400 / 120 | 16QAM, 0.48 | FR2.120-1 | TDLA30-650 | 2x2 ULA Low | 30 | [2.7] |
| 1-4 | TBD | 400 / 120 | 64QAM, 0.43 | FR2.120-1 | TDLD30-200 | 2x2 ULA Low | 70 | [11.6] |
| 1-5 | TBD | 400 / 480 | QPSK, 0.30 | FR2.480-1 | TDLA10-200 | 2x2 ULA Low | 70 | [1.0] |
| 1-6 | TBD | 400 / 480 | 16QAM  0.48 | FR2.480-1 | TDLD10-200 | 2x2 ULA Low | 70 | [8.3] |

<End of R4-2302856 >

<Start of R4-2302974 Part 2>

9.3A.1 NR CA between FR1 and FR2

9.3A.1.1 NR CA between FR1 and FR2-2

The test setup for FR1 PCell is specified in Table 9.2A.1-3. The NR PDCCH demodulation performance requirements for NR are specified in Clause 7.3. During the test, only the PDCCH performance on the FR2-2 carrier shall be verified.

10.2A Reporting of Channel Quality Indicator (CQI) for CA

10.2A.1 NR CA between FR1 and FR2

10.2A.1.1 NR CA between FR1 and FR2-2

The test setup for FR1 PCell is specified in Table 9.2A.1-3. The NR CQI reporting requirements are specified in Clause 8.2. During the test, only the performance based on NR requirements on the NR cell(s) on FR2-2 carrier shall be verified.

<End of R4-2302974 Part 2>

<Start of R4-2215586 Part1>

**Table A.1.3-3: TDD UL-DL configuration for SCS 480 kHz**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | | **Unit** | **UL-DL pattern** | |
| **FR2.480-1** |  |
| TDD Slot Configuration pattern (Note 1) | |  | DDDDDDDDDDDDDDSSUUUU |  |
| Special Slot Configuration (Note 2) | |  | S1:12D+2G+0U  S2: 0D+6G+8U |  |
| *referenceSubcarrierSpacing* | | kHz | 480 |  |
| pattern1 | *dl-UL-TransmissionPeriodicity* | ms | 0.625 |  |
| *nrofDownlinkSlots* |  | 14 |  |
| *nrofDownlinkSymbols* |  | 12 |  |
| *nrofUplinkSlot* |  | 4 |  |
| *nrofUplinkSymbols* |  | 8 |  |
| The number of slots between PDSCH and corresponding HARQ-ACK information(Note 3) | |  | TBA |  |
| Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information.  Note 2: D, G, U denote DL, guard and UL symbols, respectively. The field is for information.  Note 3: i is the slot index per frame; i = {0,…,319} | | | | |

<End of R4-2215586 Part1>

<Start of R4-2302928>

**Table A.3.2.2.5-3: PDSCH Reference Channel for TDD UL-DL pattern FR2.120-1 (64QAM)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | |
| Reference channel |  | R.PDSCH.5-3.1 TDD | R.PDSCH.5-3.2 TDD |  |  |  |
| Channel bandwidth | MHz | 100 | 100 |  |  |  |
| Subcarrier spacing | kHz | 120 | 120 |  |  |  |
| Allocated resource blocks | PRBs | 66 | 66 |  |  |  |
| Number of consecutive PDSCH symbols |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159} |  | N/A | N/A |  |  |  |
| For Slots i = 80, 81 |  | 9 | N/A |  |  |  |
| For Slot i, if mod(i, 5) = 3 for i from {0,…, 159} |  | 9 | 9 |  |  |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159} |  | 13 | 13 |  |  |  |
| Allocated slots per 2 frames |  | 127 | 125 |  |  |  |
| MCS table |  | 64QAM | 64QAM |  |  |  |
| MCS index |  | 18 | 17 |  |  |  |
| Modulation |  | 64QAM | 64QAM |  |  |  |
| Target Coding Rate |  | 0.46 | 0.43 |  |  |  |
| Number of MIMO layers |  | 1 | 1 |  |  |  |
| Number of DMRS REs |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159} |  | N/A | N/A |  |  |  |
| For Slots i = 80, 81 |  | 12 | N/A |  |  |  |
| For Slot i, if mod(i, 5) = 3 for i from {0,…, 159} |  | 12 | 12 |  |  |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159} |  | 12 | 12 |  |  |  |
| Overhead for TBS determination |  | 6 | 6 |  |  |  |
| Information Bit Payload per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159} | Bits | N/A | N/A |  |  |  |
| For Slots i = 80, 81 | Bits | 25104 | N/A |  |  |  |
| For Slot i, if mod(i, 5) = 3 for i from {0,…, 159} | Bits | 16136 | 15112 |  |  |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159} | Bits | 25104 | 23568 |  |  |  |
| Transport block CRC per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159} | Bits | N/A | N/A |  |  |  |
| For Slots i = 80, 81 | Bits | 24 | N/A |  |  |  |
| For Slot i, if mod(i, 5) = 3 for i from {0,…, 159} | Bits | 24 | 24 |  |  |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159} | Bits | 24 | 24 |  |  |  |
| Number of Code Blocks per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159} | CBs | N/A | N/A |  |  |  |
| For Slots i = 80, 81 | CBs | 3 | N/A |  |  |  |
| For Slot i, if mod(i, 5) = 3 for i from {0,…, 159} | CBs | 2 | TBA |  |  |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159} | CBs | 3 | TBA |  |  |  |
| Binary Channel Bits Per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159} | Bits | N/A | N/A |  |  |  |
| For Slots i = 80, 81 | Bits | 52470 | N/A |  |  |  |
| For Slot i, if mod(i, 5) = 3 for i from {0,…, 159} | Bits | 36630 | 35640 |  |  |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,79,82,…,159} | Bits | 54846 | 54648 |  |  |  |
| Max. Throughput averaged over 2 frames | Mbps | 145.062 | 136.1272 |  |  |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms  Note 2: Slot i is slot index per 2 frames | | | | | | |

<End of R4-2302928>

<Start of R4-2220183>

A.3.2.2.8 Reference measurement channels for SCS 480 kHz FR2-2

**Table A.3.2.2.8-1: PDSCH Reference Channel for TDD UL-DL pattern FR2.480-1 (QPSK)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** | | | | |
| Reference channel | |  | R.PDSCH.8-1.1 TDD |  |  |  |  |
| Channel bandwidth | | MHz | 400 |  |  |  |  |
| Subcarrier spacing | | kHz | 480 |  |  |  |  |
| Allocated resource blocks | | PRBs | 66 |  |  |  |  |
| Number of consecutive PDSCH symbols | |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 20) = {15,16,17,18,19} for i from {0,…,639} | |  | N/A |  |  |  |  |
| For Slots i = 320, 321 |  | | N/A |  |  |  |  |
| For Slot i, if mod(i, 20) = 14 for i from {0,…, 639} | |  | 11 |  |  |  |  |
| For Slot i, if mod(i, 5) = {0,1…13} for i from {1,…,639} | |  | 13 |  |  |  |  |
| Allocated slots per 2 frames | |  | 477 |  |  |  |  |
| MCS table | |  | 64QAM |  |  |  |  |
| MCS index | |  | 4 |  |  |  |  |
| Modulation | |  | QPSK |  |  |  |  |
| Target Coding Rate | |  | 0.30 |  |  |  |  |
| Number of MIMO layers | |  | 1 |  |  |  |  |
| Number of DMRS REs | |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 20) = {15,16,17,18,19} for i from {0,…,639} | |  | N/A |  |  |  |  |
| For Slots i = 320, 321 |  | | N/A |  |  |  |  |
| For Slot i, if mod(i, 20) = 14 for i from {0,…, 639} | |  | 12 |  |  |  |  |
| For Slot i, if mod(i, 5) = {0,1…13} for i from {1,…,639} | |  | 12 |  |  |  |  |
| Overhead for TBS determination | |  | 6 |  |  |  |  |
| Information Bit Payload per Slot | |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 20) = {15,16,17,18,19} for i from {0,…,639} | | Bits | N/A |  |  |  |  |
| For Slots i = 320, 321 | Bits | | N/A |  |  |  |  |
| For Slot i, if mod(i, 20) = 14 for i from {0,…, 639} | | Bits | T4480 |  |  |  |  |
| For Slot i, if mod(i, 5) = {0,1…13} for i from {1,…,639} | | Bits | T5504 |  |  |  |  |
| Transport block CRC per Slot | |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 20) = {15,16,17,18,19} for i from {0,…,639} | | Bits | N/A |  |  |  |  |
| For Slots i = 320, 321 | Bits | | N/A |  |  |  |  |
| For Slot i, if mod(i, 20) = 14 for i from {0,…, 639} | | Bits | T24 |  |  |  |  |
| For Slot i, if mod(i, 5) = {0,1…13} for i from {1,…,639} | | Bits | T24 |  |  |  |  |
| Number of Code Blocks per Slot | |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 20) = {15,16,17,18,19} for i from {0,…,639} | | CBs | N/A |  |  |  |  |
| For Slots i = 320, 321 | CBs | | N/A |  |  |  |  |
| For Slot i, if mod(i, 20) = 14 for i from {0,…, 639} | | CBs | T1 |  |  |  |  |
| For Slot i, if mod(i, 5) = {0,1…13} for i from {1,…,639} | | CBs | T1 |  |  |  |  |
| Binary Channel Bits Per Slot | |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 20) = {15,16,17,18,19} for i from {0,…,639} | | Bits | N/A |  |  |  |  |
| For Slots i = 320, 321 | Bits | | N/A |  |  |  |  |
| For Slot i, if mod(i, 20) = 14 for i from {0,…, 639} | | Bits | T15048 |  |  |  |  |
| For Slot i, if mod(i, 5) = {0,1…13} for i from {1,…,639} | | Bits | T18216 |  |  |  |  |
| Max. Throughput averaged over 2 frames | | Mbps | T129.632 |  |  |  |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms  Note 2: Slot i is slot index per 2 frames | | | | | | | |

**Table A.3.2.2.8-2: PDSCH Reference Channel for TDD UL-DL pattern FR2.480-1 (16QAM)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | |
| Reference channel |  | R.PDSCH.8-2.1 TDD |  |  |  |  |
| Channel bandwidth | MHz | 400 |  |  |  |  |
| Subcarrier spacing | kHz | 480 |  |  |  |  |
| Allocated resource blocks | PRBs | T20 |  |  |  |  |
| Number of consecutive PDSCH symbols |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 20) = {15,16,17,18,19} for i from {0,…,639} |  | N/A |  |  |  |  |
| For Slots i = 320, 321 |  | N/A |  |  |  |  |
| For Slot i, if mod(i, 20) = 14 for i from {0,…, 639} |  | 11 |  |  |  |  |
| For Slot i, if mod(i, 5) = {0,1…13} for i from {1,…,639} |  | 12 |  |  |  |  |
| Allocated slots per 2 frames |  | 477 |  |  |  |  |
| MCS table |  | 64QAM |  |  |  |  |
| MCS index |  | 13 |  |  |  |  |
| Modulation |  | 16QAM |  |  |  |  |
| Target Coding Rate |  | 0.48 |  |  |  |  |
| Number of MIMO layers |  | 1 |  |  |  |  |
| Number of DMRS REs |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 20) = {15,16,17,18,19} for i from {0,…,639} |  | N/A |  |  |  |  |
| For Slots i = 320, 321 |  | N/A |  |  |  |  |
| For Slot i, if mod(i, 20) = 14 for i from {0,…, 639} |  | 12 |  |  |  |  |
| For Slot i, if mod(i, 5) = {0,1…13} for i from {1,…,639} |  | 12 |  |  |  |  |
| Overhead for TBS determination |  | 6 |  |  |  |  |
| Information Bit Payload per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 20) = {15,16,17,18,19} for i from {0,…,639} | Bits | N/A |  |  |  |  |
| For Slots i = 320, 321 | Bits | N/A |  |  |  |  |
| For Slot i, if mod(i, 20) = 14 for i from {0,…, 639} | Bits | 3904 |  |  |  |  |
| For Slot i, if mod(i, 5) = {0,1…13} for i from {1,…,639} | Bits | 4736 |  |  |  |  |
| Transport block CRC per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 20) = {15,16,17,18,19} for i from {0,…,639} | Bits | N/A |  |  |  |  |
| For Slots i = 320, 321 | Bits | N/A |  |  |  |  |
| For Slot i, if mod(i, 20) = 14 for i from {0,…, 639} | Bits | T24 |  |  |  |  |
| For Slot i, if mod(i, 5) = {0,1…13} for i from {1,…,639} | Bits | T24 |  |  |  |  |
| Number of Code Blocks per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 20) = {15,16,17,18,19} for i from {0,…,639} | CBs | N/A |  |  |  |  |
| For Slots i = 320, 321 | CBs | N/A |  |  |  |  |
| For Slot i, if mod(i, 20) = 14 for i from {0,…, 639} | CBs | T1 |  |  |  |  |
| For Slot i, if mod(i, 5) = {0,1…13} for i from {1,…,639} | CBs | T1 |  |  |  |  |
| Binary Channel Bits Per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 20) = {15,16,17,18,19} for i from {0,…,639} | Bits | N/A |  |  |  |  |
| For Slots i = 320, 321 | Bits | N/A |  |  |  |  |
| For Slot i, if mod(i, 20) = 14 for i from {0,…, 639} | Bits | T8160 |  |  |  |  |
| For Slot i, if mod(i, 5) = {0,1…13} for i from {1,…,639} | Bits | T10080 |  |  |  |  |
| Max. Throughput averaged over 2 frames | Mbps | T111.6224 |  |  |  |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms  Note 2: Slot i is slot index per 2 frames | | | | | | |

#### A.3.3.2.6 Reference measurement channels for SCS 480 kHz FR2-2

Table A.3.3.2.6-1: PDCCH Reference Channels (Time domain allocation 1 symbol)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | | |
| Reference channel |  | R.PDCCH.6-1.1 TDD |  |  |  |  |  |
| Subcarrier spacing | kHz | 480 |  |  |  |  |  |
| CORESET frequency domain allocation |  | 60 |  |  |  |  |  |
| CORESET time domain allocation |  | 1 |  |  |  |  |  |
| Aggregation level |  | 8 |  |  |  |  |  |
| DCI Format |  | 1\_1 |  |  |  |  |  |
| Payload (without CRC) | Bits | 56 |  |  |  |  |  |

Table A.3.3.2.6-2: PDCCH Reference Channel (Time domain allocation 2 symbols)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | | |
| Reference channel |  | R.PDCCH.6-2.1 TDD |  |  |  |  |  |
| Subcarrier spacing | kHz | 480 |  |  |  |  |  |
| CORESET frequency domain allocation |  | 60 |  |  |  |  |  |
| CORESET time domain allocation |  | 2 |  |  |  |  |  |
| Aggregation level |  | 16 |  |  |  |  |  |
| DCI Format |  | 1\_0 |  |  |  |  |  |
| Payload (without CRC) | Bits | 40 |  |  |  |  |  |

<End of R4-2220183>

<Start of R4-2215586 Part2>

A.3.4.2 Reference measurement channels for FR2

**Table A.3.4.2-1: PBCH Reference Channel**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | |
| Reference channels |  | R.PBCH.5 | R.PBCH.6 | R.PBCH.7 |
| SS/PBCH block subcarrier spacing | kHz | 120 | 240 | 480 |
| Modulation |  | QPSK | QPSK | QPSK |
| Target coding rate |  | 56/864 | 56/864 | 56/864 |
| Payload (without CRC and timing related PBCH payload bits) | bits | 24 | 24 | 24 |

<End of R4-2215586 Part2>

<Start of R4-2302854>

B.2.1 Delay profiles

The delay profiles are simplified from the TR 38.901 [5] TDL models. The simplification steps are shown below for information. These steps are only used when new delay profiles are created. Otherwise, the delay profiles specified in B.2.1.1 and B.2.1.2 can be used as such.

Step 1: Use the original TDL model from TR 38.901[5].

Step 2: Re-order the taps in ascending delays

Step 3: Perform delay scaling according to the procedure described in clause 7.7.3 in TR 38.901 [5].

Step 4: Apply the quantization to the delay resolution 5 ns or 2ns as described in Table B.2.1.2-1. This is done simply by rounding the tap delays to the nearest multiple of the delay resolution.

Step 5: If multiple taps are rounded to the same delay bin, merge them by calculating their linear power sum.

Step 6: If there are more than 12 taps for 5ns resolution or 16 taps for 2ns resolution as described in Table B.2.1.2-1 in the quantized model, merge the taps as follows

- Find the weakest tap from all taps (both merged and unmerged taps are considered)

- If there are two or more taps having the same value and are the weakest, select the tap with the smallest delay as the weakest tap.

- When the weakest tap is the first delay tap, merge taps as follows

- Update the power of the first delay tap as the linear power sum of the weakest tap and the second delay tap.

- Remove the second delay tap.

- When the weakest tap is the last delay tap, merge taps as follows

- Update the power of the last delay tap as the linear power sum of the second-to-last tap and the last tap.

- Remove the second-to-last tap.

- Otherwise

- For each side of the weakest tap, identify the neighbour tap that has the smaller delay difference to the weakest tap.

- When the delay difference between the weakest tap and the identified neighbour tap on one side equals the delay difference between the weakest tap and the identified neighbour tap on the other side.

- Select the neighbour tap that is weaker in power for merging.

- Otherwise, select the neighbour tap that has smaller delay difference for merging.

- To merge, the power of the merged tap is the linear sum of the power of the weakest tap and the selected tap.

- When the selected tap is the first tap, the location of the merged tap is the location of the first tap. The weakest tap is removed.

- When the selected tap is the last tap, the location of the merged tap is the location of the last tap. The weakest tap is removed.

- Otherwise, the location of the merged tap is based on the average delay of the weakest tap and selected tap. If the average delay is on the sampling grid, the location of the merged tap is the average delay. Merge two parallel taps with different delays (average delay, sum power) starting from the weakest ones. Otherwise, the location of the merged tap is rounded towards the direction of the selected tap (e.g. For 5ns resolution, 10 ns & 20 ns 🡪 15 ns, 10 ns & 25 ns 🡪 20 ns, if 25 ns had higher or equal power; 15 ns, if 10 ns had higher power). The weakest tap and the selected tap are removed.

- Repeat step 6 until the final number of taps is 12 or 16.

Step 7: Round the amplitudes of taps to one decimal (e.g. -8.78 dB 🡪 -8.8 dB)

Step 8: If the delay spread has slightly changed due to the tap merge, adjust the final delay spread by increasing or decreasing the power of the last tap so that the delay spread is corrected.

Step 9: Re-normalize tap powers such that the strongest tap is at 0dB.

Note: Some values of the delay profile created by the simplification steps may differ from the values in tables B.2.1.1-2, B.2.1.1-3, B.2.1.1-4, B.2.1.2-2, and B.2.1.1-3 for the corresponding model.

Note: For Step 5 and Step 6, the power values are expressed in the linear domain using 6 digits of precision. The operations are in the linear domain.

Note: Delay profile for TDLD30 and TDLD10 is generated under assumption that Steps 1-8 are applied for taps with Rayleigh distribution.

<End of R4-2302854>

<Start of R4-2215585>

B.2.1.2 Delay profiles for FR2

The delay profiles for FR2 are specified in B.2.1.2-1 and the tapped delay line models are specified in Tables B.2.1.2-2 and Table B.2.1.2-3.

**Table B.2.1.2-1: Delay profiles for NR channel models**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Model** | **Number of  channel taps** | **Delay spread**  **(r.m.s.)** | **Maximum excess tap delay (span)** | **Delay resolution** |
| TDLA30 | 12 | 30 ns | 290 ns | 5 ns |
| TDLC60 | 12 | 60 ns | 520 ns | 5 ns |
| TDLD30 | 10 | 30 ns | 375 ns | 5 ns |
| TDLA10 | 16 | 10 ns | 96 ns | 2 ns |
| TDLD10 | 10 | 10 ns | 126 ns | 2 ns |

**Table B.2.1.2-2: TDLA30 (DS = 30 ns)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Tap #** | **Delay [ns]** | **Power [dB]** | **Fading distribution** |
| 1 | 0 | -15.5 | Rayleigh |
| 2 | 10 | 0 | Rayleigh |
| 3 | 15 | -5.1 | Rayleigh |
| 4 | 20 | -5.1 | Rayleigh |
| 5 | 25 | -9.6 | Rayleigh |
| 6 | 50 | -8.2 | Rayleigh |
| 7 | 65 | -13.1 | Rayleigh |
| 8 | 75 | -11.5 | Rayleigh |
| 9 | 105 | -11.0 | Rayleigh |
| 10 | 135 | -16.2 | Rayleigh |
| 11 | 150 | -16.6 | Rayleigh |
| 12 | 290 | -26.2 | Rayleigh |

**Table B.2.1.2-3: TDLC60 (DS = 60 ns)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Tap #** | **Delay [ns]** | **Power [dB]** | **Fading distribution** |
| 1 | 0 | -7.8 | Rayleigh |
| 2 | 15 | -0.3 | Rayleigh |
| 3 | 40 | 0 | Rayleigh |
| 4 | 50 | -8.9 | Rayleigh |
| 5 | 55 | -14.5 | Rayleigh |
| 6 | 75 | -8.5 | Rayleigh |
| 7 | 80 | -10.2 | Rayleigh |
| 8 | 130 | -12.1 | Rayleigh |
| 9 | 210 | -13.9 | Rayleigh |
| 10 | 300 | -15.2 | Rayleigh |
| 11 | 360 | -16.9 | Rayleigh |
| 12 | 520 | -19.4 | Rayleigh |

**Table B.2.1.2-4 TDLD30 (DS = 30 ns)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Tap #** | **Delay [ns]** | **Power [dB]** | **Fading distribution** |
| 1 | 0 | -0.2 | LOS path |
| 0 | -12.4 | Rayleigh |
| 2 | 20 | -21 | Rayleigh |
| 3 | 40 | -16.7 | Rayleigh |
| 4 | 55 | -18.3 | Rayleigh |
| 5 | 80 | -21.9 | Rayleigh |
| 6 | 120 | -27.8 | Rayleigh |
| 7 | 240 | -23.6 | Rayleigh |
| 8 | 285 | -24.8 | Rayleigh |
| 9 | 290 | -30.0 | Rayleigh |
| 10 | 375 | -27.6 | Rayleigh |
| Note 1: Tap #1 follows a Rician distribution. | | | |

**Table B.2.1.2-5 TDLA10 (DS = 10 ns)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Tap #** | **Delay [ns]** | **Power [dB]** | **Fading distribution** |
| 1 | 0 | -16.1 | Rayleigh |
| 2 | 4 | 0 | Rayleigh |
| 3 | 6 | -4 | Rayleigh |
| 4 | 8 | -10.2 | Rayleigh |
| 5 | 16 | -18.6 | Rayleigh |
| 6 | 18 | -9.3 | Rayleigh |
| 7 | 22 | -13.7 | Rayleigh |
| 8 | 24 | -17.9 | Rayleigh |
| 9 | 26 | -13.5 | Rayleigh |
| 10 | 30 | -14 | Rayleigh |
| 11 | 40 | -15.4 | Rayleigh |
| 12 | 44 | -18.9 | Rayleigh |
| 13 | 46 | -21.0 | Rayleigh |
| 14 | 48 | -21.6 | Rayleigh |
| 15 | 50 | -19.3 | Rayleigh |
| 16 | 96 | -25.9 | Rayleigh |

**Table B.2.1.2-6 TDLD10 (DS = 10 ns)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Tap #** | **Delay [ns]** | **Power [dB]** | **Fading distribution** |
| 1 | 0 | -0.2 | LOS |
| 0 | -12.4 | Rayleigh |
| 2 | 6 | -21.1 | Rayleigh |
| 3 | 14 | -16.7 | Rayleigh |
| 4 | 18 | -18.3 | Rayleigh |
| 5 | 26 | -22 | Rayleigh |
| 6 | 40 | -27.9 | Rayleigh |
| 7 | 80 | -23.7 | Rayleigh |
| 8 | 94 | -24.9 | Rayleigh |
| 9 | 98 | -30.0 | Rayleigh |
| 10 | 126 | -27.7 | Rayleigh |
| Note 1: Tap #1 follows a Rician distribution. | | | |

<End of R4-2215585>