**3GPP TSG- Meeting #**

 **Meeting, Oct 10 - 19, 2022**

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| --- |
| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  | **38.101-4** | **CR** | **Draft BigCR** | **rev** |  | **Current version:** | **17.6.0** |  |
|  |
| *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 |  |

|  |
| --- |
|  |
| ***Title:***  | Big CR for introduction of FR2-2 UE demodulation and CSI requirements |
|  |  |
| ***Source to WG:*** |  |
| ***Source to TSG:*** |  |
|  |  |
| ***Work item code:*** | NR\_ext\_to\_71GHz-Perf |  | ***Date:*** | 2022 10.21 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***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 canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
|  |  |
| ***Reason for change:*** | As indicated by chairman, Huawei should submit the bigCR for FR2-2 UE demodulation and CSI requirements for 38.101-4 |
|  |  |
| ***Summary of change:*** | Merge the following draft CR into this bigCR:* R4-2215585\_DraftCR\_ChanModels\_upto\_71GHz (Apple)
* R4-2215586\_DraftCR\_FRCs\_upto\_71GHz(Apple)
* R4-2216182\_draftCR for FR2-2 PBCH Requirements(Qualcomm)
* R4-2217394\_draftCR for FR2-2 General Requirements(Qualcomm)
* R4-2217395 draft CR on PDSCH requirements for 52.6 - 71 GHz band(Ericsson)
* R4-2217398 Draft CR Introduction of FR2-2 PDSCH performance requirements for FR1+FR2-2 CA in TS 38.101-4(Huawei,HiSilicon)
* R4-2217399 - Nokia\_DraftCR\_38101-4\_PDCCH (Nokia)
* R4-2217403\_DraftCR\_CQI\_Req\_upto\_71GHz(Apple)
 |
|  |  |
| ***Consequences if not approved:*** | The requirements will be missing |
|  |  |
| ***Clauses affected:*** | 7.1, 7.2, 7.3, 7.4, 8.1.1, 9.2A, A.3.2.2.8, A.3.3.2.6, A.3.4.2, B.2.1.2 |
|  |  |
|  | **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:*** | None. |
|  |  |
| ***This CR's revision history:*** |  |

**<Start of R4-2217394>**

7 Demodulation performance requirements (Radiated requirements)

7.1 General

7.1.1 Applicability of requirements

7.1.1.1 General

The minimum performance requirements are applicable to the FR2 operating bands defined in TS 38.101-2 [7] with FDL\_high not exceeding 71000MHz. Additional applicability rules for certain operating bands are specified in Clause 7.1.1.6.

The minimum performance requirements in Clause 7 are mandatary for UE supporting NR operation, except test cases listed in Clause 7.1.1.3, 7.1.1.4, 7.1.1.5, 7.1.1.7.

If same test is listed for different UE features/capabilities in Clauses 7.1.1.3 and 7.1.1.4, then this test shall apply for UEs which support all corresponding UE features/capabilities.

7.1.1.6 Applicability of requirements for operating bands

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**

|  |  |  |
| --- | --- | --- |
| **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. |
| FR2-2 TDD | PDSCH  | Clause 7.2.2.2.1(Tests [TBA]) | The requirements are applicable for bands with FDL\_high higher than 52600 MHz and lower than 71000 MHz |
| PDCCH | Clause 7.3.2.2.2(Tests [TBA]) |
| PBCH | Clause 7.4.2.2(Tests 3, 4 in Table 7.4.2.2-2) |

**<End of R4-2217394>**

**<Start of R4-2217395>**

## 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 310 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 1,2,3,4120 kHz SCS: 160 for CSI-RS resource 1,2,3,4480 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 241 for CSI-RS resource 3 and 4120 kHz SCS:80 for CSI-RS resource 1 and 281 for CSI-RS resource 3 and 4480 kHz SCS:320 for CSI-RS resource 1 and 2321 for CSI-RS resource 3 and 4 |
| Frequency Occupation |  | Start PRB 0Number 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: 80120 kHz SCS: 160480 kHz SCS: 640 |
| CSI-RS offset |  | 0 |
| Frequency Occupation |  | Start PRB 0Number 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: 80120 kHz SCS: 160480 kHz SCS: 640 |
| CSI-RS offset |  | 0 |
| Frequency Occupation |  | Start PRB 0Number 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 1l0 = 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 1,2120 kHz SCS: 160 for CSI-RS resource 1,2480 kHz SCS: 640 for CSI-RS resource 1,2 |
| CSI-RS offset | Slots | 0 for CSI-RS resource 1,2 |
| Frequency Occupation |  | Start PRB 0Number 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: 4480 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 testsOP.1 TDD as defined in Annex A.5.2.1 for FR2-1 testsNo 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 37 for CSI-RS resource 2 and 4 |
| CSI-RS offset | Slots | For Test 1-2: 82 for CSI-RS resource 1 and 283 for CSI-RS resource 3 and 4 |
| PDCCH configuration | Number of PDCCH candidates and aggregation levels |  | 1/AL4 for Test 1-4 and 2-31/AL8 for other tests |
| PDSCH configuration | Mapping type |  | Type A |
| *k0* |  | 0 |
| Starting symbol (S)  |  | 1 |
| 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 |  | Test 2-1: Type 1 with start RB = 30, LRBs = 6Test 4-4: TBD (Center)Test 4-7: TBD (Center)Other tests: Type 0 |
| RBG size |  | Test 2-1: N/AOther 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, 4-410 for Test 2-1, 2-3, 2-5, 2-6, 3-116 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) in 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 | 256QAM0.67 | FR2.120-1 | TDLD30-75 | 2x2 ULA Low | 70 | 20.2 |

Table 7.2.2.2.1-4: Minimum performance for Rank 2 (FRC) in 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 in 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) in 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 | TBD |
| 4-2 | R.PDSCH.5-2.1 TDD | 100 / 120 | 16QAM, 0.48 | FR2.120-1 | TDLA30-200 | 2x2 ULA Low | 70 | TBD |
| 4-3 | R.PDSCH.5-2.1 TDD | 100 / 120 | 16QAM, 0.48 | FR2.120-1 | [TDLA30-650] | 2x2 ULA Low | 30 | TBD |
| 4-4 | R.PDSCH.5-3.2 TDD | 100 / 120 | 64QAM, 0.43 | FR2.120-1 | TDLD30-200 | 2x2 ULA Low | 70 | TBD |
| 4-5 | R.PDSCH.7-1.1 TDD | 400 / 480 | QPSK, 0.30 | FR2.480-1 | TDLA10-200 | 2x2 ULA Low | 70 | TBD |
| 4-6 | R.PDSCH.7-2.1 TDD | 400 / 480 | 16QAM0.48 | FR2.480-1 | TDLD10-200 | 2x2 ULA Low | 70 | TBD |

**<End of R4-2217395>**

**<Start of R4-2217399>**

## 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: 4CSI-RS resource 2: 8CSI-RS resource 3: 4CSI-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 281 for CSI-RS resource 3 and 4 |
| Frequency Occupation |  | Start PRB 0Number 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: 8CSI-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 0Number 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.5.1.1OP.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, 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 1-16 for test 1-2 | 2 |
| Interleaver size |  | 3 for test 1-12 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 Periodicity | Slots | [640] |
| CSI-RS for tracking | CSI-RS offset | Slots | [320 for CSI-RS resource 1 and 2321 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, 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, 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 with 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 | TBD |
| 1a-2 | 100/120 | 60 | 1 | 4 | R.PDCCH.5-1.2 TDD | [TDLA30-200] | 1x2 Low | 1 | TBD |
| 1a-3 | 400/480 | 60 | 1 | 4 | R.PDCCH.6-1.1 TDD | TDLA10-200 | 1x2 Low | 1 | TBD |
| 1a-4 | 400/480 | 60 | 1 | 8 | R.PDCCH.6-1.2 TDD | TDLA10-200 | 1x2 Low | 1 | TBD |

##### 7.3.2.2.2 2 Tx Antenna performances

For the parameters specified in Table 7.3.2.2-1, 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, 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 | TBD |
| 3-2 | 100/120 | 60 | 2 | 16 | R.PDCCH.5-2.1 TDD | [TDLA30-200] | 2x2 Low | 1 | TBD |
| 3-3 | 400/480 | 60 | 2 | 16  | R.PDCCH.6-2.1 TDD | TDLA10-200 | 2x2 Low | 1 | TBD |

##### 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.

**<End of R4-2217399>**

**<Start of R4-2216182>**

7.4 PBCH demodulation requirements

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 in Table 7.4.2.2-2 and Tests 1, 2 in Table 7.4.2.2.3 TBA for Tests 3,4 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 | [TBD] | [TBD] | 1 x 2 Low | 1 | [TBD] |
| 4 | 400 / 480 | [TBD] | [TBD] | 1 x 2 Low | 1 | [TBD] |

**<End of R4-2216182>**

**<Start of R4-2217403>**

### 8.1.1 Applicability of requirements

#### 8.1.1.1 General

The minimum performance requirements are applicable to the FR2 operating bands defined in TS 38.101-2 [7] with FDL\_high not exceeding 71000 MHz.

The minimum performance requirements in Clause 8 are mandatory for UE supporting NR operation, except test cases listed in Clause 8.1.1.3, 8.1.1.4, 8.1.1.5, 8.1.1.6.

If same test is listed for different UE features/capabilities in Clauses 8.1.1.3 and 8.1.1.4, then this test shall apply for UEs which support all corresponding UE features/capabilities.

*<Unchanged sections skipped>*

*-----------------Change 2---------------------*

#### 8.1.1.6 Applicability of CQI reporting requirements for FR2-2 operating bands

The requirements in Table 8.1.1.6-1 shall apply to UEs which support operation in FR2-2 operating bands.

Table 8.1.1.6-1 Requirements applicability for FR2-2

|  |  |  |
| --- | --- | --- |
| Tests | Applicability  | Applicability Notes |
| Test 1, Test 2 in Table Table 8.2.2.2.1.1-2 | For UE supporting operation in FR2-2 operating bands | The requirements are applicable for bands with FDL\_high higher than 52600 MHz and lower than 71000 MHz |

*<Unchanged sections skipped>*

*-----------------Change 3 (option2)---------------------*

##### 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-RSperiodicity 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-timeConfigperiodicity 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 timeConfigperiodicity 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 | [1] | [2] | [6] | [7] |
| 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-RSperiodicity 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-timeConfigperiodicity 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 timeConfigperiodicity 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 |

**<End of R4-2217403>**

**<Start of R4-2217398>**

## 9.2A PDSCH demodulation for CA

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

The performance requirements for SCell on FR2-2 band are specified in Table [7.2.2.2.1-3], with the additional test parameters for SCell in Table [7.2.2.2.1-2], the test parameters for PCell in Table 9.2A.1-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 9.2A.1-1. During the test, only the PDSCH performance of the SCell should be verified.

Table 9.2A.1-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH performance of SCell for UE supporting FR1+FR2-2 CA  | TBD |

Table 9.2A.1-2: Test parameters for PCell

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Duplex mode |  | TDD |
| Bandwidth | MHz | 40 |
| Subcarrier spacing | kHz | 30 |
| 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 |
| CSI-RS for tracking | First OFDM symbol in the PRB used for CSI-RS  |  | Table 7.2-1 |
|  | CSI-RS periodicity | Slots | Table 7.2-1 |
|  | CSI-RS offset | Slots | Table 7.2-1 |
|  | Frequency Occupation |  | Table 7.2-1 |
| Number of HARQ Processes |  | 8  |
| The number of slots between PDSCH and corresponding HARQ-ACK information |  | HARQ-ACK information are transmitted on the nearest UL slot of Pcell |

**<End of R4-2217398>**

**<Start of R4-2215586>**

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+0US2: 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} |

*-----------------Change 2---------------------*

**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 | TBA |  |  |  |
| 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 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 | 127 |  |  |  |
| MCS table |  | 64QAM | 64QAM |  |  |  |
| MCS index |  | 18 | 17 |  |  |  |
| Modulation |  | 64QAM | 64QAM |  |  |  |
| Target Coding Rate |  | 0.46 | 0.46 |  |  |  |
| 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 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 Slot i, if mod(i, 5) = 3 for i from {0,…, 159} | Bits | 16136 | TBA |  |  |  |
|  For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159} | Bits | 25104 | TBA |  |  |  |
| 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 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 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 | TBA |  |  |  |
|  For Slot i, if mod(i, 5) = 3 for i from {0,…, 159} | Bits | 36630 | TBA |  |  |  |
|  For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,79,82,…,159} | Bits | 54846 | TBA |  |  |  |
| Max. Throughput averaged over 2 frames | Mbps | 145.062 | TBA |  |  |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 msNote 2: Slot i is slot index per 2 frames |

*-----------------Change 3---------------------*

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

Table A.3.2.2.5-1: PDSCH Reference Channel for TDD UL-DL pattern FR2.480-1 (QPSK)

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Value** |
| Reference channel |  | R.PDSCH.7-1.1 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 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 |  | 479 |  |  |  |  |
| 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 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 Slot i, if mod(i, 20) = 14 for i from {0,…, 639} | Bits | TBA |  |  |  |  |
|  For Slot i, if mod(i, 5) = {0,1…13} for i from {1,…,639} | Bits | TBA |  |  |  |  |
| 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 Slot i, if mod(i, 20) = 14 for i from {0,…, 639} | Bits | TBA |  |  |  |  |
|  For Slot i, if mod(i, 5) = {0,1…13} for i from {1,…,639} | Bits | TBA |  |  |  |  |
| 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 Slot i, if mod(i, 20) = 14 for i from {0,…, 639} | CBs | TBA |  |  |  |  |
|  For Slot i, if mod(i, 5) = {0,1…13} for i from {1,…,639} | CBs | TBA |  |  |  |  |
| 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 Slot i, if mod(i, 20) = 14 for i from {0,…, 639} | Bits | TBA |  |  |  |  |
|  For Slot i, if mod(i, 5) = {0,1…13} for i from {1,…,639} | Bits | TBA |  |  |  |  |
| Max. Throughput averaged over 2 frames | Mbps | TBA |  |  |  |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 msNote 2: Slot i is slot index per 2 frames |

Table A.3.2.2.7-2: PDSCH Reference Channel for TDD UL-DL pattern FR2.480-1 (16QAM)

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Value** |
| Reference channel |  | R.PDSCH.7-2.1 TDD |  |  |  |  |
| Channel bandwidth | MHz | 400 |  |  |  |  |
| Subcarrier spacing | kHz | 480 |  |  |  |  |
| Allocated resource blocks | PRBs | TBA |  |  |  |  |
| 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 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 |  | 479 |  |  |  |  |
| 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 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 Slot i, if mod(i, 20) = 14 for i from {0,…, 639} | Bits | TBA |  |  |  |  |
|  For Slot i, if mod(i, 5) = {0,1…13} for i from {1,…,639} | Bits | TBA |  |  |  |  |
| 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 Slot i, if mod(i, 20) = 14 for i from {0,…, 639} | Bits | TBA |  |  |  |  |
|  For Slot i, if mod(i, 5) = {0,1…13} for i from {1,…,639} | Bits | TBA |  |  |  |  |
| 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 Slot i, if mod(i, 20) = 14 for i from {0,…, 639} | CBs | TBA |  |  |  |  |
|  For Slot i, if mod(i, 5) = {0,1…13} for i from {1,…,639} | CBs | TBA |  |  |  |  |
| 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 Slot i, if mod(i, 20) = 14 for i from {0,…, 639} | Bits | TBA |  |  |  |  |
|  For Slot i, if mod(i, 5) = {0,1…13} for i from {1,…,639} | Bits | TBA |  |  |  |  |
| Max. Throughput averaged over 2 frames | Mbps | TBA |  |  |  |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 msNote 2: Slot i is slot index per 2 frames |

*-----------------Change 4---------------------*

#### 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 | R.PDCCH.6-1.2 TDD |  |  |  |  |
| Subcarrier spacing | kHz | 480 | 480 |  |  |  |  |
| CORESET frequency domain allocation |  | 60 | 60 |  |  |  |  |
| CORESET time domain allocation |  | 1 | 1 |  |  |  |  |
| Aggregation level |  | 4 | 8 |  |  |  |  |
| DCI Format |  | 1\_1 | 1\_1 |  |  |  |  |
| Payload (without CRC) | Bits | 56 | 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 |  |  |  |  |  |

*-----------------Change 5---------------------*

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 |

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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. |

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