**3GPP TSG-RAN WG4 Meeting #99-e *R4-2108508***

**E-meeting, 19th May – 27th May 2021**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.101-4** | **CR** | **0186** | **rev** | **1** | **Current version:** | **15.9.0** |  |
|  | | | | | | | | |
| *For* [***HELP***](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:*** | CR on NR UE demodulation performance requirements maintenance (R15) | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Intel Corporation | | | | | | | | | |
| ***Source to TSG:*** | RAN4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_newRAT-Perf | | | | |  | ***Date:*** | | | 2021-05-11 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***Release:*** | | | Rel-15 |
|  | *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-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | 1. Clarification for tests with multiple UE features/capabilities is missing. 2. Based on TS 38.331 CSI-RS frequency allocation has limitation that nrofRBs in CSI-FrequencyOccupation shall be multiples of 4. However, this limitation is missing in requirements        1. Incorrect number of binary channel bits for S slot in Table A.3.2.2.5-2 2. Editorial corrections | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | 1. Add clarifcation note for tests with multiple UE features/capabilities 2. Update frequency allocation of CSI-RS and ZP-CSI-RS. 3. Update number of binary channel bits for S slot in Table A.3.2.2.5-2 4. Editorial corrections    1. Rename “NZP CSI-RS for beam management” to “NZP CSI-RS for beam refinement” to align with naming for PDSCH and CSI requirements    2. Add “Frequency occupation configuration” for “NZP CSI-RS for beam refinement” | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | 1. Applicability rule for tests with multiple UE features/capabilities is confusing. 2. Incorrect CSI-RS configuration 3. Incorrect FRC in Table A.3.2.2.5-2 | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 5.1.1.1, 5.2, 5.3, 5.5A.1, 6.1.1, 6.1.2, 7.1.1, 7.2, 7.3, 7.5A.1, 8.1.1, 8.1.2, A.3.2.2.5 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | |  | | |
| ***affected:*** | | **X** |  | Test specifications | | | | TS 38.521-4 | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | |  | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

**START OF CHANGE**

5 Demodulation performance requirements (Conducted requirements)

5.1 General

5.1.1 Applicability of requirements

5.1.1.1 General

The minimum performance requirements are applicable to all FR1 operating bands defined in TS 38.101-1[6].

The minimum performance requirements in Clause 5 are mandatory for UE supporting NR operation, except test cases listed in Clauses 5.1.1.3, 5.1.1.4.

If same test is listed for different UE features/capabilities in Clauses 5.1.1.3 and 5.1.1.4, then this test shall apply for UEs which support all corresponding UE features/capabilities.

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5.2 PDSCH demodulation requirements

The parameters specified in Table 5.2-1 are valid for all PDSCH tests unless otherwise stated.

**Table 5.2-1: Common test parameters**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Value** |
| PDSCH transmission scheme | | |  | Transmission scheme 1 |
| Carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 2) | | RBs | 0 |
| Subcarrier spacing | | kHz | 15 or 30 |
| 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 38.101-1 [6] 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 |
| Symbols with PDCCH | | Symbols | 0, 1 |
| Number of PRBs in CORESET | |  | Table 5.2-2 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  l0 = 10 for CSI-RS resource 2 and 4 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 |
| CDM Type | |  | 'No CDM’ for CSI-RS resource 1,2,3,4 |
| Density (ρ) | |  | 3 for CSI-RS resource 1,2,3,4 |
| CSI-RS periodicity | | Slots | 15 kHz SCS: 20 for CSI-RS resource 1,2,3,4  30 kHz SCS: 40 for CSI-RS resource 1,2,3,4 |
| CSI-RS offset | | Slots | 15 kHz SCS:  10 for CSI-RS resource 1 and 2  11 for CSI-RS resource 3 and 4  30 kHz SCS:  20 for CSI-RS resource 1 and 2  21 for CSI-RS resource 3 and 4 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*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) | |  | Same as number of transmit antenna |
| CDM Type | |  | 'No CDM' for 1 transmit antenna  'FD-CDM2' for 2 and 4 transmit antenna |
| Density (ρ) | |  | 1 |
| CSI-RS periodicity | | Slots | 15 kHz SCS: 20  30 kHz SCS: 40 |
| CSI-RS offset | | Slots | 0 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*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 | 15 kHz SCS: 20  30 kHz SCS: 40 |
| CSI-RS offset | | Slots | 0 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*4 |
| PDSCH DMRS configuration | Antenna ports indexes | |  | {1000} for Rank 1 tests {1000, 1001} for Rank 2 tests  {1000-1002} for Rank 3 tests  {1000-1003} for Rank 4 tests |
| Position of the first DMRS for PDSCH mapping type A | |  | 2 |
| Number of PDSCH DMRS CDM group(s) without data | |  | 1 for Rank 1 and Rank 2 tests  2 for Rank 3 and Rank 4 tests |
| TCI state #0 | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| 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 |  | N/A |
| QCL Type |  | N/A |
| PT-RS configuration | | |  | PT-RS is not configured |
| Maximum number of code block groups for ACK/NACK feedback | | |  | 1 |
| Maximum number of HARQ transmission | | |  | 4 |
| 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, and with PRB bundling granularity |
| 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 |
| 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 38.101-1 [6] for tested channel bandwidth and subcarrier spacing. | | | | |

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## 5.3 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 5.3-1 are valid for all PDCCH tests unless otherwise stated.

**Table 5.3-1: 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 |
| RB offset | | RBs | 0 |
| Common serving cell parameters | Physical Cell ID | |  | 0 |
| SSB position in burst | |  | 1 |
| 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 | 15 kHz SCS: 20  30 kHz SCS: 40 |
| CSI-RS offset | | Slots | 15 kHz SCS:  10 for CSI-RS resource 1 and 2  11 for CSI-RS resource 3 and 4  30 kHz SCS:  20 for CSI-RS resource 1 and 2  21 for CSI-RS resource 3 and 4 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*4 |
| QCL info | |  | TCI state #0 |
| 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 |
| PDCCH Precoding configuration | | |  | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination with REG bundling granularity for number of Tx larger than 1 |
| 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 |
| Physical signals, channels mapping and precoding | | |  | As specified in Annex B.4.1 |
| 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. | | | | |

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5.5A Sustained downlink data rate provided by lower layers

5.5A.1 FR1 CA requirements

<SKIP UNCHANGED PART>

**Table 5.5A-1: Common test parameters for FDD and TDD component carriers**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Value** |
| PDSCH transmission scheme | | |  | Transmission scheme 1 |
| EPRE ratio of PTRS to PDSCH | | | dB | N/A |
| Channel bandwidth | | | MHz | Channel bandwidth from selected CA bandwidth combination |
| Common serving cell parameters | Physical Cell ID | |  | 0 |
| SSB position in burst | |  | First SSB in Slot #0 |
| SSB periodicity | | ms | 20 |
| First DMRS position for Type A PDSCH mapping | |  | 2 |
| Cross carrier scheduling | | |  | Not configured |
| Active DL BWP index | | |  | 1 |
| Actual carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 2) | | RBs | 0 |
| Subcarrier spacing | | kHz | 15 or 30 |
| DL BWP configuration #1 | RB offset | | RBs | 0 |
| Number of contiguous PRB | |  | Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing |
| Subcarrier spacing | | kHz | 15 or 30 |
| Cyclic prefix | |  | Normal |
| PDCCH configuration | Slots for PDCCH monitoring | |  | Each slot |
| Symbols with PDCCH | |  | Symbols #0 |
| Number of PRBs in CORESET | |  | Table 5.5A-4 |
| Number of PDCCH candidates and aggregation levels | |  | 1/AL 1 for 30 kHz / 5 MHz  1/AL4 for 15 kHz / 5 MHz, 30 kHz / 10 MHz and 30 kHz / 15 MHz  1/AL 8 for other combinations |
| CCE-to-REG mapping type | |  | Non-interleaved |
| DCI format | |  | 1\_1 |
| TCI State | |  | TCI state #1 |
| PDCCH & PDCCH DMRS Precoding configuration | |  | For 2Tx:  Single Panel Type I, Random precoder chosen from precoder index 0 and 2, selection updated per slot  For 4Tx:  Single Panel Type I, Random precoder chosen from precoders with i\_1,1 in {1,2,3,5,6,7} and i\_2 in {0,2}, selection updated per slot |
| PDSCH configuration | Mapping type | |  | Type A |
| k0 | |  | 0 |
| PDSCH aggregation factor | |  | 1 |
| PRB bundling type | |  | Static |
| PRB bundling size | |  | WB |
| Resource allocation type | |  | Type 0 |
| 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 |
| Length | |  | 1 |
| Antenna ports indexes | |  | {1000} for 1 Layer CCs {1000, 1001} for 2 Layers CCs  {1000 – 1003} for 4 Layers CCs |
| Number of PDSCH DMRS CDM group(s) without data | |  | 1 for 1 layer and 2 layers CCs  2 for 4 Layers CCs |
| PTRS configuration | | |  | PTRS is not configured |
| CSI-RS for tracking | Subcarrier indexes in the PRB used for CSI-RS | |  | k0 = 3 for CSI-RS resource 1,2,3,4 |
| OFDM symbols in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resource 1 and 3  l0 = 10 for CSI-RS resource 2 and 4 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 |
| CDM Type | |  | 'No CDM' for CSI-RS resource 1,2,3,4 |
| Density (ρ) | |  | 3 for CSI-RS resource 1,2,3,4 |
| CSI-RS periodicity | | Slots | 15 kHz SCS: 20 for CSI-RS resource 1,2,3,4  30 kHz SCS: 40 for CSI-RS resource 1,2,3,4 |
| CSI-RS offset | | Slots | 15 kHz SCS:  10 for CSI-RS resource 1 and 2  11 for CSI-RS resource 3 and 4  30 kHz SCS:  20 for CSI-RS resource 1 and 2  21 for CSI-RS resource 3 and 4 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*4 |
| QCL info | |  | TCI state #0 |
| NZP CSI-RS for CSI acquisition | Subcarrier indexes in the PRB used for CSI-RS | |  | k0 = 4 |
| OFDM symbols in the PRB used for CSI-RS | |  | l0 = 12 |
| Number of CSI-RS ports (X) | |  | Same as number of transmit antenna |
| CDM Type | |  | 'FD-CDM2' |
| Density (ρ) | |  | 1 |
| CSI-RS periodicity | |  | 15 kHz SCS: 20  30 kHz SCS: 40 |
| CSI-RS offset | |  | 0 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*4 |
| QCL info | |  | TCI state #1 |
| ZP CSI-RS for CSI acquisition | Subcarrier indexes in the PRB used for CSI-RS | |  | k0 = 0 |
| OFDM symbols in the PRB used for CSI-RS | |  | l0 = 12 |
| Number of CSI-RS ports (X) | |  | 4 |
| CDM Type | |  | 'FD-CDM2' |
| Density (ρ) | |  | 1 |
| CSI-RS periodicity | |  | 15 kHz SCS: 20  30 kHz SCS: 40 |
| CSI-RS offset | |  | 0 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*4 |
| TCI state #0 | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| 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 |  | N/A |
| QCL Type |  | N/A |
| Maximum number of code block groups for ACK/NACK feedback | | |  | 1 |
| Maximum number of HARQ transmission | | |  | 4 |
| 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 with PRB bundling granularity |
| Symbols for all unused REs | | |  | OP.1 FDD as defined in Annex A.5.1.1  OP.1 TDD as defined in Annex A.5.2.1 |
| Propagation condition | | |  | Static propagation condition  No external noise sources are applied |
| Antenna configuration | 1 layer CCs | |  | 1x2 or 1x4 |
| 2 layers CCs | |  | 2x2 or 2x4 |
| 4 layers CCs | |  | 4x4 |
| 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 38.101-1 [6] for tested channel bandwidth and subcarrier spacing | | | | |

<SKIP UNCHANGED PART>

6 CSI reporting requirements (Conducted requirements)

6.1 General

This clause includes conducted requirements for the reporting of channel state information (CSI).

6.1.1 Applicability of requirements

6.1.1.1 General

The minimum performance requirements are applicable to all FR1 operating bands defined in TS 38.101-1 [6].

The minimum performance requirements in Clause 6 are mandatary for UE supporting NR operation, except test cases listed in Clause 6.1.1.3, 6.1.1.4.

If same test is listed for different UE features/capabilities in Clauses 6.1.1.3 and 6.1.1.4, then this test shall apply for UEs which support all corresponding UE features/capabilities.

<SKIP UNCHANGED PART>

6.1.2 Common test parameters

Parameters specified in Table 6.1.2-1 are applied for all test cases in this clause unless otherwise stated.

**Table 6.1.2-1: Test parameters for CSI test cases**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | | | | | **Unit** | **Value** |
| PDSCH transmission scheme | | | | |  | Transmission scheme 1 |
| Actual carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 3) | | | | RBs | 0 |
| Subcarrier spacing | | | | kHz | 15 or 30 |
| 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 38.101-1 [6] for tested channel bandwidth and subcarrier spacing |
| Active DL BWP index | | | | |  | 1 |
| 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 |
| Symbols with PDCCH | | |  | 0,1 |
| Number of PDCCH candidates and aggregation levels | | |  | 1/AL8 |
| DCI format | | |  | 1\_1 |
| TCI state | | |  | TCI state #1 |
| PDCCH & PDCCH DMRS Precoding configuration | | |  | Multi-path fading propagation conditions:  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  Static propagation conditions:  Single Panel Type I, Random precoder chosen from precoder index 0 and 2, selection updated per slot |
| Additional PDCCH Configuration for Aperiodic Reporting (Note 4) | | Slots for PDCCH monitoring | | |  | Each slot |
| Symbols with PDCCH | | |  | 0,1 |
| Number of PDCCH candidates and aggregation levels | | |  | 1/AL8 |
| DCI format | | |  | 0\_1 |
| TCI state | | |  | TCI state #1 |
| PDCCH & PDCCH DMRS Precoding configuration | | |  | Multi-path fading propagation conditions:  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 |
| 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 |
| 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 |
| DMRS ports indexes | | |  | {1000} for Rank1  {1000,1001} for Rank2  {1000,1001,1002} for Rank3  {1000,1001,1002,1003} for Rank4 |
| Number of PDSCH DMRS CDM group(s) without data | | |  | 2 |
| PTRS configuration | | Frequency density (*KPT-RS*) | | |  | N/A |
| Time density (*LPT-RS*) | | |  | N/A |
| 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*) | |  | 4 for CSI-RS resource 1 and 3  8 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 | | slot | 15 kHz SCS: 20 for CSI-RS resource 1,2,3,4  30 kHz SCS: 40 for CSI-RS resource |
| CSI-RS offset | | slot | 15 kHz SCS:  10 for CSI-RS resource 1 and 2  11 for CSI-RS resource 3 and 4  30 kHz SCS:  20 for CSI-RS resource 1 and 2  21 for CSI-RS resource 3 and 4 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*4 |
| QCL info | |  | TCI state #0 |
| NZP CSI-RS for CSI acquisition | | | Frequency Occupation | |  | Start PRB 0  Number of PRB = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*4 |
| QCL info | |  | TCI state #1 |
| ZP CSI-RS for CSI acquisition | | | Frequency Occupation | |  | Start PRB 0  Number of PRB = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*4 |
| TCI state #0 | | | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| 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 |  | N/A |
| QCL Type |  | N/A |
| Number of HARQ Processes | | | | |  | 4 For FDD  8 for TDD |
| HARQ ACK/NACK bundling | | | | |  | Multiplexed |
| Redundancy version coding sequence | | | | |  | {0,2,3,1} |
| K1 value (PDSCH-to-HARQ-timing-indicator) | | | | |  | 2 for FDD  For FR1.30-1:  8 if mod(i,10) = 0 6 if mod(i,10) = 2 5 if mod(i,10) = 3 5 if mod(i,10) = 4 4 if mod(i,10) = 5 3 if mod(i,10) = 6  Where i is slot index per radio frame with 0~19 |
| Symbols for unused REs | | | | |  | OP.1 FDD as defined in Annex A.5.1.1  OP.1 TDD as defined in Annex A.5.2.1 |
| Physical signals, channels mapping and precoding | | | | |  | As specified in Annex B.4.1 |
| Note 1: PDSCH is not scheduled on slots containing CSI-RS or slots which are not full DL.  Note 2: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission.  Note 3: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing.  Note 4: Additional PDCCH configuration for aperiodic reporting is only for test cases with aperiodic CSI reporting configured. | | | | | | |

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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 40000 MHz.

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.

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.

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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 |
| 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 | |  | 1 |
| SSB periodicity | | ms | 20 |
| PDCCH configuration | Slots for PDCCH monitoring | |  | Each slot |
| 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 |
| CSI-RS offset | | Slots | 60 kHz SCS:  40 for CSI-RS resource 1 and 2  41 for CSI-RS resource 3 and 4  120 kHz SCS:  80 for CSI-RS resource 1 and 2  81 for CSI-RS resource 3 and 4 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*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 |
| CSI-RS offset | |  | 0 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*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 |
| CSI-RS offset | |  | 0 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*4 |
| CSI-RS for beam refinement | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resource 1,2 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 8 for CSI-RS resource 1  l0 = 9 for CSI-RS resource 2 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2 |
| CDM Type | |  | 'No CDM' for CSI-RS resource 1,2 |
| Density (ρ) | |  | 3 for CSI-RS resource 1,2 |
| CSI-RS periodicity | | Slots | 60 kHz SCS: 80 for CSI-RS resource 1,2  120 kHz SCS: 160 for CSI-RS resource 1,2 |
| CSI-RS offset | | Slots | 0 for CSI-RS resource 1,2 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*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 | | |  | 4 |
| 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  OP.1 TDD as defined in Annex A.5.2.1 |
| 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. | | | | |

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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 | |  | 1 |
| 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 = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*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 = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*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 |
| Physical signals, channels mapping and precoding | | |  | As specified in Annex B.4.1 |
| 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 |
| 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. | | | | |

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7.5A Sustained downlink data rate provided by lower layers

7.5A.1 FR2 CA requirements

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Value** |
| PDSCH transmission scheme | | |  | Transmission scheme 1 |
| PTRS epre-Ratio | | |  | 0 |
| Channel bandwidth | | | MHz | Channel bandwidth from selected CA bandwidth combination |
| Common serving cell parameters | Physical Cell ID | |  | 0 |
| SSB position in burst | |  | First SSB in Slot #0 |
| SSB periodicity | | ms | 20 |
| First DMRS position for Type A PDSCH mapping | |  | 2 |
| Cross carrier scheduling | | |  | Not configured |
| Active DL BWP index | | |  | 1 |
| Actual carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 3) | | RBs | 0 |
| Subcarrier spacing | | kHz | 60 or 120 |
| DL BWP configuration #1 | RB Offset | |  | 0 |
| Number of contiguous PRB | |  | Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing |
| Subcarrier spacing | | kHz | 60 or 120 |
| Cyclic prefix | |  | Normal |
| PDCCH configuration | Slots for PDCCH monitoring | |  | Each slot |
| Symbols with PDCCH | |  | Symbols #0 |
| Number of PRBs in CORESET | |  | Table 7.5A.1-2 |
| Number of PDCCH candidates and aggregation levels | |  | 1/8 |
| CCE-to-REG mapping type | |  | Non-interleaved |
| DCI format | |  | 1-1 |
| TCI State | |  | TCI state #1 |
| PDCCH &PDCCH DMRS Precoding configuration | |  | Single Panel Type I, Random per slot with equal probability of precoder index 0 and 2, and with REG bundling granularity for number of Tx larger than 1 |
| PDSCH configuration | Mapping type | |  | Type A |
| k0 | |  | 0 |
| PDSCH aggregation factor | |  | 1 |
| PRB bundling type | |  | Static |
| PRB bundling size | |  | WB |
| Resource allocation type | |  | Type 0 |
| RBG size | |  | Config2 |
| VRB-to-PRB mapping type | |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size | |  | N/A |
| Starting symbol (S) | |  | 1 |
| Length (L) | |  | 13 |
| PDSCH DMRS configuration | DMRS Type | |  | Type 1 |
| Number of additional DMRS | |  | 1 |
| Length | |  | 1 |
| Antenna ports indexes | |  | {1000} for 1 Layer CCs {1000, 1001} for 2 Layers CCs |
| Number of PDSCH DMRS CDM group(s) without data | |  | 1 |
| PTRS configuration | Frequency density (*KPT-RS*) | |  | 2 |
| Time density (*LPT-RS*) | |  | 1 |
| CSI-RS for tracking | Subcarrier indexes in the PRB used for CSI-RS | |  | k0 = 3 for CSI-RS resource 1,2,3,4 |
| OFDM symbols in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resource 1 and 3  l0 = 10 for CSI-RS resource 2 and 4 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 |
| CDM Type | |  | 'No CDM' for CSI-RS resource 1,2,3,4 |
| Density (ρ) | |  | 3 for CSI-RS resource 1,2,3,4 |
| CSI-RS periodicity | | Slots | 60 kHz SCS: 80 for CSI-RS resource 1,2,3,4  120 kHz SCS: 160 for CSI-RS resource 1,2,3,4 |
| CSI-RS offset | | Slots | 60 kHz SCS:  40 for CSI-RS resource 1 and 2  41 for CSI-RS resource 3 and 4  120 kHz SCS:  80 for CSI-RS resource 1 and 2  81 for CSI-RS resource 3 and 4 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*4 |
| QCL info | |  | TCI state #0 |
| NZP CSI-RS for CSI acquisition | Subcarrier indexes in the PRB used for CSI-RS | |  | k0 = 4 |
| OFDM symbols in the PRB used for CSI-RS | |  | l0 = 13 |
| Number of CSI-RS ports (X) | |  | Same as number of transmit antenna |
| CDM Type | |  | 'FD-CDM2' |
| Density (ρ) | |  | 1 |
| CSI-RS periodicity | | Slots | 60 kHz SCS: 80  120 kHz SCS: 160 |
| CSI-RS offset | |  | 0 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*4 |
| QCL info | |  | TCI state #1 |
| ZP CSI-RS for CSI acquisition | Subcarrier indexes in the PRB used for CSI-RS | |  | k0 = 0 |
| OFDM symbols in the PRB used for CSI-RS | |  | l0 = 12 |
| Number of CSI-RS ports (X) | |  | 4 |
| CDM Type | |  | 'FD-CDM2' |
| Density (ρ) | |  | 1 |
| CSI-RS periodicity | | Slots | 60 kHz SCS: 80  120 kHz SCS: 160 |
| CSI-RS offset | |  | 0 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*4 |
| CSI-RS for beam refinement | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resource 1,2 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 8 for CSI-RS resource 1  l0 = 9 for CSI-RS resource 2 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2 |
| CDM Type | |  | 'No CDM' for CSI-RS resource 1,2 |
| Density (ρ) | |  | 3 for CSI-RS resource 1,2 |
| CSI-RS periodicity | | Slots | 60 kHz SCS: 80 for CSI-RS resource 1,2  120 kHz SCS: 160 for CSI-RS resource 1,2 |
| CSI-RS offset | | Slots | 0 for CSI-RS resource 1,2 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*4 |
| Repetition | |  | ON |
| QCL info | |  | TCI state #1 |
| TCI state #0 | Tyoe 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Tyoe 2 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type D |
| TCI state #1 | Tyoe 1 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
| QCL Type |  | Type A |
| Tyoe 2 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
| QCL Type |  | Type D |
| Maximum number of code block groups for ACK/NACK feedback | | |  | 1 |
| Number of HARQ Processes | | |  | 10 for FR2.60-1 and 8 for FR2.120-1 |
| K1 value | | |  | Specific to each UL-DL pattern |
| Maximum number of HARQ transmission | | |  | 4 |
| HARQ ACK/NACK bundling | | |  | Multiplexed |
| Redundancy version coding sequence | | |  | {0,2,3,1} |
| TDD UL-DL pattern | | |  | 60 kHz SCS: FR2.60-1  120 kHz SCS: FR2.120-1 |
| PDSCH & PDSCH DMRS Precoding configuration | | |  | Single Panel Type I, Precoder index 0 per slot with Wideband granularity for Rank 2 |
| Symbols for all unused REs | | |  | OP.1 FDD as defined in Annex A.5.1.1  OP.1 TDD as defined in Annex A.5.2.1 |
| Propagation condition | | |  | Static propagation condition  No external noise sources are applied |
| Antenna configuration | 1 layer CCs | |  | 1x2 or 1x4 |
| 2 layers CCs | |  | 2x2 or 2x4 |
| Physical signals, channels mapping and precoding | | |  | As specified in Annex B.4.1 |
| Note 1: PDSCH is scheduled only on full DL slots not containing SSB or TRS.  Note 2: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission.  Note 3: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing. | | | | |

<SKIP UNCHANGED PART>

8 CSI reporting requirements (Radiated requirements)

8.1 General

This clause includes radiated requirements for the reporting of channel state information (CSI).

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 40000 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.

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.

<SKIP UNCHANGED PART>

8.1.2 Common test parameters

Parameters specified in Table 8.1.2-1 are applied for all test cases in this clause unless otherwise stated.

**Table 8.1.2-1: Test parameters for CSI test cases**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameter** | | | | **Unit** | **Value** |
| PDSCH transmission scheme | | | |  | Transmission scheme 1 |
| Duplex Mode | | | |  | TDD |
| PTRS *epre-Ratio* | | | |  | 0 |
| Actual carrier configuration | | Offset between Point A and the lowest usable subcarrier on this carrier (Note 3) | | RBs | 0 |
| Subcarrier spacing | | kHz | 120 |
| 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 |
| Active DL BWP index | | | |  | 1 |
| 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 |
| Symbols with PDCCH | | |  | 0,1 |
| Number of PDCCH candidates and aggregation levels | | |  | 1/AL8 |
| DCI format | | |  | 1\_1 |
| TCI state | | |  | TCI state #1 |
| PDCCH & PDCCH DMRS Precoding configuration | | |  | Multi-path fading propagation conditions:  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  Static propagation conditions:  Single Panel Type I, Random precoder chosen from precoder index 0 and 2, selection updated per slot |
| Additional PDCCH Configuration for Aperiodic Reporting (Note 4) | Slots for PDCCH monitoring | | |  | Each slot |
| Symbols with PDCCH | | |  | 0,1 |
| Number of PDCCH candidates and aggregation levels | | |  | 1/AL8 |
| DCI format | | |  | 0\_1 |
| TCI state | | |  | TCI state #1 |
| PDCCH & PDCCH DMRS Precoding configuration | | |  | Multi-path fading propagation conditions:  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 |
| 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 |
| Number of additional DMRS | | |  | 1 |
| DMRS ports indexes | | |  | {1000} for Rank1  {1000,1001} for Rank2 |
| Maximum number of OFDM symbols for DL front loaded DMRS | | |  | 1 |
| Number of PDSCH DMRS CDM group(s) without data | | |  | 2 |
| PTRS configuration | Frequency density (*KPT-RS*) | | |  | 2 |
| Time density (*LPT-RS*) | | |  | 1 |
| Resource Element Offset | | |  | 2 |
| 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*) | |  | 4 for CSI-RS resource 1 and 3  8 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 | | slot | 120kHz SCS: 160 for CSI-RS resource 1,2,3,4 |
| CSI-RS offset | | slot | 120 kHz SCS:  80 for CSI-RS resource 1 and 2  81 for CSI-RS resource 3 and 4 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*4 |
| QCL info | |  | TCI state #0 |
| NZP CSI-RS for CSI acquisition | | Frequency Occupation | |  | Start PRB 0  Number of PRB = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*4 |
| QCL info | |  | TCI state #1 |
| ZP CSI-RS for CSI acquisition | | Frequency Occupation | |  | Start PRB 0  Number of PRB = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*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 | 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 = BWP size, if mod(BWP size, 4) = 0, otherwise (floor(BWP size/4)+1)\*4 |
| Repetition | |  | ON |
| QCL info | |  | TCI state #1 |
| TCI state #0 | | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type D |
| TCI state #1 | | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
| QCL Type |  | Type D |
| Number of HARQ Processes | | | |  | 8 |
| HARQ ACK/NACK bundling | | | |  | Multiplexed |
| Redundancy version coding sequence | | | |  | {0,2,3,1} |
| K1 value (PDSCH-to-HARQ-timing-indicator) | | | |  | For FR2.120-1:  3 if mod (i.5) = 0,  6 if mod(i,5) = 2  For FR2.120-2:  11 if mod(i,8) = 0,  7]if mod(i,8) = 4,  6]if mod(i,8) = 5,  where i is slot index per radio fame with values 0-79. |
| Symbols for unused REs | | | |  | OP.1 FDD as defined in Annex A.5.1.1  OP.1 TDD as defined in Annex A.5.2.1 |
| Physical signals, channels mapping and precoding | | | |  | As specified in Annex B.4.1 |
| Note 1: PDSCH is not scheduled on slots containing CSI-RS or slots which are not full DL.  Note 2: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission.  Note 3: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing.  Note 4: Additional PDCCH configuration for aperiodic reporting is only for test cases with aperiodic CSI reporting configured. | | | | | |

A.3 DL reference measurement channels

<SKIP UNCHANGED PART>

A.3.2 Reference measurement channels for PDSCH performance requirements

<SKIP UNCHANGED PART>

A.3.2.2 TDD

<SKIP UNCHANGED PART>

A.3.2.2.5 Reference measurement channels for SCS 120 kHz FR2

<SKIP UNCHANGED PART>

**Table A.3.2.2.5-2: PDSCH Reference Channel for TDD UL-DL pattern FR2.120-1 (16QAM)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | |
| Reference channel |  | R.PDSCH.5-2.1 TDD | R.PDSCH.5-2.2 TDD | R.PDSCH.5-2.3 TDD |  |  |
| Channel bandwidth | MHz | 100 | 100 | 200 |  |  |
| Subcarrier spacing | kHz | 120 | 120 | 120 |  |  |
| Allocated resource blocks | PRBs | 66 | 66 | 132 |  |  |
| Number of consecutive PDSCH symbols |  |  |  |  |  |  |
| For Slot i, if mod(i, 5) = 3 for i from {0,…, 159} |  | 9 | 9 | 9 |  |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159} |  | 13 | 13 | 13 |  |  |
| Allocated slots per 2 frames |  | 127 | 127 | 127 |  |  |
| MCS table |  | 64QAM | 64QAM | 64QAM |  |  |
| MCS index |  | 13 | 13 | 13 |  |  |
| Modulation |  | 16QAM | 16QAM | 16QAM |  |  |
| Target Coding Rate |  | 0.48 | 0.48 | 0.48 |  |  |
| Number of MIMO layers |  | 1 | 2 | 2 |  |  |
| Number of DMRS REs |  |  |  |  |  |  |
| For Slot i, if mod(i, 5) = 3 for i from {0,…, 159} |  | 12 | 12 | 12 |  |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159} |  | 12 | 12 | 12 |  |  |
| Overhead for TBS determination |  | 6 | 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 | N/A |  |  |
| For Slot i, if mod(i, 5) = 3 for i from {0,…, 159} | Bits | 11272 | 22536 | 45096 |  |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159} | Bits | 17424 | 34816 | 69672 |  |  |
| 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 | N/A |  |  |
| For Slot i, if mod(i, 5) = 3 for i from {0,…, 159} | Bits | 24 | 24 | 24 |  |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159} | Bits | 24 | 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 | N/A |  |  |
| For Slot i, if mod(i, 5) = 3 for i from {0,…, 159} | CBs | 2 | 3 | 6 |  |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159} | CBs | 3 | 5 | 9 |  |  |
| 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 | N/A |  |  |
| For Slots i = 80, 81 | Bits | 36564 | 69960 | 139920 |  |  |
| For Slots i = 82 | Bits | 34980 | 73128 | 146256 |  |  |
| For Slots i = 83 | Bits | 22308 | 48840 | 97680 |  |  |
| For Slot i, if mod(i, 5) = 3 for i from {0,…, 159} | Bits | 24420 | 48840 | 97680 |  |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,79,84,…,159} | Bits | 36564 | 73128 | 146256 |  |  |
| Max. Throughput averaged over 2 frames | Mbps | 100.799 | 201.434 | 403.096 |  |  |
| 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 CHANGE**