**3GPP TSG-RAN WG4 Meeting #99-e R4-2110550**

**Electronic Meeting, 19th - 27th May, 2021**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **38.101-4** | **CR** | **0223** | **rev** | **-** | **Current version:** | **17.0.0** |  |
|  |
| *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 |  | Radio Access Network | **X** | Core Network |  |

|  |
| --- |
|  |
| ***Title:***  | CR on UE demodulation and CSI repopting for 35MHz and 45MHz channel bandwidth for FR1 FDD (Rel-17) |
|  |  |
| ***Source to WG:*** | Huawei, HiSilicon |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_FR1\_35MHz\_45MHz\_BW-Perf |  | ***Date:*** | 2021-05-24 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-17 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories 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-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
|  |  |
| ***Reason for change:*** | Provide initial CR on UE demodulation and CSI reqopting for 35MHz and 45MHz channel bandwidth for FR1 FDD. |
|  |  |
| ***Summary of change:*** | For CA requirements, update Table 5.2A.2.1-1 and Table 5.2A.3.1-1.For SDR requirements, update Table 5.2-2 and Table 5.5A-4.For CQI requirements, update Table 6.2A.3.1.1-2.For FRC, update Table A.3.2.1.1-9. |
|  |  |
| ***Consequences if not approved:*** | There will be inconsistence between the specification 38.101-4 and RAN 4 agreements. |
|  |  |
| ***Clauses affected:*** | 5.2, 5.2A.2.1, 5.2A.3.1, 5.5A.1, 6.2A.3.1.1, A.3.2.1.1. |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **x** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **X** |  |  Test specifications | TS 38.521-4 |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

*<START OF THE CHANGE 1>*

## 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 3l0 = 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 1,2,3,430 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 211 for CSI-RS resource 3 and 430 kHz SCS:20 for CSI-RS resource 1 and 221 for CSI-RS resource 3 and 4 |
|  | Frequency Occupation |  | Start PRB 0Number of PRB = BWP size |
|  | 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: 2030 kHz SCS: 40 |
|  | CSI-RS offset | Slots | 0 |
|  | Frequency Occupation |  | Start PRB 0Number of PRB = BWP size |
|  | 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: 2030 kHz SCS: 40 |
|  | CSI-RS offset | Slots | 0 |
|  | Frequency Occupation |  | Start PRB 0Number of PRB = BWP size |
| 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 tests2 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.5.1.1OP.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. |

Table 5.2-2: Number of PRBs in CORESET

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SCS (kHz)** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **25 MHz** | **30 MHz** | **35 MHz** | **40 MHz** | **45 MHz** | **50 MHz** | **60 MHz** | **80 MHz** | **100 MHz** |
| 15 | 24 | 48 | 78 | 102 | 132 | 156 | 188 | 216 | 242 | 270 | N/A | N/A | N/A |
| 30 | 6 | 24 | 36 | 48 | 60 | 78 | 92 | 102 | 119 | 132 | 162 | 216 | 270 |

*(Unchanged part skiped)*

*<END OF THE CHANGE 1>*

*<START OF THE CHANGE 2>*

#### 5.2A.2.1 Minimum requirements

For CA with different numbers of DL component carriers, the requirements are defined in Table 5.2A.2.1-4 based on the single carrier requirements for different SCSs and different bandwidth specified in Table 5.2A.2.1-1 ~ Table 5.2A.2.1-3, with the parameters in Table 5.2A-1 ~ Table 5.2A-3 and the downlink physical channel setup according to Annex C.3.1. The performance requirements specified in this sub-cluase do not apply for UE single carrier test.

Table 5.2A.2.1-1: Single carrier performance for FDD 15 kHz SCS for CA configurations

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Bandwidth (MHz)  | Reference channel | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value |
| Fraction of maximum throughput (%) | SNR (dB) |
| 5 | R.PDSCH.1-9.1 FDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.6 |
| 10 | R.PDSCH.1-2.2 FDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.6 |
| 15 | R.PDSCH.1-9.2 FDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.6 |
| 20 | R.PDSCH.1-9.3 FDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.8 |
| 25 | R.PDSCH.1-9.4 FDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.0 |
| 30 | R.PDSCH.1-9.5 FDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.8 |
| 35 | R.PDSCH.1-10.3 FDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | TBD |
| 40 | R.PDSCH.1-10.1 FDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.0 |
| 45 | R.PDSCH.1-10.4 FDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | TBD |
| 50 | R.PDSCH.1-10.2 FDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.4 |

Table 5.2A.2.1-2 Single carrier performance for TDD 15 kHz SCS for CA configurations

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Bandwidth (MHz)  | Reference channel | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value |
| Fraction of maximum throughput (%) | SNR (dB) |
| 5 | R.PDSCH.1-2.1 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.6 |
| 10 | R.PDSCH.1-2.2 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.8 |
| 15 | R.PDSCH.1-2.3 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.8 |
| 20 | R.PDSCH.1-2.4 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.9 |
| 25 | R.PDSCH.1-2.5 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.0 |
| 30 | R.PDSCH.1-3.1 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.9 |
| 40 | R.PDSCH.1-3.2 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.2 |
| 50 | R.PDSCH.1-3.3 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.5 |

Table 5.2A.2.1-3 Single carrier performance for TDD 30 kHz SCS for CA configurations

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Bandwidth (MHz)  | Reference channel | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value |
| Fraction of maximum throughput (%) | SNR (dB) |
| 5 | R.PDSCH.2-13.1 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.6 |
| 10 | R.PDSCH.2-13.2 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.6 |
| 15 | R.PDSCH.2-13.3 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.6 |
| 20 | R.PDSCH.2-13.4 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.7 |
| 25 | R.PDSCH.2-13.5 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.7 |
| 30 | R.PDSCH.2-14.1 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.7 |
| 40 | R.PDSCH.2-2.2 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.9 |
| 50 | R.PDSCH.2-14.2 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.1 |
| 60 | R.PDSCH.2-14.3 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.0 |
| 80 | R.PDSCH.2-14.4 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.5 |
| 90 | R.PDSCH.2-14.5 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.3 |
| 100 | R.PDSCH.2-15.1 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.7 |

Table 5.2A.2.1-4: Minimum performance for multiple CA configurations

|  |  |  |
| --- | --- | --- |
| Test number | CA duplex mode | Minimum performance requirements |
| 1 | FDD 15 kHz + FDD 15 kHz | As defined in Table 5.2A.2.1-1 |
| 2 | TDD 30 kHz + TDD 30 kHz | As defined in Table 5.2A.2.1-3 |
| 3 | FDD 15 kHz + TDD 30 kHz | As defined in Table 5.2A.2.1-1 and Table 5.2A.2.1-3 per CC |
| 4 | FDD 15 kHz + TDD 15 kHz | As defined in Table 5.2A.2.1-1 and Table 5.2A.2.1-2 per CC |
| 5 | TDD 15 kHz + TDD 30 kHz | As defined in Table 5.2A.2.1-2 and Table 5.2A.2.1-3 per CC |
| Note 1: The applicability of requirements for different CA duplex modes, SCSs, CA configurations and bandwidth combination sets is defined in 5.1.1.5. |

*<END OF THE CHANGE 2>*

*<START OF THE CHANGE 3>*

#### 5.2A.3.1 Minimum requirements

For CA with different numbers of DL component carriers, the requirements are defined in Table 5.2A.3.1-4 based on the single carrier requirements for different SCSs and different bandwidth specified in Table 5.2A.3.1-1 ~ Table 5.2A.3.1-3, with the parameters in Table 5.2A-1 ~ Table 5.2A-3 and the downlink physical channel setup according to Annex C.3.1. The performance requirements specified in this sub-cluase do not apply for UE single carrier test.

Table 5.2A.3.1-1: Single carrier performance for FDD 15 kHz SCS for CA configurations

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Bandwidth (MHz)  | Reference channel | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value |
| Fraction of maximum throughput (%) | SNR (dB) |
| 5 | R.PDSCH.1-9.1 FDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.5] |
| 10 | R.PDSCH.1-2.2 FDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.5] |
| 15 | R.PDSCH.1-9.2 FDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.6] |
| 20 | R.PDSCH.1-9.3 FDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.6] |
| 25 | R.PDSCH.1-9.4 FDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.7] |
| 30 | R.PDSCH.1-9.5 FDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.6] |
| 35 | R.PDSCH.1-10.3 FDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | TBD |
| 40 | R.PDSCH.1-10.1 FDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.7] |
| 45 | R.PDSCH.1-10.4 FDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | TBD |
| 50 | R.PDSCH.1-10.2 FDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.9] |

Table 5.2A.3.1-2: Single carrier performance for TDD 15 kHz SCS for CA configurations

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Bandwidth (MHz)  | Reference channel | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value |
| Fraction of maximum throughput (%) | SNR (dB) |
| 5 | R.PDSCH.1-2.1 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.5] |
| 10 | R.PDSCH.1-2.2 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.6] |
| 15 | R.PDSCH.1-2.3 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.7] |
| 20 | R.PDSCH.1-2.4 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.6] |
| 25 | R.PDSCH.1-2.5 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.8] |
| 30 | R.PDSCH.1-3.1 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.6] |
| 40 | R.PDSCH.1-3.2 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.8] |
| 50 | R.PDSCH.1-3.3 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [9.0] |

Table 5.2A.3.1-3: Single carrier performance for TDD 30 kHz SCS for CA configurations

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Bandwidth (MHz)  | Reference channel | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value |
| Fraction of maximum throughput (%) | SNR (dB) |
| 5 | R.PDSCH.2-13.1 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.5] |
| 10 | R.PDSCH.2-13.2 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.5] |
| 15 | R.PDSCH.2-13.3 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.5] |
| 20 | R.PDSCH.2-13.4 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.6] |
| 25 | R.PDSCH.2-13.5 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.6] |
| 30 | R.PDSCH.2-14.1 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.6] |
| 40 | R.PDSCH.2-2.2 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.7] |
| 50 | R.PDSCH.2-14.2 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.9] |
| 60 | R.PDSCH.2-14.3 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [8.8] |
| 80 | R.PDSCH.2-14.4 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [9.1] |
| 90 | R.PDSCH.2-14.5 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [9.0] |
| 100 | R.PDSCH.2-15.1 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | [9.3] |

Table 5.2A.3.1-4: Minimum performance for multiple CA configurations

|  |  |  |
| --- | --- | --- |
| Test number | CA duplex mode | Minimum performance requirements |
| 1 | FDD 15 kHz + FDD 15 kHz | As defined in Table 5.2A.3.1-1 |
| 2 | TDD 30 kHz + TDD 30 kHz | As defined in Table 5.2A.3.1-3 |
| 3 | FDD 15 kHz + TDD 30 kHz | As defined in Table 5.2A.3.1-1 and Table 5.2A.3.1-3 per CC |
| 4 | FDD 15 kHz + TDD 15 kHz | As defined in Table 5.2A.3.1-1 and Table 5.2A.3.1-2 per CC |
| 5 | TDD 15 kHz + TDD 30 kHz | As defined in Table 5.2A.3.1-2 and Table 5.2A.3.1-3 per CC |
| Note 1: The applicability of requirements for different CA duplex modes, SCSs, CA configurations and bandwidth combination sets is defined in 5.1.1.5. |

*<END OF THE CHANGE 3>*

*<START OF THE CHANGE 4>*

### 5.5A.1 FR1 CA requirements

*<Editor*'*s note: Open issues to be resolved:*

*Whether same requirements apply for FR1 DC>*

The Sustained Data Rate (SDR) requirements in this clause are applicable to the FR1 CA.

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

The test parameters are determined by the following procedure:

- Select one CA bandwidth combination among all supported CA configurations and set of per component carrier (CC) UE capabilities among all supported UE capabilities that provides the largest data rate in accordance with clause 4.1.2 of TS 38.306 [14].

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

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

- For each CC in CA bandwidth combination, use Table 5.5A-5 to determine MCS based on test parameters and indicated UE capabilities.

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

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

The common test parameters are specified in Table 5.5A-1. The parameters specified in Table 5.5A-2 are applicable for tests on FDD CCs and parameters specified in Table 5.5A-3 are applicable for tests on TDD CCs.

Unless otherwise stated, no user data is scheduled on slot #0, 10 and 11 within 20 ms for SCS 15 kHz.

Unless otherwise stated, no user data is scheduled on slot #0, 20 and 21 within 20 ms for SCS 30 kHz.

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 MHz1/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 slotFor 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 CCs2 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 3l0 = 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 1,2,3,430 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 211 for CSI-RS resource 3 and 430 kHz SCS:20 for CSI-RS resource 1 and 221 for CSI-RS resource 3 and 4 |
| Frequency Occupation |  | Start PRB 0Number of PRB = BWP size |
| 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: 2030 kHz SCS: 40  |
| CSI-RS offset |  | 0 |
| Frequency Occupation |  | Start PRB 0Number of PRB = BWP size |
| 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: 2030 kHz SCS: 40 |
| CSI-RS offset |  | 0 |
| Frequency Occupation |  | Start PRB 0Number of PRB = BWP size |
| 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.5.1.1OP.1 TDD as defined in Annex A.5.2.1 |
| Propagation condition |  | Static propagation conditionNo 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 transmissionNote 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 |

Table 5.5A-2: Additional test parameters for FDD CC

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Value** |
| Duplex mode |  | FDD |
| PDSCH configuration | Starting symbol (S)  |  | 1 |
| Length (L) |  | 13 |
| Number of HARQ Processes |  | 4 |
| K1 value |  | 2 |

Table 5.5A-3: Additional test parameters for TDD CC

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Value** |
| Duplex mode |  | TDD |
| PDSCH configuration | Starting symbol (S)  |  | 1 |
| Length (L) |  | 13 |
| Number of HARQ Processes |  | 8 |
| K1 value |  | Specific to each UL-DL pattern |
| TDD UL-DL pattern |  | 15 kHz SCS: FR1.15-130 kHz SCS: FR1.30-1 |
| Note 1: PDSCH is scheduled only on full DL slots |

Table 5.5A-4: Number of PRBs in CORESET

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SCS (kHz)** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **25 MHz** | **30 MHz** | **35 MHz** | **40 MHz** | **45 MHz** | **50 MHz** | **60 MHz** | **80 MHz** | **100 MHz** |
| 15 | 24 | 48 | 78 | 102 | 132 | 156 | 188 | 216 | 242 | 270 | N/A | N/A | N/A |
| 30 | 6 | 24 | 36 | 48 | 60 | 78 | 92 | 102 | 119 | 132 | 162 | 216 | 270 |

Table 5.5A-5: MCS indexes for indicated UE capabilities

|  |  |  |  |
| --- | --- | --- | --- |
| **Maximum number of PDSCH MIMO layers** | **Maximum modulation format** | **Scaling factor** | **MCS** |
| 1 | 8 | 1 | 26 |
| 1 | 8 | 0.8 | 21 |
| 1 | 8 | 0.75 | 20 |
| 1 | 8 | 0.4 | 11 |
| 1 | 6 | 1 | 27 |
| 1 | 6 | 0.8 | 23 |
| 1 | 6 | 0.75 | 22 |
| 1 | 6 | 0.4 | 14 |
| 1 | 4 | 1 | 16 |
| 1 | 4 | 0.8 | 16 |
| 1 | 4 | 0.75 | 16 |
| 1 | 4 | 0.4 | 10 |
| 1 | 2 | 1 | 9 |
| 1 | 2 | 0.8 | 9 |
| 1 | 2 | 0.75 | 9 |
| 1 | 2 | 0.4 | 4 |
| 2 | 8 | 1 | 26 |
| 2 | 8 | 0.8 | 21 |
| 2 | 8 | 0.75 | 20 |
| 2 | 8 | 0.4 | 11 |
| 2 | 6 | 1 | 27 |
| 2 | 6 | 0.8 | 23 |
| 2 | 6 | 0.75 | 22 |
| 2 | 6 | 0.4 | 14 |
| 2 | 4 | 1 | 16 |
| 2 | 4 | 0.8 | 16 |
| 2 | 4 | 0.75 | 16 |
| 2 | 4 | 0.4 | 10 |
| 2 | 2 | 1 | 9 |
| 2 | 2 | 0.8 | 9 |
| 2 | 2 | 0.75 | 9 |
| 2 | 2 | 0.4 | 4 |
| 4 | 8 | 1 | 26 |
| 4 | 8 | 0.8 | 23 |
| 4 | 8 | 0.75 | 22 |
| 4 | 8 | 0.4 | 12 |
| 4 | 6 | 1 | 27 |
| 4 | 6 | 0.8 | 24 |
| 4 | 6 | 0.75 | 23 |
| 4 | 6 | 0.4 | 14 |
| 4 | 4 | 1 | 16 |
| 4 | 4 | 0.8 | 16 |
| 4 | 4 | 0.75 | 16 |
| 4 | 4 | 0.4 | 11 |
| 4 | 2 | 1 | 9 |
| 4 | 2 | 0.8 | 9 |
| 4 | 2 | 0.75 | 9 |
| 4 | 2 | 0.4 | 5 |
| Note 1: MCS Index for maximum modulation format 2,4 and 6 is based on MCS index table 1 defined in clause 5.1.3.1 of TS 38.214 [12]Note 2: MCS Index for maximum modulation format 8 is based on MCS index table 2 defined in clause 5.1.3.1 of TS 38.214 [12] |

*<END OF THE CHANGE 4>*

*<START OF THE CHANGE 5>*

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

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

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

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

wideband CQIPCell – wideband CQISCell ≥ 2

for more than 90% of the time.

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

wideband CQIPCell – wideband CQISCell1 ≥ 2

wideband CQISCell1 – wideband CQISCell2, 3… ≥ 2

for more than 90% of the time.

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

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

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

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Duplex Mode |  | FDD |
| Subcarrier spacing | kHz | 15 |
| ZP CSI-RS configuration | CSI-RSperiodicity and offset | slot | 5/1 |
| NZP CSI-RS for CSI acquisition | NZP CSI-RS-timeConfigperiodicity and offset | slot | 5/1 |
| CSI-IM configuration | CSI-IM timeConfigperiodicity and offset | slot | 5/1 |
| CSI-Report periodicity and offset | slot | 5/0 |
| CQI/RI/PMI delay | ms | 8 |
| Sub-band Size | RB | 8 for 5MHz and 10MHz, 16 for 15MHz, 20MHz and 25MHz, 32 for 30MHz, 35MHz, 40MHz, 45MHz and 50MHz |

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

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Duplex Mode |  | TDD |
| Subcarrier spacing | kHz | 30 |
| TDD UL-DL pattern |  | FR1.30-1 |
| ZP CSI-RS configuration | CSI-RSperiodicity and offset | slot | 10/1 |
| NZP CSI-RS for CSI acquisition | NZP CSI-RS-timeConfigperiodicity and offset | slot | 10/1 |
| CSI-IM configuration | CSI-IM timeConfigperiodicity and offset | slot | 10/1 |
| CSI-Report periodicity and offset | slot | 10/9 |
| CQI/RI/PMI delay  | ms | 9.5 |
| Sub-band Size | RB | 8 for 10MHz, 15MHz, 20MHz and 25MHz, 16 for 30MHz, 40MHz and 50MHz, 32 for 60MHz, 80MHz, 90MHz and 100MHz |

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

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

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

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

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

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

*<END OF THE CHANGE 5>*

*<START OF THE CHANGE 6>*

#### A.3.2.1.1 Reference measurement channels for SCS 15 kHz FR1

*(Unchanged part skiped)*

Table A.3.2.1.1-10: PDSCH Reference Channel for FDD CC and CA scenario

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Value** |
| Reference channel |  | R.PDSCH.1-10.1 FDD | R.PDSCH.1-10.2 FDD | R.PDSCH.1-10.3 FDD | R.PDSCH.1-10.4 FDD |  |
| Channel bandwidth | MHz | 40 | 50 | 35 | 45 |  |
| Subcarrier spacing | kHz | 15 | 15 | 15 | 15 |  |
| Number of allocated resource blocks | PRBs | 216 | 270 | 188 | 242 |  |
| Number of consecutive PDSCH symbols |  | 12 | 12 | 12 | 12 |  |
| Allocated slots per 2 frames | Slots | 19 | 19 | 19 | 19 |  |
| MCS table |  | 64QAM | 64QAM | 64QAM | 64QAM |  |
| MCS index |  | 13 | 13 | 13 | 13 |  |
| Modulation |  | 16QAM | 16QAM | 16QAM | 16QAM |  |
| Target Coding Rate |  | 0.48 | 0.48 | 0.48 | 0.48 |  |
| Number of MIMO layers |  | 2 | 2 | 2 | 2 |  |
| Number of DMRS REs |  | 12 | 12 | 12 | 12 |  |
| Overhead for TBS determination |  | 0 | 0 | 0 | 0 |  |
| Information Bit Payload per Slot  |  |  |  |  |  |  |
|  For Slot i = 0 | Bits | N/A | N/A | N/A | N/A |  |
|  For Slots i = 1,…, 19 | Bits | 108552 | 135296 | 94248 | 122976 |  |
| Transport block CRC per Slot |  |  |  |  |  |  |
|  For Slot i = 0 | Bits | N/A | N/A | N/A | N/A |  |
|  For Slots i = 1,…, 19 | Bits | 24 | 24 | 24 | 24 |  |
| Number of Code Blocks per Slot |  |  |  |  |  |  |
|  For Slot i = 0 | CBs | N/A | N/A | N/A | N/A |  |
|  For Slots i = 1,…, 19 | CBs | 13 | 17 | 12 | 15 |  |
| Binary Channel Bits Per Slot |  |  |  |  |  |  |
|  For Slot i = 0 | Bits | N/A | N/A | N/A | N/A |  |
|  For Slots i = 10, 11 | Bits | 217728 | 272160 | 189504 | 243936 |  |
|  For Slots i =1,…, 9, 12, …, 19 | Bits | 228096 | 285120 | 198528 | 255552 |  |
| Max. Throughput averaged over 2 frames | Mbps | 103.124 | 128.531 | 89.536 | 116.827 |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 msNote 2: Slot i is slot index per 2 frames |

 *(Unchanged part skiped)*

*<END OF THE CHANGE 6>*