**3GPP TSG-RAN WG4 Meeting #110bis *R4-2406030***

**Changsha, China, 15 April – 19 April, 2024**

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| --- |
| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
|  |
|  | **38.101-4** | **CR** |  | **rev** | **-** | **Current version:** | **18.3.0** |  |
|  |
| *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:***  | Draft CR on 8Rx PDSCH demodulation requirements |
|  |  |
| ***Source to WG:*** | Samsung |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_ENDC\_RF\_FR1\_enh2-Perf |  | ***Date:*** | 2024-05-20 |
|  |  |  |  |  |
| ***Category:*** | ***B*** |  | ***Release:*** | Rel-18 |
|  | *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-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)Rel-20 (Release 20)* |
|  |  |
| ***Reason for change:*** | Update requirements for FR1 8Rx PDSCH demodulation performance according simulation results summary R4-2408739 |
|  |  |
| ***Summary of change:*** | The summary of changes in this CR as below:* update requirements in Clause
* 5.2

5.2.4 5.2.4.1.15.2.4.2.1 |
|  |  |
| ***Consequences if not approved:*** | * No requirement for FR1 8Rx PDSCH demodulation performance
 |
|  |  |
| ***Clauses affected:*** | 5.25.2.45.2.4.1.15.2.4.2.1 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **x** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **x** |  |  Test specifications | TS 38.521-4  |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** | Revision of R4-2406030 |

**<Start of changes>**

## 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 |  | For number of TX = 1: No precoding;For number of TX > 1: Single Panel Type I; Randomized precoder selection for every REG bundle and updated per slot with equal probability of each applicable i1/i2 combination or codebookindex, chosen from section 5.2.2.2.1 of TS 38.214 [12]For number of Tx>2, set “codebookMode” to 1 as defined in section 5.2.2.2.1 of TS 38.214 [12] |
| 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 = ceil(BWP size/4)\*4 |
| QCL info |  | TCI state #0 |
| NZP CSI-RS for CSI acquisition | Row index (Note 3) |  | 3 for 2 CSI-RS ports, 5 for 4 CSI-RS ports and 6 for 8 CSI-RS ports |
| 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 = ceil(BWP size/4)\*4 |
| QCL info |  | TCI state #1 |
| ZP CSI-RS for CSI acquisition | Row index (Note 3) |  | 5 |
| 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 = ceil(BWP size/4)\*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{1000-1007} for Rank 8 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 |
| PUCCH HARQ ACK spaitial bundling |  | Not configured |
| Redundancy version coding sequence |  | {0,2,3,1} |
| PDSCH & PDSCH DMRS Precoding configuration |  | For number of TX = 1: No precoding;For number of TX > 1:Single Panel Type I; Randomized precoder selection for every PRB bundle and updated per slot, with equal probability of each applicable i1/i2 combination or codebookindex, chosen from section 5.2.2.2.1 of TS 38.214 [12].For number of Tx>2 and Rank=1 or 2, Set “codebookMode” to 1 as defined in section 5.2.2.2.1 of TS 38.214 [12] |
| 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.Note 3: Refer to Table 7.4.1.5.3-1 in [9] |

**<Unchanged sections omitted>**

### 5.2.4 8RX requirements

#### 5.2.4.1 FDD

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

The performance requirements are specified in Table 5.2.4.1.1-3 - Table 5.2.4.1.1-7, with the addition of test parameters in Table 5.2.4.1.1-2 and the downlink physical channel setup according to Annex C.3.1.

The test purpose are specified in Table 5.2.4.1.1-1.

**Table 5.2.4.1.1-1: Tests purpose**

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH mapping Type A normal performance under 8 receive antenna conditions and with different channel models, MCSs and number of MIMO layers | 1-1, , 2-1, , 3-1, 4-1, 5-1 |

Table 5.2.4.1.1-2: Test parameters

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Value** |
| Duplex mode |  | FDD |
| Active DL BWP index |  | 1 |
| PDSCH configuration | Mapping type |  | Type A |
| k0 |  | 0 |
| Starting symbol (S)  |  | 2 |
| Length (L) |  | 12 |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| Resource allocation type |  | Type 0 |
| RBG size |  | Config2 |
| VRB-to-PRB mapping type |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size |  | N/A |
| PDSCH DMRS configuration | DMRS Type |  | Type 1 |
| Number of additional DMRS |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 for rank <= 42 for rank > 4 |
| Codebook configuration  | CodebookType |  | typeI-SinglePanel for 4Tx and 8Tx |
| CodebookMode |  | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | (2,1) for 4Tx(4,1) for 8Tx |
| (CodebookConfig-O1,CodebookConfig-O2) |  | (4,1) |
| CSI-RS for tracking | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 5 for CSI-RS resource 1 and 3l0 = 9 for CSI-RS resource 2 and 4 |
| Number of HARQ Processes |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information |  | 2 |

Table 5.2.4.1.1-3: Minimum performance for Rank 2 with Baseline SU-MIMO 8Rx receiver

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Modulation format and code rate** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 1-1 | R.PDSCH.1-3.1 FDD | 10 / 15 | 64QAM, 0.50 | TDLC300-100 | 2x8, ULA Medium B | 70 | [13.5] |

Table 5.2.4.1.1-4: Minimum performance for Rank 2 with Simplified SU-MIMO 8Rx receiver

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Modulation format and code rate** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 2-1 | R.PDSCH.1-3.1 FDD | 10 / 15 | 64QAM, 0.50 | TDLC300-100 | 2x8, ULA Medium B | 70 | [15.7] |

Table 5.2.4.1.1-5: Minimum performance for Rank 4 with Baseline SU-MIMO 8Rx receiver

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Modulation format and code rate** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 3-1 | R.PDSCH.1-3.7 FDD | 10 / 15 | 64QAM, 0.43 | TDLA30-10 | 4x8, ULA Low | 70 | [12.8] |

Table 5.2.4.1.1-6: Minimum performance for Rank 4 with Simplified SU-MIMO 8Rx receiver

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Modulation format and code rate** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 4-1 | R.PDSCH.1-3.7 FDD | 10 / 15 | 64QAM, 0.43 | TDLA30-10 | 4x8, ULA Low | 70 | [15.8] |

Table 5.2.4.1.1-7: Minimum performance for Rank 8

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Modulation format and code rate** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 5-1 | R.PDSCH.1-3.8 FDD | 10 / 15 | 64QAM, 0.43 | TDLA30-10 | 8x8, ULA Low | 70 | [22.7] |

#### 5.2.4.2 TDD

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

The performance requirements are specified in Table 5.2.4.2.1-3 - Table 5.2.4.2.1-7, with the addition of test parameters in Table 5.2.4.2.1-2 and the downlink physical channel setup according to Annex C.3.1.

The test purpose are specified in Table 5.2.4.2.1-1.

**Table 5.2.4.2.1-1: Tests purpose**

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH mapping Type A normal performance under 8 receive antenna conditions and with different channel models, MCSs and number of MIMO layers | 1-1, 2-1, 3-1, 4-1, 5-1 |

Table 5.2.4.2.1-2: Test parameters

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Value** |
| Duplex mode |  | TDD |
| Active DL BWP index |  | 1 |
| PDSCH configuration | Mapping type |  | Type A |
| k0 |  | 0 |
| Starting symbol (S)  |  | 2 |
| Length (L) |  | Specific to each Reference channel |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| Resource allocation type |  | Type 0 |
| RBG size |  | Config2 |
| VRB-to-PRB mapping type |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size |  | N/A |
| PDSCH DMRS configuration | DMRS Type |  | Type 1 |
| Number of additional DMRS |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 for rank <= 42 for rank > 4 |
| Codebook configuration  | CodebookType |  | typeI-SinglePanel for 4Tx and 8Tx |
| CodebookMode |  | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | (2,1) for 4Tx(4,1) for 8Tx |
| (CodebookConfig-O1,CodebookConfig-O2) |  | (4,1) |
| CSI-RS for tracking | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 5 for CSI-RS resource 1 and 3l0 = 9 for CSI-RS resource 2 and 4 |
| Number of HARQ Processes |  | 8 |
| The number of slots between PDSCH and corresponding HARQ-ACK information |  | Specific to each TDD UL-DL pattern and as defined in Annex A.1.2 |

Table 5.2.4.2.1-3: Minimum performance for Rank 2 with Baseline SU-MIMO 8Rx receiver

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Modulation format and code rate** | **TDD UL-DL pattern** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 1-1 | R.PDSCH.2-3.1 TDD | 40 / 30 | 64QAM, 0.50 | FR1.30-1 | TDLC300-100 | 2x8, ULA Medium B | 70 | [13.7] |

Table 5.2.4.2.1-4: Minimum performance for Rank 2 with Simplified SU-MIMO 8Rx receiver

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Modulation format and code rate** | **TDD UL-DL pattern** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 2-1 | R.PDSCH.2-3.1 TDD | 40 / 30 | 64QAM, 0.50 | FR1.30-1 | TDLC300-100 | 2x8, ULA Medium B | 70 | [15.8] |

Table 5.2.4.2.1-5: Minimum performance for Rank 4 with Baseline SU-MIMO 8Rx receiver

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Modulation format and code rate** | **TDD UL-DL pattern** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 3-1 | R.PDSCH.2-3.6 TDD | 40 / 30 | 64QAM, 0.43 | FR1.30-1 | TDLA30-10 | 4x8, ULA Low | 70 | [12.9] |

Table 5.2.4.2.1-6: Minimum performance for Rank 4 with Simplified SU-MIMO 8Rx receiver

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Modulation format and code rate** | **TDD UL-DL pattern** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 4-1 | R.PDSCH.2-3.6 TDD | 40 / 30 | 64QAM, 0.43 | FR1.30-1 | TDLA30-10 | 4x8, ULA Low | 70 | [16.0] |

Table 5.2.4.2.1-7: Minimum performance for Rank 8

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Modulation format and code rate** | **TDD UL-DL pattern** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 5-1 | R.PDSCH.2-3.7 TDD | 40 / 30 | 64QAM, 0.43 | FR1.30-1 | TDLA30-10 | 8x8, ULA Low | 70 | [23.2] |

**<End of changes>**