**3GPP TSG-RAN WG4 Meeting #107 R4-2309806**

**Incheon, South Korea, 22 – 26 May 2023**

**Title:** WF for 8Rx UE performance requirements

**Agenda Item:** 8.5.3.1

**Source:** Huawei, HiSilicon

**Document for:** Approval

# 1 General

**Issue 1-1: Whether to consider FDD requirements**

* RAN4 starts to discuss FDD part from next meeting and focuses on TDD part for this meeting

**Issue 1-2: Applicability rules for PDSCH/PDCCH/PBCH tests**

Updated Table 5.1.1.2-1: Requirements applicability

|  |  |  |  |
| --- | --- | --- | --- |
| Supported RX antenna ports | Test type | Test list | Exceptions |
| UE supports only 2RX | PDSCH | All tests in Clause 5.2.2 |  |
|  | PDCCH | All tests in Clause 5.3.2 |  |
|  | PBCH | All tests in Clause 5.4.2 |  |
| UE supports only 4RX or both 2RX and 4RX | PDSCH | All tests in Clause 5.2.3 (Note 2) |  |
|  | PDCCH | All tests in Clause 5.3.3 (Note 2) |  |
|  | PBCH | All tests in Clause 5.4.2 or 5.4.3 (Note 1) |  |
| UE supports 2Rx,4Rx and 8Rx, or  UE supports 4Rx and 8Rx | PDSCH | All tests in Clause 5.2.3.(Note 2,3)  All tests in Clause 5.2.4.(Note 2) | If UE has passed tests in Clause 5.2.4, UE can skip Test 2-1 and Test 2-2 in Clause 5.2.3 Table 5.2.3.2.1-4 and Test 4-1 in Table 5.2.3.2.1-6  If UE has passed tests in Clause 5.2.4, UE can skip Test 2-1 and Test 2-2 in Table 5.2.3.1.1-4 and Test 4-1 in Table 5.2.3.1.1-6 in Clause 5.2.3 |
| PDCCH | All tests in Clause 5.3.3.(Note 2,3) |  |
| PBCH | All tests in Clause 5.4.3(Note 1) |  |
| UE supports 2Rx and 8Rx | PDSCH | All tests in Clause 5.2.2.(Note 2, 4)  All tests in Clause 5.2.4.(Note 2) | If UE has passed test in Clause 5.2.4, UE can skip Test 2-1 and Test 2-2 in Clause 5.2.2 Table 5.2.2.2.1-4  If UE has passed test in Clause 5.2.4, UE can skip Test 2-1 and Test 2-2 in Clause 5.2.2 Table 5.2.2.1.1-4 |
| PDCCH | All tests in Clause 5.3.2.(Note 2,4) |  |
| PBCH | All tests in Clause 5.4.2 |  |
| UE supports only 8Rx | PDSCH | All tests in Clause 5.2.4.(Note 2) |  |
| PDCCH | N/A |  |
| PBCH | N/A |  |
| Note 1: Requirements for PBCH with 4Rx is up to UE declaration  Note 2: ‘*maxMIMO-Layers-r16*’ is not configured during the performance requirements testing for UE supporting Release 16 per-BWP MIMO layer adaptation.  Note 3: 8Rx capable UEs are tested on any of the 4Rx supported RF bands by connecting 4 out of 8 Rx with data source from system simulator, and the other 4 Rx are connected with zero input, depending on UE’s declaration and AP configuration. Requirements specified with 4Rx should be applied.  Note 4: 8Rx capable UEs are tested on any of the 2Rx supported RF bands by connecting 2 out of 8 Rx with data source from system simulator, and the other 6 Rx are connected with zero input, depending on UE’s declaration and AP configuration. Requirements specified with 2Rx should be applied. | | | |

**Issue 1-3: Applicability rules for CSI test**

Updated Table 6.1.1.2-1: Requirements applicability

|  |  |  |  |
| --- | --- | --- | --- |
| Supported RX antenna ports | Test type | Test list | Exception |
| UE supports only 2RX | CQI | All tests in Clause 6.2.2 |  |
| PMI | All tests in Clause 6.3.2 |  |
| RI | All tests in Clause 6.4.2 |  |
| UE supports only 4RX or both 2RX and 4RX | CQI | All tests in Clause 6.2.3 |  |
| PMI | All tests in Clause 6.3.3 |  |
| RI | All tests in Clause 6.4.3 |  |
| UE supports 2Rx, 4Rx and 8Rx, or  UE supports 4Rx and 8Rx | CQI | Tests in Clause 6.2.3(Note 1)  All tests in Clause 6.2.4 | If UE has passed Tests in Clause 6.2.4, UE can skip tests in Clause 6.2.3.2.1.1  If UE has passed Tests in Clause 6.2.4, UE can skip tests in Clause 6.2.3.1.1.1 |
| PMI | All tests in Clause 6.3.3 |  |
| RI | All tests in Clause 6.4.3 |  |
| UE supports 2Rx and 8Rx | CQI | Tests in Clause 6.2.2(Note 2)  All tests in Clause 6.2.4 | If UE has passed Tests in Clause 6.2.4, UE can skip tests in Clause 6.2.2.2.1.1  If UE has passed Tests in Clause 6.2.4, UE can skip tests in Clause 6.2.2.1.1.1 |
| PMI | All tests in Clause 6.3.2 |  |
| RI | All tests in Clause 6.4.2 |  |
| UE supports only 8Rx | CQI | All tests in Clause 6.2.4 |  |
| PMI | N/A |  |
| RI | N/A |  |
| Note 1: 8Rx capable UEs are tested on any of the 4Rx supported RF bands by connecting 4 out of 8 Rx with data source from system simulator, and the other 4 Rx are connected with zero input, depending on UE’s declaration and AP configuration. Requirements specified with 4Rx should be applied.  Note 2: 8Rx capable UEs are tested on any of the 2Rx supported RF bands by connecting 2 out of 8 Rx with data source from system simulator, and the other 6 Rx are connected with zero input, depending on UE’s declaration and AP configuration. Requirements specified with 2Rx should be applied. | | | |

# 2 PDSCH requirements

**Issue 2-1: Propagation conditions and antenna correlation for Rank 2 test**

* TDLC300-100 ULA Medium B

**Issue 2-2: MCS for Rank 2 test**

* Agree [MCS 20] (Table 2) for this meeting, if any issues are figured out for next meeting, MCS 19 (Table 1) will be selected

**Issue 2-3: MCS for Rank 4 test**

* Agree [MCS 26] (Table 1) for this meeting, if any issues are figured out for next meeting, MCS 17 (Table 1) will be selected

**Issue 2-4: MCS configuration for Rank 8 test**

* MCS 17

# 3 SDR requirements

**Issue 3-1: MCS look up Table for 64QAM**

|  |  |  |  |
| --- | --- | --- | --- |
| **Maximum number of PDSCH MIMO layers** | **Maximum modulation format** | **Scaling factor** | **MCS** |
| 8 | 6 | 1 | 26 |
| 8 | 6 | 0.8 | 24 |
| 8 | 6 | 0.75 | 23 |
| 8 | 6 | 0.4 | 14 |
| 8 | 4 | 1 | 16 |
| 8 | 4 | 0.8 | 16 |
| 8 | 4 | 0.75 | 16 |
| 8 | 4 | 0.4 | 11 |
| 8 | 2 | 1 | 9 |
| 8 | 2 | 0.8 | 9 |
| 8 | 2 | 0.75 | 9 |
| 8 | 2 | 0.4 | 5 |
| Note 1: MCS index for maximum modulation format 8 is based on MCS index Table 1 defined in clause 5.1.3.1 of TS 38.214 | | | |

**Issue 3-2: Maximum MCS and 8 MIMO layers for 256QAM with scaling factor = 1**

* MCS 24

**Issue 3-3: MCS look-up Table for 256QAM table**

|  |  |  |  |
| --- | --- | --- | --- |
| **Maximum number of PDSCH MIMO layers** | **Maximum modulation format** | **Scaling factor** | **MCS** |
| 8 | 8 | 1 | 24 |
| 8 | 8 | 0.8 | 23 |
| 8 | 8 | 0.75 | 22 |
| 8 | 8 | 0.4 | 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 | | | |

**Issue 3-4: Maximum MCS and MIMO layers for 1024QAM with scaling factor = 1**

* MCS 24 with 2layers

**Issue 3-5: MCS look-up Table for 1024 QAM**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Supported RX  antenna ports | Maximum number of PDSCH MIMO layers | Maximum modulation format | Scaling factor | MCS |
| 8RX | 2 | 10 | 1 | 24 |
|  | 2 | 10 | 0.8 | 21 |
|  | 2 | 10 | 0.75 | 19 |
|  | 2 | 10 | 0.4 | 9 |
| Note 1: MCS Index for maximum modulation format 10 is based on MCS index Table 4 defined in clause 5.1.3.1 of TS 38.214 [12] | | | | |

# 4 CSI requirements

**Issue 4-1: Reporting quantity configuration**

* Fixed i2 = 0

**Issue 4-2: SNR points**

* Proposals
  + Option 1: [4,5] dB and [10,11] dB
  + Option 2: [1, 2] dB and [7,8] dB

# 5 Simulation results alignment

Interesting companies are encouraged to bring both FDD and TDD related simulation results for next August RAN4#108 meeting for alignment.

# 6 CR split for TS 38.101-4

Companies are welcome to bring draft CRs for next August RAN4#108 meeting as per the following CR work splitting:

|  |  |  |
| --- | --- | --- |
| **Section** | **Test cases** | **Companies** |
| 5.1.1.2 Applicability of requirements for different number of RX antenna ports | Table PDSCH/PDCCH/PBCH test applicability rules for 8Rx | Nokia |
| 5.2.4 8RX requirements (New) | 5.2.4.1 FDD PDSCH performance requirements | Samsung |
| 5.2.4.2 TDD PDSCH performance requirements |
| 5.5A Sustained downlink data rate provided by lower layers | SDR tests | Ericsson |
| 6.1.1.2 Applicability of requirements for different number of RX antenna ports | Table 6.1.1.2-1: Requirements applicability for CSI applicabaility rules | Huawei |
| 6.2.4 8RX requirements (New) | 6.2.4.1 FDD CQI requirements | CTC |
| 6.2.4.2 TDD CQI requirements |
| A.3.2 Reference measurement channels for PDSCH performance requirements | A.3.2.1.1 Reference measurement channels for SCS 15 kHz FR1 | MediaTek |
| A.3.2.2.2 Reference measurement channels for SCS 30 kHz FR1 |  |
| B.1 Static propagation condition | B.1.2 UE Receiver with 8Rx (New) | ZTE |
| B.2.3 MIMO Channel Correlation Matrices | MIMO Correlation Matrices using Uniform Linear Array (ULA) | Apple |

# Annex A: Simulation assumptions (for information)

## A.1 Simulation assumptions for PDSCH

Other common parameters, refer to TS 38.101-4: Table 5.2-1: Common test parameters for PDSCH

**Table 1: Simulation assumptions for PDSCH performance**

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex mode | |  | TDD, FDD |
| TDD pattern | |  | 7D1S2U  S=6D:4G:4U |
| SCS(kHz)/Bandwidth (MHz) | |  | TDD: 30/40  FDD: 15/10 |
| MIMO layer and Antenna configuration | |  | Rank 2: 2x8  Rank 4: 4x8  Rank 8: 8x8 |
| Propagation condition and antenna correlation | |  | Rank 2: TDLC300-100 ULA Medium B (α = 0.3, β = 0.005154)  Rank 4: TDLA30-10 Low  Rank 8: TDLA30-10 Low |
| PDSCH configuration | Mapping type |  | Type A |
|  | k0 |  | 0 |
|  | Starting symbol (S) |  | 2 |
|  | Length (L) |  | 12 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 2 |
| PDSCH DMRS configuration | DMRS Type |  | Type 1 |
|  | Number of additional DMRS |  | 1 |
|  | Maximum number of OFDM symbols (maxLength) for DL |  | Rank2/4: Single-symbol  Rank 8: Double-symbol |
| TRS configuration | |  | Symbol#{5, 9} |
| PT-RS | |  | Not configured |
| NZP-CSI-RS configuration | |  | Rank 8: row 6 |
| Overhead | |  | 0 |
| N1 and N2 configurations for 8Tx cases | |  | Use (N1,N2) = (4,1), (O1, O2) = (4,1) |
| Coodebook for PDCCH for PDSCH tests with 4Tx and 8Tx | |  | Keep same number of Tx for PDSCH and PDCCH during PDSCH test. Set “codebookMode” to 1 |
| Special slot (S slot) scheduling | |  | Not schedule PDSCH in special slot for 8 layers cases |
| Number of HARQ Processes | |  | TDD: 8  FDD: 4 |
| HARQ ACK/NACK bundling | |  | Multiplexed |
| Maximum HARQ transmissions | |  | 4 |
| 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 |
| Tx EVM (Explicitly modeled in the simulation) | |  | 64QAM:6%  256QAM:3% |
| Test metric | |  | SNR@70% max TP |

## A.2 Simulation assumptions for SDR

Other common parameters, refer to TS 38.101-4:

* Table 5.5A-1: Common test parameters for FDD and TDD component carriers
* Table 5.5A-2: Additional test parameters for FDD CC
* Table 5.5A-3: Additional test parameters for TDD CC

**Table 2: Simulation assumptions for SDR performance**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| PDSCH configuration | Mapping type |  | Type A |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | wideband |
| Resource allocation type |  | Type 0 |
| PDSCH DMRS configuration | DMRS Type |  | Type 1 |
| Number of additional DMRS |  | 1 |
| Maximum number of OFDM symbols (maxLength) DL |  | Rank2/4: Single-symbol  Rank 8: Double-symbol |
| Antenna ports indexes |  | {1000, 1001} for 2 Layers CCs  {1000 – 1003} for 4 Layers CCs  {1000 – 1007} for 8 Layers CCs |
| Number of PDSCH DMRS CDM group(s) without data |  | 1 for 2 layers CCs  2 for others |
| PTRS configuration | |  | PTRS is not configured |
| Maximum number of HARQ transmission | |  | 4 |
| 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 chosen avoid zeros on Rx |
| Propagation condition | |  | Static propagation condition  No external noise sources are applied |
| Tx EVM | |  | Tx EVM = 6% for up to 64QAM  Tx EVM = 3% for 256QAM  Tx EVM = 2.5% for 1024QAM |
| MIMO layers | |  | 64QAM and 256QAM: 8  1024QAM: 2 |
| Antenna configuration | 2 layers |  | 2x8 |
| 4 layers |  | 4x8 |
| 8 layers |  | 8x8 |

## A.3 Simulation assumptions for CQI test

Other common parameters, refer to TS 38.101-4:

* Table 6.2.2.1.1.1-1: CQI reporting definition test for FDD
* Table 6.2.2.2.1.1-1: CQI reporting definition test for TDD

**Table 3: Simulation assumptions for CQI test**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Test 1** | | **Test 2** | |
| Duplex Mode | | |  | TDD, FDD | | | |
| Bandwidth/SCS | | | MHz | TDD: 40MHz/30kHz  FDD: 10MHz/15kHz | | | |
| TDD UL-DL pattern | | |  | 7D1S2U S=6D+4G+4U | | | |
| SNR | | | dB | TBD | TBD | TBD | TBD |
| Propagation channel | | |  | static channel model with 4T8R | | | |
| Antenna configuration | | |  | XP 4×8 | | | |
| Beamforming Model | | |  | As specified in Annex B.4.1 in 38.101-4 | | | |
| 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 | | | |
| CSI-RS  periodicity and offset | | slot | TDD: 10/1 FDD: 5/1 | | | |
| NZP CSI-RS for CSI acquisition | 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 4,(0) | | | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 13 | | | |
| NZP CSI-RS-timeConfig  periodicity and offset | | slot | TDD: 10/1  FDD: 5/1 | | | |
| CSI-IM configuration | CSI-IM resource Type | |  | Periodic | | | |
| CSI-IM RE pattern | |  | 0 | | | |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) | |  | (4, 9) | | | |
| CSI-IM timeConfig  periodicity and offset | | slot | TDD: 10/1  FDD: 5/1 | | | |
| ReportConfigType | | |  | Periodic | | | |
| CQI-table | | |  | Table 2 | | | |
| reportQuantity | | |  | cri-RI-PMI-CQI | | | |
| timeRestrictionForChannelMeasurements | | |  | Not configured | | | |
| timeRestrictionForInterferenceMeasurements | | |  | Not configured | | | |
| cqi-FormatIndicator | | |  | Wideband | | | |
| pmi-FormatIndicator | | |  | Wideband | | | |
| Sub-band Size | | | RB | TDD: 16  FDD: 8 | | | |
| Csi-ReportingBand | | |  | 1111111 | | | |
| CSI-Report periodicity and offset | | | slot | TDD: 10/9  FDD: 5/0 | | | |
| aperiodicTriggeringOffset | | |  | Not configured | | | |
| Codebook configuration | | Codebook Type |  | typeI-SinglePanel | | | |
| Codebook Mode |  | 1 | | | |
| (CodebookConfig-N1,CodebookConfig-N2) |  | (2,1) | | | |
| (CodebookConfig-O1,CodebookConfig-O2) |  | (4,1) | | | |
| CodebookSubsetRestriction |  | 00000001 | | | |
| RI Restriction |  | N/A | | | |
| Physical channel for CSI report | | |  | PUCCH | | | |
| CQI/RI/PMI delay | | | ms | TDD: 9.5  FDD: 8 | | | |
| Maximum number of HARQ transmission | | |  | 1 | | | |
| Number of HARQ Processes | | |  | FDD: 4  TDD: 8 | | | |
| Measurement channel | | |  | TDD: As specified in Table A.4-3, TBS.3-4  FDD: As specified in Table A.4-1, TBS.1-3 | | | |

## A.4 Reference

[1] R4-2220613, WF on 8RX UE demodulation and CSI requirements, RAN4#105, Huawei, HiSilicon

[2] R4-2302942, WF for 8Rx UE performance requirements, RAN4#106, Huawei, HiSilicon

[3] R4-2305888, WF for 8Rx UE performance requirements, RAN4#106bis-e, Huawei, HiSilicon