**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, orUE 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 5.2.3.2.1-6If 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 5.2.2.2.1-4If 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 declarationNote 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, orUE 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 6.2.3.2.1.1If 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 6.2.2.2.1.1If 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 RXantenna 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 |  | 7D1S2US=6D:4G:4U |
| SCS(kHz)/Bandwidth (MHz) |  | TDD: 30/40FDD: 15/10 |
| MIMO layer and Antenna configuration |  | Rank 2: 2x8Rank 4: 4x8Rank 8: 8x8 |
| Propagation condition and antenna correlation |  | Rank 2: TDLC300-100 ULA Medium B (α = 0.3, β = 0.005154)Rank 4: TDLA30-10 LowRank 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-symbolRank 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: 8FDD: 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-symbolRank 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 CCs2 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 conditionNo external noise sources are applied |
| Tx EVM |  | Tx EVM = 6% for up to 64QAM Tx EVM = 3% for 256QAMTx 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/30kHzFDD: 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-RSperiodicity and offset | slot | TDD: 10/1FDD: 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-timeConfigperiodicity and offset | slot | TDD: 10/1FDD: 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 timeConfigperiodicity and offset | slot | TDD: 10/1FDD: 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: 16FDD: 8 |
| Csi-ReportingBand |  | 1111111 |
| CSI-Report periodicity and offset | slot | TDD: 10/9FDD: 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: 9.5FDD: 8 |
| Maximum number of HARQ transmission |  | 1 |
| Number of HARQ Processes |  | FDD: 4TDD: 8 |
| Measurement channel |  | TDD: As specified in Table A.4-3, TBS.3-4FDD: 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