**3GPP TSG-RAN WG4 Meeting # 107 R4-230xxxx**

**Incheon, Korea, May 22 – 26, 2023**

**Agenda item:** 8.5.3.1

**Source:** Moderator (Huawei, HiSilicon)

**Title:** Topic summary for [107][320] RF\_FR1\_enh2\_Demod\_Part1

**Document for:** Information

# Introduction

This summarizes the open issues on 8Rx demodulation and CSI reporting requirements for Rel-18 WI Further RF requirements enhancement for NR and EN-DC in FR1.

It is appreciated that the delegates for this topic put their contact information in the table below.

**Contact information for companies**

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| Company | Contact | Email address |
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Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)

# Topic #1: General parts

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2307023**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307023.zip) | Nokia, Nokia Shanghai Bell | Proposal 1: We propose RAN4 shall define applicability rules for PDSCH based upon UE declared capability.  Proposal 2: We propose RAN4 shall define applicability rules for PDCCH based upon UE declared capability  Proposal 3: We propose that CSI reporting applicability rules are included in the work split.  Observation 1: There is currently no proposals for an 8Rx PBCH Applicability Rule  Proposal 4: We propose that a PBCH Applicability Rule for 8Rx UEs shall be introduced which includes representative 2Rx and 4Rx applicability tests depending on UE capability.  Proposal 5: RAN4 to adapt the following as an update of Table 5.1.1.2-1 Requirements Applicability within TS 38.101-4.  Table 5.1.1.2-1: Requirements applicability (updated from [5])   |  |  |  | | --- | --- | --- | | Supported RX antenna ports | Test type | Test list | | 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 8Rx, 4Rx and 2Rx | PDSCH | All tests in Clause 5.2.3 or 5.2.4(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 4) | | UE supports only 8Rx and 4Rx | PDSCH | All tests in Clause 5.2.3 or 5.2.4(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 4) | | UE supports only 8Rx and 2Rx | PDSCH | All tests in Clause 5.2.2 or 5.2.4(Note 2) | | PDCCH | All tests in Clause 5.3.2 | | PBCH | All tests in Clause 5.4.2 | | UE supports only 8Rx | PDSCH | All tests in Clause 5.2.3 or 5.2.4(Note 2) | | PDCCH | All tests in Clause 5.3.3 (Note 2, Note 3) | | PBCH | All tests in Clause 5.4.2 or 5.4.3 (Note 4) | | 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: For UEs supporting only 8Rx, tests will apply by duplicating the fading channel from each Tx antenna with the application of independent noise for each Rx demodulation branch.  Note 4: Requirements for PBCH with 8Rx is up to UE declaration | | | |
| [**R4-2307815**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307815.zip) | Samsung | Proposal 1: Extend current applicability rule in 38.101-4 Table 5.1.1.2-1 for 8RX as  Table 5.1.1.2-1: Requirements applicability   |  |  |  | | --- | --- | --- | | Supported RX antenna ports | Test type | Test list | | 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 (Note1) | | UE supports only 8RX | PDSCH | All tests in Clause 5.2.4 (new requirements for 8RX) and all tests in Clause 5.2.3(Note 2) except for Tests in Table 5.2.3.1.1-4, 5.2.3.1.1-6, Table 5.2.3.2.1-4 and Table 5.2.3.2.1-6 | | PDCCH | All tests in Clause 5.3.3.1.1, 5.3.3.1.2, 5.3.3.2.1, 5.3.3.2.2 | | PBCH | All tests in Clause 5.4.3 (Note1) | | UE supports both 2RX and 8RX | PDSCH | All tests in Clause 5.2.4 (new requirements for 8RX) and all tests in Clause 5.2.2 except for Tests in Table 5.2.2.1.1-4, and Table 5.2.2.2.1-4 | | PDCCH | All tests in Clause 5.3.2.1.1, 5.3.2.1.2, 5.3.2.2.1, 5.3.2.2.2 | | PBCH | All tests in Clause 5.4.2 | | UE supports both 4RX and 8RX, or support 2RX, 4RX and 8RX | PDSCH | All tests in Clause 5.2.4 (new requirements for 8RX) and all tests in Clause 5.2.3(Note 2) except for Tests in Table 5.2.3.1.1-4, 5.2.3.1.1-6, Table 5.2.3.2.1-4 and Table 5.2.3.2.1-6 | | PDCCH | All tests in Clause 5.3.3.1.1, 5.3.3.1.2, 5.3.3.2.1, 5.3.3.2.2 | | PBCH | All tests in Clause 5.4.3 (Note1) | | 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. | | |   For UE supports only 8RX, test cases specified in test list are tested on any of the 8RX supported RF bands by duplicating the fading channel from each TX antenna and add independent noise for each RX antenna. The SNR requirements of PDSCH should be applied with 1.5 dB less than the number specified for 4Rx tests. The SNR requirements of PDCCH and PBCH should be as same as the number specified for 4Rx tests.  For UE supports both 2RX and 8RX, test cases for 2RX specified in test list 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. Same requirements specified with 2RX should be applied.  For UE supports both 4RX and 8RX, or support 2RX, 4RX and 8RX, test cases for 4RX specified in test list 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. Same requirements specified with 4RX should be applied.  Applicability rules for CSI test  Proposal 2: support option 1 (8Rx capable UE can skip all legacy 2Rx and 4Rx CSI tests). |
| [**R4-2308936**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308936.zip) | Ericsson | Proposal 1: Limit the applicability rules for TDD case and postpone FDD related rules to be treated thoroughly once FDD cases are defined.  Proposal 2: PDSCH test cases in TS 38.101-4 that can be skipped for 8 RX UEs are given by the following Table   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Cases | 2RX test in clause 5.2.2.2 in TS 38.101-4 | 4RX test in clause 5.2.3.2 in TS 38.101-4 | 8RX test | Tests skipped | | UE supports both 2RX and 4RX | × | √ | √ | * Basic Rank2 tests: Test 2-1 and 2-2 in Table 5.2.3.2.1-4. * Basic Rank4 tests: Test 4-1 in Table 5.2.3.2.1-6. | | UE supports 4Rx only | × | √ | √ | * Basic Rank2 tests: Test 2-1 and 2-2 in Table 5.2.3.2.1-4. * Basic Rank4 tests: Test 4-1 in Table 5.2.3.2.1-6. | | UE supports 2Rx only | √ | × | √ | * Basic Rank2 tests: Test 2-1 and 2-2 in Table 5.2.2.2.1-4 | | UE neither supports 2RX nor 4RX | × | √ | √ | * Basic Rank2 tests: Test 2-1 and 2-2 in Table 5.2.3.2.1-4. * Basic Rank4 tests: Test 4-1 in 5.2.3.2.1-6. |   Use PDSCH test applicability rules as follows:   |  | | --- | | * Case 1 and Case 2: For UEs supporting 8RX antenna ports, and based on the UE declaration, the single carrier test cases driven for UEs supporting 4RX only or both 2RX and 4RX antenna ports in clause 5.2.3.2 can be performed by connecting only 4 out of 8 Rx antenna ports to the data generator, except for Test 2-1 and Test 2-2 in Table 5.2.3.2.1-4 (Basic Rank 2 test) and Test 4-1 in Table 5.2.3.2.1-6 (Basic Rank 4 test). Keep 4RX requirements applicable. * Case 3: For UEs supporting 8RX antenna ports, and based on the UE declaration, the single carrier test cases driven for UEs supporting 2RX only in clause 5.2.2.2 can be performed by connecting only 2 out of 8 RX antenna ports to the data generator, except for Test 2-1 and 2-2 in Table 5.2.2.2.1-4 (Basic Rank 2 test). Keep 2RX requirements applicable. * Case 4: For UEs supporting 8RX antenna ports, and based on the UE declaration, and except for Case 1, Case 2 and Case 3 tests, the single carrier tests can be performed considering any of the supported RF bands. |   Proposal 3: 8Rx capable UE can skip all legacy 2RX and 4RX PDCCHtests.  Proposal 4: 8Rx capable UE can skip all legacy 2RX and 4RX CSI tests. |
| [**R4-2309370**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2309370.zip) | Apple | Observation#1: Case4 for PDSCH and PDCCH only differ that in PDSCH applicability rules we require that the SNR requirements should be applied with 1.5 dB less than the number specified for 4Rx tests.  Proposal#1: Define PDCCH applicability rules as stated in the previous way forward. |
| [**R4-2308028**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308028.zip) | NTT DOCOMO, INC. | Proposal 1: Initiate the discussion on 8Rx UE demodulation requirements for FDD from RAN4#107.  Proposal 2: Define 8Rx UE demodulation requirements for FDD with the following parameters.   SCS/Bandwidth: 15kHz/10MHz   Number of HARQ process: 4 |
| [**R4-2308868**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308868.zip) | Huawei, HiSilicon | Proposal 1: Use following approach to capture the applicability rules to 38.101-4   For PDSCH and PDCCH applicability rules:   Captured in Clause 5.1.1.2   Add following wording:  For 8Rx capable UEs, the 2Rx supported RF bands, 4Rx supported RF bands and 8Rx supported RF bands are up to UE’s declaration.  For any demodulation tests conducted in the 8Rx supported RF band, four receive antenna ports that UE may use for control channel demodulation are clarified via UE declaration. When testing an N-Rx (N = 2,4) demodulation on the 8Rx supported band, the fading duplication and antenna mapping should guarantee that the four receive antennas UE declares for the PDCCH demodulation collectively receives at least 4/N duplicated version of the fading channel seen at each receive antenna of the N-Rx test, i.e., the connection diagrams in Figure 5.1.1.12.1-1 to Figure 5.1.1.12.1-4 are valid under the condition that Rx1, Rx3, Rx5 and Rx7 are the four receive antennas declared by UE for the PDCCH demodulation.   Update Table 5.1.1.2-1(Existing requirements applicability rules for different number of Rx antenna ports) to Table 2-2:   For CSI tests, create a new sub-clause for applicability rules for different applicability rules and capture following wording to this sub-clause  8Rx capable UE shall skip all 2Rx and 4Rx tests and shall only test 8Rx tests listed in clause 6.2.4 |

## Open issues summary

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| *WF in RAN4#106bis-e: R4-2305888:*  ***Issue 1-4: Applicability rules for PDSCH***   * + *Option 1:*  |  |  |  |  |  | | --- | --- | --- | --- | --- | | ***Cases*** | ***2Rx test in section 5.2.2 in TS 38.101-4*** | ***4Rx test in section 5.2.3 in TS 38.101-4*** | ***8RX test*** | ***Tests skipped*** | | *8Rx UE supporting both 2Rx and 4Rx band* | *×* | *√* | *√* | * *Basic Rank2 tests: Test 2-1 and 2-2 in Table 5.2.3.1.1-4 and Table 5.2.3.2.1-4.* * *Basic Rank4 tests: Test 4-1 in Table 5.2.3.1.1-6 and Table 5.2.3.2.1-6.* | | *8Rx UE supporting 4Rx band but not supporting 2Rx band* | *×* | *√* | *√* | * *Basic Rank2 tests: Test 2-1 and 2-2 in Table 5.2.3.1.1-4 and Table 5.2.3.2.1-4.* * *Basic Rank4 tests: Test 4-1 in Table 5.2.3.1.1-6 and Table 5.2.3.2.1-6.* | | *8Rx UE supporting 2Rx band but not supporting 4Rx band* | *√* | *×* | *√* | * *Basic Rank2 tests: Test 2-1 and 2-2 in Table 5.2.2.1.1-4 and Table 5.2.2.2.1-4* | | *8Rx UE not supporting both 2Rx band and 4Rx band* | *×* | *√* | *√* | * *Basic Rank2 tests: Test 2-1 and 2-2 in Table 5.2.3.1.1-4 and Table 5.2.3.2.1-4.* * *Basic Rank4 tests: Test 4-1 in Table 5.2.3.1.1-6 and Table 5.2.3.2.1-6.* * *Enhanced Receiver Type 1 test: Test 5-1 in Table 5.2.3.1.1-7 and Table 5.2.3.2.1-7* * *MMSE-IRC with inter cell interference: All cases in section 5.2.3.1.15 and 5.2.3.2.16* * *MMSE-IRC with intra cell inter user interference: All cases in section 5.2.3.1.16 and 5.2.3.2.17* * *CRS-IM with scenario 1: All cases in section 5.2.3.1.17 and 5.2.3.2.18* * *CRS-IM with scenario 2: All cases in section 5.2.3.1.18 and 5.2.3.2.19* |   *Use PDSCH test applicability rules as follows:*   |  | | --- | | * *Case1&Case2: For 8RX capable UEs support only 4Rx bands or both 2RX and 4RX bands, single carrier test cases specified in 5.2.3.1 and 5.2.3.2 with 4Rx except for Test 2-1 and 2-2 in Table 5.2.3.1.1-4 and Table 5.2.3.2.1-4 (Basic Rank 2 test) and Test 4-1 in Table 5.2.3.1.1-6 and Table 5.2.3.2.1-6 (Basic Rank 4 test) 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. Same requirements specified with 4Rx should be applied.* * *Case3: For 8RX capable UEs support only 2Rx bands, single carrier test cases specified in 5.2.2.1 and 5.2.2.2 with 2Rx except for Test 2-1 and 2-2 in Table 5.2.2.1.1-4 and Table 5.2.2.2.1-4 (Basic Rank 2 test) 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. Same requirements specified with 2Rx should be applied.* * *Case4: For 8RX capable UEs without support of any 4Rx and 2Rx bands, single carrier tests specified in 5.2.3.1 and 5.2.3.2 with 4Rx except for Test 2-1 and 2-2 in Table 5.2.3.1.1-4 and Table 5.2.3.2.1-4 (Basic Rank 2 test), Test 4-1 in Table 5.2.3.1.1-6 and Table 5.2.3.2.1-6 (Basic Rank 4 test), Test 5-1 in Table 5.2.3.1.1-7 and Table 5.2.3.2.1-7(Enhanced Receiver Type 1 test), cases in section 5.2.3.1.15 and 5.2.3.2.16 (MMSE-IRC with inter cell interference), cases in section 5.2.3.1.16 and 5.2.3.2.17(MMSE-IRC with intra cell inter user interference), cases in section 5.2.3.1.17 and 5.2.3.2.18(CRS-IM with scenario 1), cases in section 5.2.3.1.18 and 5.2.3.2.19 (CRS-IM with scenario 2) are tested on any of the 8Rx supported RF bands by duplicating the fading channel from each Tx antenna and add independent noise for each Rx antenna. The SNR requirements should be applied with 1.5 dB less than the number specified for 4Rx tests.* |   ***Issue 1-5: Applicability rules for PDCCH***   * + *Option 1:*  |  |  |  | | --- | --- | --- | | ***Cases*** | ***2Rx test in section 5.3.2 in TS 38.101-4*** | ***4Rx test in section 5.3.3 in TS 38.101-4*** | | *8Rx UE supporting both 2Rx and 4Rx band* | *×* | *√* | | *8Rx UE supporting 4Rx band but not supporting 2Rx band* | *×* | *√* | | *8Rx UE supporting 2Rx band but not supporting 4Rx band* | *√* | *×* | | *8Rx UE not supporting both 2Rx band and 4Rx band* | *×* | *√* |  |  | | --- | | *Use PDCCH test applicability rules as follows:*   * *Case1&Case2: For 8RX capable UEs support only 4Rx bands or both 2RX and 4RX bands, all single carrier test cases specified in 5.3.3.1 and 5.3.3.2 with 4Rx 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. Same requirements specified with 4Rx should be applied.* * *Case3: For 8RX capable UEs support only 2Rx bands, all single carrier test cases specified in 5.3.2.1 and 5.3.2.2 with 2Rx 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. Same requirements specified with 2Rx should be applied.* * *Case4: For 8RX capable UEs without support of any 4Rx and 2Rx bands, all single carrier test cases specified in 5.3.3.1 and 5.3.3.2 with 4Rx are tested on any of the 8Rx supported RF bands by duplicating the fading channel from each Tx antenna and add independent noise for each Rx antenna. Same requirements specified with 4Rx should be applied.* |   ***Issue 1-6: Applicability rules for CSI test***  *Option1: 8Rx capable UE can skip all legacy 2Rx and 4Rx CSI tests.* |

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| *RAN4#105: R4-2302942*  ***Duplex model***   * *Focus on TDD as first priority* * *FFS on FDD pending on the progress in RF core requirements.*   ***SCS/Bandwidth***   * *FDD: 15kHz/10MHz (If agreed)* * *TDD: 30kHz/40MHz*   ***Number of HARQ process***   * *FDD:4* * *TDD:8* |
| *RAN4#106: R4-2220613*  ***Duplex mode***   * *Focus on TDD and then define requirements for FDD when RF session has conclusion for FDD* |
| *RAN4#106bis-e: R4-2306597*  ***ΔRIB for FDD band n7***   * *[4.5] dB for n7* |

**Issue 1-1: Whether to limit the test applicability rule to TDD cases**

* Proposals
  + Option 1: Limit the applicability rules for TDD case and postpone FDD related rules to be treated thoroughly once FDD cases are defined (Ericsson):
  + Option 2: Define 8Rx UE demodulation requirements for FDD with the following parameters. (NTT DOCOMO)
  + SCS/Bandwidth: 15kHz/10MHz
  + Number of HARQ process: 4
* Recommended WF
  + TBA.

**Issue 1-2: PDCCH antenna connection during the 8Rx performance tests with 2Rx and 4Rx**

* Proposals
  + Option 1: Add the following in Clause 5.1.1.2 of TS 38.101-4 (Huawei):

For 8Rx capable UEs, the 2Rx supported RF bands, 4Rx supported RF bands and 8Rx supported RF bands are up to UE’s declaration.

For any demodulation tests conducted in the 8Rx supported RF band, four receive antenna ports that UE may use for control channel demodulation are clarified via UE declaration. When testing an N-Rx (N = 2,4) demodulation on the 8Rx supported band, the fading duplication and antenna mapping should guarantee that the four receive antennas UE declares for the PDCCH demodulation collectively receives at least 4/N duplicated version of the fading channel seen at each receive antenna of the N-Rx test, i.e., the connection diagrams in Figure 5.1.1.12.1-1 to Figure 5.1.1.12.1-4 are valid under the condition that Rx1, Rx3, Rx5 and Rx7 are the four receive antennas declared by UE for the PDCCH demodulation.

* + Other options:
* Recommended WF
  + TBA.

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

*Background: RAN4#106 approved R4-2302942:*

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| --- |
| * ***Rank 2:*** *[Existing corresponding rank 2 test cases can be skipped with test applicable rule if new test case with rank 2 verified]* * ***Rank 4:*** *Existing rank 4 test cases can be skipped with test applicable rule if new test case with rank 4 verified* |

Moderator’s summary of test applicability rules for PDSCH tests

* The except FDD test cases depends on Issue 1-1
* The except test cases of advanced receiver for UE only supporting 8Rx need further discussion.

|  |  |  |  |
| --- | --- | --- | --- |
| Supported Rx antenna ports | Test case Type | Test case list | Test cases to be skipped |
| 8Rx, 2Rx and 4Rx | PDSCH | All tests in Clause 5.2.3.(Note 3)  All tests in Clause 5.2.4.(New clause for 8Rx) | * Basic Rank2 and Rank 4 tests:   + TDD: Test 2-1 and 2-2 in Table 5.2.3.2.1-4 and Table 5.2.3.2.1-6   + [FDD: Tests in Table 5.2.3.1.1-4 and Table 5.2.3.1.1-6] |
| 8Rx and 4Rx | PDSCH | All tests in Clause 5.2.3.(Note 3)  All tests in Clause 5.2.4.(New clause for 8Rx) | * Basic Rank2 and Rank 4 tests:   + TDD: Tests Table 5.2.3.2.1-4 and Table 5.2.3.2.1-6   + [FDD: Tests in Table 5.2.3.1.1-4 and Table 5.2.3.1.1-6] |
| 8Rx and 2Rx | PDSCH | All tests in Clause 5.2.2.(Note 4)  All tests in Clause 5.2.4.(New clause for 8Rx) | * Basic Rank2 tests:   + TDD: Tests in Table 5.2.2.2.1-4   + [FDD: Tests in Table 5.2.2.1.1-4] |
| only 8Rx | PDSCH | All tests in Clause 5.2.3.(Note 3)  All tests in Clause 5.2.4.(New clause for 8Rx) | * Basic Rank2 and Rank 4 tests:   + TDD: Tests in Table 5.2.3.2.1-4 and Table 5.2.3.2.1-6   + [FDD: Tests in Table 5.2.3.1.1-4, 5.2.3.1.1-6] * [Test for advanced receiver:   + Test 5-1 in Table 5.2.3.1.1-7 and Table 5.2.3.2.1-7 (Enhanced Receiver Type 1)   + All cases in section 5.2.3.1.15 and 5.2.3.2.16 (MMSE-IRC with inter cell interference)   + MMSE-IRC with intra cell inter user interference: All cases in section 5.2.3.1.16 and 5.2.3.2.17   + All cases in section 5.2.3.1.17 and 5.2.3.2.18 (CRS-IM with scenario 1)   + All cases in section 5.2.3.1.18 and 5.2.3.2.19 (CRS-IM with scenario 2)] |
| Note 1: Requirements for PBCH with 4Rx [and 8Rx] 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: For UEs supporting only 8Rx, tests will apply by duplicating the fading channel from each Tx antenna with the application of independent noise for each Rx demodulation branch.  [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.  Note 5: 8Rx capable UEs are tested 4Rx tests on any of the 8Rx supported RF bands by duplicating the fading channel from each Tx antenna and add independent noise for each Rx antenna. The SNR requirements should be applied with 1.5 dB less than the number specified for 4Rx tests.] | | | |

* Proposals for UE only supporting 8Rx
  + Option 1: Skipp advanced receiver related test cases, i.e. (Huawei, Nokia?, Apple?)
  + Test 5-1 in Table 5.2.3.1.1-7 and Table 5.2.3.2.1-7 (Enhanced Receiver Type 1)
  + All cases in section 5.2.3.1.15 and 5.2.3.2.16 (MMSE-IRC with inter cell interference)
  + MMSE-IRC with intra cell inter user interference: All cases in section 5.2.3.1.16 and 5.2.3.2.17
  + All cases in section 5.2.3.1.17 and 5.2.3.2.18 (CRS-IM with scenario 1)
  + All cases in section 5.2.3.1.18 and 5.2.3.2.19 (CRS-IM with scenario 2)
  + Option 2: Not skipp advanced receiver related test cases (Samsung,)
* Recommended WF
  + - TBA

**Proposals from companies:**

* + Proposal 1: (Ericsson) PDSCH test cases in TS 38.101-4 that can be skipped for 8 RX UEs are given by the following Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Cases | 2RX test in clause 5.2.2.2 in TS 38.101-4 | 4RX test in clause 5.2.3.2 in TS 38.101-4 | 8RX test | Tests skipped |
| UE supports both 2RX and 4RX | × | √ | √ | * Basic Rank2 tests: Test 2-1 and 2-2 in Table 5.2.3.2.1-4. * Basic Rank4 tests: Test 4-1 in Table 5.2.3.2.1-6. |
| UE supports 4Rx only | × | √ | √ | * Basic Rank2 tests: Test 2-1 and 2-2 in Table 5.2.3.2.1-4. * Basic Rank4 tests: Test 4-1 in Table 5.2.3.2.1-6. |
| UE supports 2Rx only | √ | × | √ | * Basic Rank2 tests: Test 2-1 and 2-2 in Table 5.2.2.2.1-4 |
| UE neither supports 2RX nor 4RX | × | √ | √ | * Basic Rank2 tests: Test 2-1 and 2-2 in Table 5.2.3.2.1-4. * Basic Rank4 tests: Test 4-1 in 5.2.3.2.1-6. |

Use PDSCH test applicability rules as follows:

|  |
| --- |
| * Case 1 and Case 2: For UEs supporting 8RX antenna ports, and based on the UE declaration, the single carrier test cases driven for UEs supporting 4RX only or both 2RX and 4RX antenna ports in clause 5.2.3.2 can be performed by connecting only 4 out of 8 Rx antenna ports to the data generator, except for Test 2-1 and Test 2-2 in Table 5.2.3.2.1-4 (Basic Rank 2 test) and Test 4-1 in Table 5.2.3.2.1-6 (Basic Rank 4 test). Keep 4RX requirements applicable. * Case 3: For UEs supporting 8RX antenna ports, and based on the UE declaration, the single carrier test cases driven for UEs supporting 2RX only in clause 5.2.2.2 can be performed by connecting only 2 out of 8 RX antenna ports to the data generator, except for Test 2-1 and 2-2 in Table 5.2.2.2.1-4 (Basic Rank 2 test). Keep 2RX requirements applicable. * Case 4: For UEs supporting 8RX antenna ports, and based on the UE declaration, and except for Case 1, Case 2 and Case 3 tests, the single carrier tests can be performed considering any of the supported RF bands. |

* Proposal 2: (Nokia) RAN4 to adapt the following as an update of Table 5.1.1.2-1 Requirements Applicability within TS 38.101-4.

Table 5.1.1.2-1: Requirements applicability (updated from [5])

|  |  |  |
| --- | --- | --- |
| Supported RX antenna ports | Test type | Test list |
| 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 8Rx, 4Rx and 2Rx | PDSCH | All tests in Clause 5.2.3 or 5.2.4(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 4) |
| UE supports only 8Rx and 4Rx | PDSCH | All tests in Clause 5.2.3 or 5.2.4(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 4) |
| UE supports only 8Rx and 2Rx | PDSCH | All tests in Clause 5.2.2 or 5.2.4(Note 2) |
| PDCCH | All tests in Clause 5.3.2 |
| PBCH | All tests in Clause 5.4.2 |
| UE supports only 8Rx | PDSCH | All tests in Clause 5.2.3 or 5.2.4(Note 2) |
| PDCCH | All tests in Clause 5.3.3 (Note 2, Note 3) |
| PBCH | All tests in Clause 5.4.2 or 5.4.3 (Note 4) |
| 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: For UEs supporting only 8Rx, tests will apply by duplicating the fading channel from each Tx antenna with the application of independent noise for each Rx demodulation branch.  Note 4: Requirements for PBCH with 8Rx is up to UE declaration | | |

* Proposal 3: (Samsung) Extend current applicability rule in 38.101-4 Table 5.1.1.2-1 for 8RX as

Table 5.1.1.2-1: Requirements applicability

|  |  |  |
| --- | --- | --- |
| Supported RX antenna ports | Test type | Test list |
| 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 (Note1) |
| UE supports only 8RX | PDSCH | All tests in Clause 5.2.4 (new requirements for 8RX) and all tests in Clause 5.2.3(Note 2) except for Tests in Table 5.2.3.1.1-4, 5.2.3.1.1-6, Table 5.2.3.2.1-4 and Table 5.2.3.2.1-6 |
| PDCCH | All tests in Clause 5.3.3.1.1, 5.3.3.1.2, 5.3.3.2.1, 5.3.3.2.2 |
| PBCH | All tests in Clause 5.4.3 (Note1) |
| UE supports both 2RX and 8RX | PDSCH | All tests in Clause 5.2.4 (new requirements for 8RX) and all tests in Clause 5.2.2 except for Tests in Table 5.2.2.1.1-4, and Table 5.2.2.2.1-4 |
| PDCCH | All tests in Clause 5.3.2.1.1, 5.3.2.1.2, 5.3.2.2.1, 5.3.2.2.2 |
| PBCH | All tests in Clause 5.4.2 |
| UE supports both 4RX and 8RX, or support 2RX, 4RX and 8RX | PDSCH | All tests in Clause 5.2.4 (new requirements for 8RX) and all tests in Clause 5.2.3(Note 2) except for Tests in Table 5.2.3.1.1-4, 5.2.3.1.1-6, Table 5.2.3.2.1-4 and Table 5.2.3.2.1-6 |
| PDCCH | All tests in Clause 5.3.3.1.1, 5.3.3.1.2, 5.3.3.2.1, 5.3.3.2.2 |
| PBCH | All tests in Clause 5.4.3 (Note1) |
| 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. | | |

* For UE supports only 8RX, test cases specified in test list are tested on any of the 8RX supported RF bands by duplicating the fading channel from each TX antenna and add independent noise for each RX antenna. The SNR requirements of PDSCH should be applied with 1.5 dB less than the number specified for 4Rx tests. The SNR requirements of PDCCH and PBCH should be as same as the number specified for 4Rx tests.
* For UE supports both 2RX and 8RX, test cases for 2RX specified in test list 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. Same requirements specified with 2RX should be applied.
* For UE supports both 4RX and 8RX, or support 2RX, 4RX and 8RX, test cases for 4RX specified in test list 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. Same requirements specified with 4RX should be applied.

Option 3: (Huawei) Update Table 5.1.1.2-1 as following:

**Table 2-1: Updated Requirements applicability rules for different number of Rx antenna ports**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Supported RX antenna ports | Test type | Test list | If a UE pass | UE can skip |
| 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) |  |  |
| UEs supports 8Rx,4Rx and 2Rx | PDSCH | All tests in Clause 5.2.4.  All tests in Clause 5.2.3.(Note 3) | 8Rx tests with 2 and 4 MIMO layers | Test 2-1 and 2-2 in Table 5.2.3.1.1-4 and Table 5.2.3.2.1-4.  Test 4-1 in Table 5.2.3.1.1-6 and Table 5.2.3.2.1-6 |
|  | PDCCH | All tests in Clause 5.3.3. |  |  |
| UEs supports 8Rx and 4Rx | PDSCH | All tests in Clause 5.2.4.  All tests in Clause 5.2.3.(Note 3) | 8Rx tests with 2 and 4 MIMO layers | Test 2-1 and 2-2 in Table 5.2.3.1.1-4 and Table 5.2.3.2.1-4.  Test 4-1 in Table 5.2.3.1.1-6 and Table 5.2.3.2.1-6 |
|  | PDCCH | All tests in Clause 5.3.3. |  |  |
| UEs supports 8Rx and 2Rx | PDSCH | All tests in Clause 5.2.4.  All tests in Clause 5.2.2.(Note 4) | 8Rx tests with 2 MIMO layers | Test 2-1 and 2-2 in Table 5.2.3.1.1-4 and Table 5.2.3.2.1-4. |
|  | PDCCH | All tests in Clause 5.3.2. |  |  |
| UEs supports only 8Rx | PDSCH | All tests in Clause 5.2.4.  All tests in Clause 5.2.3 except for Enhanced Receiver Type 1 tests, MMSE-IRC with inter cell interference tests, MMSE-IRC with intra cell inter user interference, CRS interference mitigation under NR-LTE coexistence scenario tests, PDSCH with inter cell CRS interference tests | 8Rx tests with 2 and 4 MIMO layers | Test 2-1 and 2-2 in Table 5.2.3.1.1-4 and Table 5.2.3.2.1-4.  Test 4-1 in Table 5.2.3.1.1-6 and Table 5.2.3.2.1-6 |
|  | PDCCH | All tests in Clause 5.3.3. |  |  |
| 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. Same 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. Same requirements specified with 2Rx should be applied.  Note 5: 8Rx capable UEs are tested 4Rx tests on any of the 8Rx supported RF bands by duplicating the fading channel from each Tx antenna and add independent noise for each Rx antenna. The SNR requirements should be applied with 1.5 dB less than the number specified for 4Rx tests. | | | | |

**Issue 1-4: Applicability rules for PDCCH test**

* Proposals
  + Option 1: (Ericsson) 8Rx capable UE can skip all legacy 2Rx and 4Rx PDCCH tests
  + Option 1: (Apple, Huawei, Nokia, Samsung)

|  |  |  |  |
| --- | --- | --- | --- |
| Supported Rx antenna ports | Test case Type | Test case list | Test cases to be skipped |
| 8Rx, 2Rx and 4Rx | PDCCH | All tests in Clause 5.3.3. (Note 1) |  |
| 8Rx and 4Rx | PDCCH | All tests in Clause 5.3.3.(Note 1) |  |
| 8Rx and 2Rx | PDCCH | All tests in Clause 5.3.2.(Note 2) |  |
| only 8Rx | PDCCH | All tests in Clause 5.3.3. (Note 3) |  |
| Note 1: All single carrier test cases specified in 5.3.3.1 and 5.3.3.2 with 4Rx 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: All single carrier test cases specified in 5.3.2.1 and 5.3.2.2 with 2Rx 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.  Note 3: All single carrier test cases specified in 5.3.3.1 and 5.3.3.2 with 4Rx are tested on any of the 8Rx supported RF bands by duplicating the fading channel from each Tx antenna and add independent noise for each Rx antenna. Requirements specified with 4Rx should be applied. | | | |

* Recommended WF
  + TBA

**Issue 1-5: Applicability rules for PBCH tests**

* Proposals
  + Option 2: Not introduce PBCH test applicability rules for 8Rx (Huawei)
  + Option 1: Introduce PBCH applicability rules for 8Rx which includes representative 2Rx and 4Rx applicability tests depending on UE capability. (Nokia, Samsung)

|  |  |  |  |
| --- | --- | --- | --- |
| Supported Rx antenna ports | Test case Type | Test case list | Test cases to be skipped |
| 8Rx, 2Rx and 4Rx | PBCH | Option 1: All tests in Clause 5.4.2 or 5.4.3 (Note 4) (Nokia)  Option 2: All tests in 5.4.3 (Note 1) (Samsung) |  |
| 8Rx and 4Rx | PBCH | Option 1: All tests in Clause 5.4.2 or 5.4.3 (Note 4) (Nokia)  Option 2: All tests in 5.4.3 (Note 1) (Samsung) |  |
| 8Rx and 2Rx | PBCH | All tests in Clause 5.4.2 |  |
| only 8Rx | PBCH | Option 1: All tests in Clause 5.4.2 or 5.4.3 (Note 4) (Nokia)  Option 2: All tests in 5.4.3 (Note 1) (Samsung) |  |
| Note 1: Requirements for PBCH with 4Rx is up to UE declaration  Note 4: Requirements for PBCH with 8Rx is up to UE declaration | | | |

* Recommended WF
  + TBA

**Issue 1-6: Applicability rules for CSI test**

* Proposals
  + Option 1: 8Rx capable UE can skip all legacy 2Rx and 4Rx CSI tests. (Samsung, Nokia?, Ericsson, Huawei)
* Recommended WF
  + Option 1 is agreeable?

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
|  |  |
|  |  |
|  |  |
|  |  |

## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary** |
|  |  |
|  |  |

## Discussion on 2nd round

# Topic #2: PDSCH requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2307434**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307434.zip) | QUALCOMM Europe Inc. - Spain | Proposal 1: RAN4 to use only TDLC300-100 ULA Medium B for Rank 2 case.  Proposal 2: RAN4 to use MCS 19 for 2 layers, 8Rx with TDLC 300-100, medium B PDSCH demod requirements.  Proposal 3: RAN4 to use MCS 17 for 4 layers, 8Rx PDSCH demod requirements  Proposal 4: RAN4 to use MCS13 for 8 layers, 8Rx PDSCH demod requirements |
| [**R4-2307435**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307435.zip) | QUALCOMM Europe Inc. - Spain | Simulation results for PDSCH requirements |
| [**R4-2307024**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307024.zip) | Nokia, Nokia Shanghai Bell | Observation 1: Prior agreements from RAN4#106 include both TDLC 300-100 and TDLA 30-10.  Observation 2: TDLA 30-10 requirements are defined for all other Ranks within 8 Rx  Observation 3: TDLC300-100 propagation conditions provide feasible test points for all MCS.  Proposal 1: We propose that Option 1 shall be taken forward, which includes both TDLC 300-100 and TDLA 30-10 ULA Medium B.  Observation 4: MCS 19 (Table 1) does provide a testable and reasonable result in TDLC 300-100 ULA Medium B conditions.  Proposal 2: We propose that either option 1 MCS 2, 7 (Table 2) or option 2 MCS 19 (Table 1) shall be taken forward for TDLC300-100 ULA Medium B, with all MCSs providing a reasonable test point.  Observation 5: MCS 19 (Table 1) does provide a reasonable testable result in TDLA 30-10 ULA Medium B conditions.  Proposal 3: We propose that either option 1 MCS 13,26 (Table 2) or option 2 MCS 19 (Table 1) shall be taken forward for TDLA30-10 ULA Medium B, with all MCSs providing a reasonable test point.  Observation 6: Both option 1 (with MCS 26) and option 2 (with MCS 17) provide 64QAM modulation options for defining performance.  Proposal 4: We propose that either option is suitable however, to provide diversity of modulation order and max throughput RAN4 shall use option 1 with MCS 13 and MCS 26.  Observation 7: Both MCS 13 and MCS 17 provide reasonable performance based on simulation, therefore either could be chosen to define the performance of Rank 8 tests.  Observation 8: Most companies opted for MCS 13 at Round 2 of RAN4#106-bis-e.  Proposal 5: We propose that MCS 13 shall be used for Rank 8 Performance requirements. |
| [**R4-2307025**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307025.zip) | Nokia, Nokia Shanghai Bell | Simulation results for PDSCH requirements |
| [**R4-2307113**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307113.zip) | MediaTek inc. | Proposal 1: Introduce PDSCH requirements for 8Rx UE with the following MCS:  • MCS19 (rank2, ULA Medium B, TDLC 300-100)  • MCS17 (rank4, ULA low, TDLA 30-10)  • MCS13 (rank8, ULA low, TDLA 30-10) |
| [**R4-2307816**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307816.zip) | Samsung | Proposal 1: Introduce two test cases for rank 2, TDLC300-100 ULA Medium B and TDLA30-10 ULA Medium B.  Proposal 2: Use MCS19 (Table 1) for TDLC300-100 ULA Medium B and TDLA30-10 ULA Medium Rank 2 tests.  Proposal 3: option 2, use MCS17 (Table 1) for Rank 4 test.  Proposal 4: option 1, use MCS13 (Table 1) for Rank 8 test.  Proposal 5: introduce PDSCH performance requirements for 8Rx as   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | Test num. | 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 | 40 / 30 | 64QAM, 0.51 | FR1.30-1 | TDLA30-10 | 2x8, ULA Medium B | 70 | 10.37 | | 1-2 | 40 / 30 | 64QAM, 0.51 | FR1.30-1 | TDLC300-100 | 2x8, ULA Medium B | 70 | 11.42 | | 2-1 | 40 / 30 | 64QAM, 0.43 | FR1.30-1 | TDLA30-10 | 4x8, ULA Low | 70 | 10.93 | | 3-1 | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLA30-10 | 8x8, ULA Low | 70 | 14.73 | |
| [**R4-2308405**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308405.zip) | ZTE Corporation | Proposal 1: To consider TDLC300-100 ULA Medium B.  Proposal 2: Only consider MCS 19 for TDLC300-100 ULA Medium B.  Proposal 3: Only consider MCS 17 for Rank 4.  Proposal 4: Only consider MCS 13 for Rank 8. |
| [**R4-2308868**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308868.zip) | Huawei, HiSilicon | Proposal 1: Use following approach to capture the applicability rules to 38.101-4   For PDSCH and PDCCH applicability rules:   Captured in Clause 5.1.1.2   Add following wording:  For 8Rx capable UEs, the 2Rx supported RF bands, 4Rx supported RF bands and 8Rx supported RF bands are up to UE’s declaration.  For any demodulation tests conducted in the 8Rx supported RF band, four receive antenna ports that UE may use for control channel demodulation are clarified via UE declaration. When testing an N-Rx (N = 2,4) demodulation on the 8Rx supported band, the fading duplication and antenna mapping should guarantee that the four receive antennas UE declares for the PDCCH demodulation collectively receives at least 4/N duplicated version of the fading channel seen at each receive antenna of the N-Rx test, i.e., the connection diagrams in Figure 5.1.1.12.1-1 to Figure 5.1.1.12.1-4 are valid under the condition that Rx1, Rx3, Rx5 and Rx7 are the four receive antennas declared by UE for the PDCCH demodulation.   Update Table 5.1.1.2-1(Existing requirements applicability rules for different number of Rx antenna ports) to Table 2-2:   For CSI tests, create a new sub-clause for applicability rules for different applicability rules and capture following wording to this sub-clause  8Rx capable UE shall skip all 2Rx and 4Rx tests and shall only test 8Rx tests listed in clause 6.2.4  Proposal 2: Use following parameters for 8Rx PDSCH requirements definition:   For Rank 2: TDLC300-100, 2T8R Medium B, MCS19   For Rank 4: TDLA30-10, 4T8R Low, MCS17   For Rank 8: TDLA30-10, 8T8R Low, MCS13 |
| [**R4-2308869**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308869.zip) | Huawei, HiSilicon | Simulation results for PDSCH requirements |
| [**R4-2308937**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308937.zip) | Ericsson | Observation 1: Referring to our simulation results in R4-2308938 [3], we note that 8 Rx UE can support 8 DL MIMO Layers in FR1 using MCS17 (Table 1) under TDLA30-10 propagation environment, where an SNR of 19.3 dB is required to achieve 70% of the peat throughput. This requirement remains 5 dB below the maximum SNR levels for conducted requirements.  Proposal 1: Consider PDSCH mapping Type A for 8 Rx UE and Rank 8 with the following test cases and parameters   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Test num. | Bandwidth (MHz) / Subcarrier spacing (kHz)/  (RB)/ | TDD UL-DL pattern | Modulation format and code rate | Rank | Propagation condition | Correlation matrix and antenna configuration | Reference value | | | Fraction of maximum throughput (%) | SNR (dB) | | 1-1 | 40 / 30  (106) | FR1.30-1 | QPSK, 0.30  MCS 4 | 8 | TDLA30-10 | 8x8, ULA Low | 70 | TBD | | 1-2 | 40 / 30  (106) | FR1.30-1 | 16QAM, 0.48  MCS 13 | 8 | TDLA30-10 | 8x8, ULA Low | 70 | TBD | | 1-3 | 40 / 30  (106) | FR1.30-1 | 64QAM, 0.43  MCS 17 | 8 | TDLA30-10 | 8x8, ULA Low | 70 | TBD | | MCS were defined based on TS 38.214 Table 5.1.3.1-1: MCS index table 1 for PDSCH (64QAM Table)  Use Tx EVM 6% for QPSK/16QAM/64QAM | | | | | | | | |   Observation 2: Referring to our simulation results in R4-2308938 [3], we note that 8 Rx UE can support 4 DL MIMO Layers in FR1 using MCS26 (Table 1) under TDLA30-10 propagation environment, where an SNR of 18.5 dB is required to achieve 70% of the peat throughput. This requirement remains 6 dB below the maximum SNR levels for conducted requirements.  Proposal 2: Consider PDSCH mapping Type A for 8 Rx UE and Rank 4 with the following test cases and parameters   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Test num. | Bandwidth (MHz) / Subcarrier spacing (kHz)/  (RB) | TDD UL-DL pattern | Modulation format and code rate | Rank | Propagation condition | Correlation matrix and antenna configuration | Reference value | | | Fraction of maximum throughput (%) | SNR (dB) | | 2-1 | 40 / 30  (106) | FR1.30-1 | QPSK, 0.30  MCS 4 | 4 | TDLA30-10 | 4x8, ULA Low | 70 | TBD | | 2-2 | 40 / 30  (106) | FR1.30-1 | 16QAM, 0.48  MCS 13 | 4 | TDLA30-10 | 4x8, ULA Low | 70 | TBD | | 2-3 | 40 / 30  (106) | FR1.30-1 | 64QAM, 0.85  MCS 26 | 4 | TDLA30-10 | 4x8, ULA Low | 70 | TBD | | MCS were defined based on TS 38.214 Table 5.1.3.1-1: MCS index table 1 for PDSCH (64QAM Table)  Use Tx EVM 6% for QPSK/16QAM/64QAM | | | | | | | | |   Observation 3: It is worth reminding that 256QAM has been used in Table 5.2.3.2.1-3 (TS 38.101-4) for 4 Rx UE with Rank 1. Consequently, and based on our simulation results in R4-2308938 [3], 256QAM can be considered for 8 RX UE with Rank 2 in 2x8 ULA Medium B channels.  Observation 4: Considering 256QAM for 8 Rx UE with Rank 2, our simulation results in R4-2308938 [3] show that MCS26 (Table 2) can be achieved in TDLA30-10 ULA Medium B channel, where an SNR of 23.5 dB is required to achieve 70% of the peak throughput. This requirement remains 6.5 dB below the maximum SNR levels for conducted requirements.  Proposal 3: Consider PDSCH mapping Type A for 8 Rx UE and Rank 2 with the following test cases and parameters   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Test num. | Bandwidth (MHz) / Subcarrier spacing (kHz)/  (RB) | TDD UL-DL pattern | Modulation format and code rate | Rank | Propagation condition | Correlation matrix and antenna configuration | Reference value | | | Fraction of maximum throughput (%) | SNR (dB) | | 3-1 | 40 / 30  (106) | FR1.30-1 | QPSK, 0.30  MCS 2 | 2 | TDLC300-100 | 2x8, ULA Medium B | 70 | TBD | | 3-2 | 40 / 30  (106) | FR1.30-1 | 16QAM, 0.48  MCS 7 | 2 | TDLC300-100 | 2x8, ULA Medium B | 70 | TBD | | 3-3 | 40 / 30  (106) | FR1.30-1 | 64QAM, 0.56  MCS 13 | 2 | TDLA30-10 | 2x8, ULA Medium B | 70 | TBD | | 3-4 | 40 / 30  (106) | FR1.30-1 | 256QAM, 0.89  MCS 26 | 2 | TDLA30-10 | 2x8, ULA Medium B | 70 | TBD | | MCS were defined based on TS 38.214 Table 5.1.3.1-2: MCS index table 2 for PDSCH (256QAM Table)  Use Tx EVM 6% for QPSK/16QAM/64QAM  Use Tx EVM 3% for 256QAM. | | | | | | | | |   Observation 5: Considering 256QAM for 8 Rx UE with Rank 2, our simulation results in R4-2308938 [3] show that MCS20 (Table 2) can be achieved in TDLC300-100 ULA Medium B channel, where an SNR of 18.5 dB is required to achieve 70% of the peak throughput. This requirement remains 11.5 dB below the maximum SNR levels for conducted requirements.  Proposal 4: If only TDLC channel model will be considered for 8 Rx UE with Rank 2, consider the following test cases and parameters   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Test num. | Bandwidth (MHz) / Subcarrier spacing (kHz)/  (RB) | TDD UL-DL pattern | Modulation format and code rate | Rank | Propagation condition | Correlation matrix and antenna configuration | Reference value | | | Fraction of maximum throughput (%) | SNR (dB) | | 3-1 | 40 / 30  (106) | FR1.30-1 | QPSK, 0.30  MCS 2 | 2 | TDLC300-100 | 2x8, ULA Medium B | 70 | TBD | | 3-2 | 40 / 30  (106) | FR1.30-1 | 16QAM, 0.48  MCS 7 | 2 | TDLC300-100 | 2x8, ULA Medium B | 70 | TBD | | 3-3 | 40 / 30  (106) | FR1.30-1 | 64QAM, 0.56  MCS 13 | 2 | TDLC300-100 | 2x8, ULA Medium B | 70 | TBD | | 3-4 | 40 / 30  (106) | FR1.30-1 | 256QAM, 0.67  MCS 20 | 2 | TDLC300-100 | 2x8, ULA Medium B | 70 | TBD | | MCS were defined based on TS 38.214 Table 5.1.3.1-2: MCS index table 2 for PDSCH (256QAM Table)  Use Tx EVM 6% for QPSK/16QAM/64QAM  Use Tx EVM 3% for 256QAM. | | | | | | | | | |
| [**R4-2308938**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308938.zip) | Ericsson | Observation 1: Considering Tx EVM at 6%, we can note that 8 Rx UE can support 8 DL MIMO Layers in FR1 using MCS17 under TDLA30-10 propagation environment. The SNR value is at 19.3 dB, thus 5 dB below the maximum SNR levels for conducted requirements.  Observation 2: Considering Tx EVM at 6%, we can note that 8 Rx UE can support 4 DL MIMO Layers in FR1 using MCS26 under TDLA30-10 propagation environment. The SNR value is at 18.5 dB, thus almost 6 dB below the maximum SNR levels for conducted requirements.  Observation 3: We can note that 8 Rx UE can support 2 DL MIMO Layers in FR1 using MCS20 (256QAM) under TDLC300-100 with ULA Medium B propagation environment. Furthermore, we can further boost the achievable MCS level to MCS26 (256QAM) for 8 Rx UE with Rank 2 under TDLA30-10 with ULA Medium B where an SNR margin of 6.5 dB below the maximum SNR level is enough to count for possible RF impairments (at 3% of Tx EVM). |
| R4-2308939 | Ericsson | Not available yet |
| [**R4-2309365**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2309365.zip) | Apple | Observation#1: Vehicle propagation scenario is well address by a low-rank high-delay high-doppler propagation. No other relevant scenarios are needed for Rank-2.  Proposal#1: Define TDLC300-100 ULA Medium B as single propagation scenario for Rank-2 vehicle operation.  Proposal#2: Define only MCS19 (Table 1) for the Rank-2 TDLC300-100 ULA MediumB requirement.  Proposal#3: Define only MCS17 (Table 1) for Rank-4 TDLC30-10 ULA Low requirement.  Proposal#4: Define either MCS13 (Table 1) or MCS17 (Table 1) for Rank-8 TDLC30-10 ULA Low requirement. |
| [**R4-2309368**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2309368.zip) | Apple | Simulation results for PDSCH requirements |

## Open issues summary

### Rank 2 test

*Background: Agreements in last meeting in R4-2305888:*

|  |
| --- |
| ***Issue 2-3: Propagation conditions for Rank 2 test***   * *Option 1: TDLC300-100 ULA Medium B and TDLA30-10 ULA Medium B* * *Option 2: Only TDLC300-100 ULA Medium B*   ***Issue 2-4: MCS and antenna correlation for Rank 2 test***   * *Proposals for TDLC300-100 ULA Medium B*   + *Option 1: MCS 2, 7 (Table 2)*   + *Option 2: MCS 19 (Table 1)* * *Proposals for TDLA30-10 ULA Medium B (if agreed)*   + *Option 1: MCS 13, 26 (Table 2)*   + *Option 2: MCS 19 (Table 1)* |

**Issue 2-1: Propagation conditions for Rank 2 test**

* Proposals
  + Option 1: Both TDLC300-100 and TDLA30-10 (Nokia, Samsung, Ericsson)
  + Option 2: Only TDLC300-100 (Qualcomm, MTK, Huawei, ZTE, Huawei, Apple, Ericsson)
* Recommended WF
  + TBA

**Issue 2-2: MCS and antenna correlation for Rank 2 test**

* Proposals for TDLC300-100 ULA Medium B
  + Option 1: MCS 2, 7 (Table 2) (Nokia, Ericsson)
  + Option 2: MCS 19 (Table 1) (Nokia, Qualcomm, MTK, Samsung, ZTE, Huawei, Apple)
  + Option 3: MCS 2, MCS 7, MCS 13 and MCS 20 (All in Table 2) if only TDLC300-100 is agreed (Ericsson)
* Proposals for TDLA30-10 ULA Medium B (if agreed)
  + Option 1: MCS 13, 26 (Table 2) (Nokia, Ericsson)
  + Option 2: MCS 19 (Table 1) (Nokia, Samsung)
* Recommended WF:

### Rank 4 test

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

*Background: Agreements in last meeting in R4-2305888:*

|  |
| --- |
| ***Issue 2-5: MCS for Rank 4 test***   * *Option 1: MCS 13 and MCS26 (Table 1)* * *Option 2: Only MCS17 (Table 1)* |

* Proposals
  + Option 1: MCS 13 and MCS 26 (Table 1) (Nokia)
  + Option 2: MCS 17 (Table 1) (Qualcomm, MTK, Samsung, ZTE, Huawei, Apple)
  + Option 3: MCS 4, MCS 13 and MCS 26 (Ericsson)
* Recommended WF
  + TBA.

### Rank 8 test

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

*Background: Agreements in last meeting in R4-2305888:*

|  |
| --- |
| ***Issue 2-7: Single MCS configuration for Rank 8 test***   * *Option 1:MCS13* * *Option 2: MCS17* |

* Proposals
  + Option 1: MCS 13 (Table 1) (Nokia, Qualcomm, MTK, Samsung, ZTE, Huawei, Apple)
  + Option 2: MCS 17 (Table 1) (Apple)
  + Option 3: MCS 4, MCS 13 and MCS 17 (Ericsson)
* Recommended WF
  + TBA.

# Topic #3: SDR requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2307434**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307434.zip) | QUALCOMM Europe Inc. – Spain | Proposal 5: RAN4 to use maximum MCS 24 (scaling factor =1) for 256 QAM, 8 layers, 8Rx SDR case  Proposal 6: RAN4 to use maximum MCS 24 (scaling factor =1) for 1024 QAM, 2 layers, 8Rx SDR case  Proposal 7: RAN4 to use maximum MCS 23 (scaling factor =1) for 1024 QAM, 4 layers, 8Rx SDR case |
| [**R4-2307026**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307026.zip) | Nokia, Nokia Shanghai Bell | Observation 1: Both MCS 24 and 22 are feasible options for MCS choice for 256 QAM with 8 layers.  Proposal 1: MCS 24 shall be used for 256 QAM with 8 layers.  Observation 2: Both MCS 22 and MCS 24 are feasible options for MCS choice for 1024 QAM with both 2 and 4 layers  Proposal 2: MCS 24 shall be used for both 2 and 4 layer performance requirements of 1024 QAM.  Observation 3: Neither option as presented within the Topic Summary of RAN4#106-bis-e includes the MCS configurations proposed by Nokia as the max MCS  Proposal 3: The MCS look-up table shall be agreed by RAN4 following the agreement of the MCS choice for SDR. |
| [**R4-2307027**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307027.zip) | Nokia, Nokia Shanghai Bell | Simulation results for SDR test |
| [**R4-2307114**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307114.zip) | MediaTek inc. | ***Proposal 1***: For 1024QAM, define SDR requirements only for 2 layers.  ***Proposal 2***: For 8Rx UE SDR requirements, we propose the following maximum achievable MCS:   * MCS24 (MCS table 2) for 8 layers 256QAM. * MCS24 (MCS table 4) for 2 layers 1024QAM   ***Proposal 3***: The MCS indexes for 8Rx UE SDR requirements are proposed in Table 2 and Table 3.  Table 2. MCS indexes for indicated UE capabilities   |  |  |  |  | | --- | --- | --- | --- | | 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 | | 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 2,4 and 6 is based on MCS index Table 1 defined in clause 5.1.3.1 of TS 38.214  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 | | | |   Table 3. MCS indexes for indicated UE capabilities (1024QAM)   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Supported RX  antenna ports | Maximum number of PDSCH MIMO layers | Maximum modulation format | Scaling factor | MCS | | 8 | 2 | 10 | 1 | 24 | | 10 | 0.8 | 21 | | 10 | 0.75 | 19 | | 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 | | | | | |
| [**R4-2307817**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307817.zip) | Samsung | Proposal 1: Define the maximum achievable MCS for 256QAM 8Rx 8 layers as no more than MCS25.  Proposal 2: Propose the maximum achievable MIMO layers for 1024QAM 8Rx is layer 4.  Proposal 3: Define the maximum achievable MCS for 1024QAM 8Rx 2 layers as no more than MCS24.  Proposal 4: Define the maximum achievable MCS for 1024QAM 8Rx 4 layers as no more than MCS23.  Proposal 5: Define MCS indexes for 8 MIMO layers as   |  |  |  |  | | --- | --- | --- | --- | | 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 | | 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 2, 4 and 6 is based on MCS index Table 1 defined in clause 5.1.3.1 of TS 38.214  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 | | | |   Proposal 6: Define MCS indexes for 1024QAM 8Rx as   |  |  |  |  |  | | --- | --- | --- | --- | --- | | 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 | 22 | | 2 | 10 | 0.75 | 20 | | 2 | 10 | 0.4 | 10 | | 4 | 10 | 1 | 23 | | 4 | 10 | 0.8 | 21 | | 4 | 10 | 0.75 | 19 | | 4 | 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 | | | | | |
| [**R4-2308870**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308870.zip) | Huawei,HiSilicon | Proposal 1: For 256QAM, both MCS 22 and MCS 24 are fine.  Proposal 2: For 1024QAM, only consider 2 MIMO layers, both MCS 23 and 24 are fine |
| [**R4-2308871**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308871.zip) | Huawei,HiSilicon | Simulation results for SDR tests |
| [**R4-2308940**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308940.zip) | Ericsson | Observation 1: RAN4 needs to extend the SDR applicability rule for FR1 where 8 PDSCH MIMO layers using 8 Rx are considered.  Proposal 1: Define SDR requirements applicable to FR1 CC, considering   * Update Table 5.5A-5 to support ‘Maximum number of PDSCH MIMO layers = 8’  |  |  |  |  | | --- | --- | --- | --- | | 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 2,4 and 6 is based on MCS index Table 1 defined in clause 5.1.3.1 of TS 38.214  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 | | | |   Proposal 2: Define SDR requirements applicable to FR1 CC, considering   * Update Table 5.5A-5 to support ‘Maximum number of PDSCH MIMO layers = 8’  |  |  |  |  | | --- | --- | --- | --- | | Maximum number of PDSCH MIMO layers | Maximum modulation format | Scaling factor | MCS | | 8 | 8 | 1 | 24 | | 8 | 8 | 0.8 | 22 | | 8 | 8 | 0.75 | 21 | | 8 | 8 | 0.4 | 12 | | Note 1: 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 | | | |   Proposal 3: Define SDR requirements applicable to FR1 CC, considering   * Update Table 5.5A-6 (1024QAM) to support 8Rx. Note the Maximum number of PDSCH MIMO layers is 4.  |  |  |  |  |  | | --- | --- | --- | --- | --- | | Supported RX antenna ports | Maximum number of PDSCH MIMO layers | Maximum modulation format | Scaling factor | MCS | | 8RX | 4 | 10 | 1 | 24 | | 10 | 0.8 | 21 | | 10 | 0.75 | 19 | | 10 | 0.4 | 9 | | 2 | 10 | 1 | 24 | |  | 10 | 0.8 | 21 | |  | 10 | 0.75 | 19 | |  | 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 | | | | | |
| [**R4-2308941**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308941.zip) | Ericsson | Simulation results for SDR tests:  Observation 1: We can note that SDR results with Rank 8 can be verified for FR1 8Rx UE using 64QAM with MCS26.  Observation 2: We can note that SDR results with Rank 8 can be verified for FR1 8Rx UE using 256QAM with MCS24.  Observation 3: We can note that SDR results with Rank 2 and Rank 4 can be verified for FR1 8Rx UE using 1024QAM with MCS24. |
| [**R4-2309366**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2309366.zip) | Apple | Observation#1: For SDR 256QAM, both MCS22 and MCS24 are feasible, since full thougput can be obtained well below the 30dB cuttoff, including a ~3dB additional margin for RF impairments.  Proposal#1: For SDR 8 Layers, define requirements with MCS24 for256QAM.  Observation#2: For SDR 1024QAM, only Rank-2 seems feasible, at MCS24. For Rank-4 and the minimum MCS, MCS23, the SNR results is too close to the 30dB target.  Proposal#2: For SDR 2 Layers, define requirements 1024QAM requirements with MCS24 (Option 1b).  Proposal #3: Define MCS look-up tables as follows:   |  |  |  |  | | --- | --- | --- | --- | | 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 | | | |  |  |  |  |  | | --- | --- | --- | --- | | 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 1: 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 | | | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | | Supported RX  antenna ports | Maximum number of PDSCH MIMO layers | Maximum modulation format | Scaling factor | MCS | |  | 2 | 10 | 1 | 24 | |  | 10 | 0.8 | 21 | |  | 10 | 0.75 | 19 | |  | 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 | | | | | |
| [**R4-2309369**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2309369.zip) | Apple | Simulation results for SDR tests |

## Open issues summary

*Background: Agreements in last meeting in R4-2305888:*

|  |
| --- |
| ***Issue 3-3: Maximum MCS and MIMO layers for 64QAM***   * *2 and 4 MIMO layers resus the existing MCS value defined in Table 5.5A-5 of TS 38.101-4* * *8 layers: MCS26 (Table 1)*   ***Issue 3-4: Maximum MCS and MIMO layers for 256QAM***   * *2 and 4 layers: reuse the requirements defined in Table 5.5A-5 of TS 38.101-4* * *Candidate options for maximum achievable MCS for 8 layers*   + *Option 1: MCS22*   + *Option 2: MCS24*   ***Issue 3-5: Maximum MCS and MIMO layers for 1024QAM***   * *Introduce SDR requirements for 1024QAM at least for 2 MIMO layers* * *Candidate options*    + *Option 1: Only 2 layers:* * *Option 1a: MCS23* * *Option 1b: MCS24*   + *Option 2: Both 2 and 4 layers:* * *Option 2a: MCS23* * *Option 2b: MCS24* |

### Sub-topic 2-1 64QAM

**Issue 3-1: MCS look up Table**

* Proposals
  + Option 1: (Ericsson, Apple, Samsung, MTK)

|  |  |  |  |
| --- | --- | --- | --- |
| **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 | | | |

* Recommended WF
  + Option 1 is agreeable

### Sub-topic 2-2 256QAM

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

* Proposals
  + Option 1: MCS 22 (Samsung?, Huawei)
  + Option 2: MCS 24 (Qualcomm, Nokia, MTK, Samsung, Huawei, Ericsson, Apple)
* Recommended WF
  + Option 2 is agreeable.

**Issue 3-3: MCS look-up Table**

* Proposals
  + Option 1: (Ericsson)

|  |  |  |  |
| --- | --- | --- | --- |
| **Maximum number of PDSCH MIMO layers** | **Maximum modulation format** | **Scaling factor** | **MCS** |
| 8 | 8 | 1 | 24 |
| 8 | 8 | 0.8 | 22 |
| 8 | 8 | 0.75 | 21 |
| 8 | 8 | 0.4 | 12 |
| Note 1: 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 | | | |

* + Option 2: (MTK, Apple, Samsung)

|  |  |  |  |
| --- | --- | --- | --- |
| 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 | | | |

* Recommended WF
  + Option 2 is agreeable.

### Sub-topic 2-3 1024QAM

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

* Proposals
  + Option 1: Only 2 layers: MCS 24 (MTK, Huawei, Apple)
  + Option 2: Both 2 and 4 layers (Qualcomm, Nokia, Samsung, Ericsson)
    - Option 2a: MCS 24 (Nokia, Ericsson)
    - Option 2b: MCS 24 for 2 layers, MCS 23 for 4 layers (Qualcomm, Samsung)
* Recommended WF
  + MCS 24 for 2 layers is agreeable
  + FFS 4 layers

**Issue 3-5: MCS look-up Table**

* Proposals
  + Option 1: Use following MCS look-up Table (Samsung)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 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 | 22 |
| 2 | 10 | 0.75 | 20 |
| 2 | 10 | 0.4 | 10 |
| 4 | 10 | 1 | 23 |
| 4 | 10 | 0.8 | 21 |
| 4 | 10 | 0.75 | 19 |
| 4 | 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 | | | | |

* + Option 2: Use following MCS look-up Table (Ericsson)
* Update Table 5.5A-6 (1024QAM) to support 8Rx. Note the Maximum number of PDSCH MIMO layers is 4.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Supported RX antenna ports | Maximum number of PDSCH MIMO layers | Maximum modulation format | Scaling factor | MCS |
| 8RX | 4 | 10 | 1 | 24 |
| 10 | 0.8 | 21 |
| 10 | 0.75 | 19 |
| 10 | 0.4 | 9 |
| 2 | 10 | 1 | 24 |
|  | 10 | 0.8 | 21 |
|  | 10 | 0.75 | 19 |
|  | 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 | | | | |

* + Option 3: The MCS indexes for 8Rx UE SDR requirements. (MTK, Apple)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Supported RX  antenna ports | Maximum number of PDSCH MIMO layers | Maximum modulation format | Scaling factor | MCS |
| 8 | 2 | 10 | 1 | 24 |
| 10 | 0.8 | 21 |
| 10 | 0.75 | 19 |
| 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 | | | | |

* Recommended WF
  + TBA.

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
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## Summary for 1st round

### Open issues

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|  | **Status summary** |
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## Discussion on 2nd round

# Topic #4: CQI requirements

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2307434**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307434.zip) | QUALCOMM Europe Inc. - Spain | **Proposal 8: RAN4 to use (4,5) and (10,11) as SNR points in dB for 4L, 8Rx static channel CQI reporting.** |
| [**R4-2307028**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307028.zip) | Nokia, Nokia Shanghai Bell | Simulation results for 8Rx CQI tests |
| [**R4-2307029**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307029.zip) | Nokia, Nokia Shanghai Bell | Observation 1: The choice of i2 will no impact performance in any way.  Observation 2: A random i2 will impose randomness and higher implementation complexity on Test Equipment behaviour.  Proposal 1: We propose that to reduce unnecessary randomness in test equipment, i2 shall be fixed at a value of 0 (option 2).  Proposal 2: RAN4 shall use {option 2: [7,8] dB for 64QAM, [1,2] dB for 16QAM } as the SNR points for CQI reporting. |
| [**R4-2307115**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307115.zip) | MediaTek inc. | Proposal 1: We support Option 2. RAN4 defines 8Rx CQI requirements with fixed value i2 = 0 during the test.  Proposal 2: For 8Rx UE CQI requirements under static channels, RAN4 can use “SNR [4,5] dB for 16QAM” and “SNR [10,11] dB for 64QAM”. |
| [**R4-2308872**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308872.zip) | Huawei,HiSilicon | Proposal 1: Set random i2 or fixed i2 during the test  Proposal 2: Set SNR test point to [4, 5] dB and [10, 11] dB |
| [**R4-2308873**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308873.zip) | Huawei,HiSilicon | Simulation results for 8Rx CQI tests |
| [**R4-2308942**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308942.zip) | Ericsson | Observation 1: For 8 Rx UE CQI reporting, it has been agreed to  Consider the legacy configuration report quantity 'cri-RI-PMI-CQI '  Use two-one-TypeI-SinglePanel-Restriction = 00000001  Observation 2: Based on Table 5.2.2.2.1-8 and Table 5.2.2.2.1-4 in TS 38.214, i\_(1,2)=0 and i\_(1,3)=0. The index i\_(1,1) should be one out of eight values, {0,…, 7}, while i\_2 should be one of 2 values, {0, 1}.  Proposal 1: For 8 Rx UE CQI reporting, define requirements considring  Legacy configuration report quantity 'cri-RI-PMI-CQI '  two-one-TypeI-SinglePanel-Restriction = 00000001  TE sets random i2 (1 out of 2 possibilities) during the test  Proposal 2: Define the CQI reporting requirements for 8Rx UE under static conditions while considering Rank 4, 64QAM as the highest modulation order and based on the measurement channel as specified in Table A.4-3 using TBS.3-4 in TS 38.101-4, with test points  64QAM is at SNR = 7/8 dB (CQI 7).  16QAM is at SNR = 1/2 dB (CQI 4).  Proposal 3: Based on our simulation results, EVM values did not impact CQI reporting requirements. However, we can always keep EVM = 3% since we are using Table 2 for CQI reporting. |
| [**R4-2308943**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308943.zip) | Ericsson | Simulation results for CQI tests.  Observation 1: The results show that the lowest SNR to report efficiently a CQI with Rank 4 related to  • 64QAM is at SNR = 7/8 dB (CQI 7).  • 16QAM is at SNR = 1/2 dB (CQI 4).  Observation 2: The results show that the EVM values did not impact the CQI reporting requirements. |
| [**R4-2309367**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2309367.zip) | Apple | Proposal#1: Maintain the same TxEVM assumption as the values used for PDSCH demodulation performance requirements.  Proposal#2: Use Option 1, [2,3] dB and [8,9] dB, for the single CQI test considered for 8Rx UEs. |

## Open issues summary

### Sub-topic 3-1 CQI requirements

*Background: Agreements in last meeting in R4-2305888:*

|  |
| --- |
| ***Issue 4-1: Report quantity configuration***   * *Use the legacy configuration, report quantity 'cri-RI-PMI-CQI '* * *Use two-one-TypeI-SinglePanel-Restriction = 00000001* * *Following options for i2 will be discussed for next RAN4 meeting:*   + *Option 1: TE sets random i2 (1 out of 2 possibilities) during the test*   + *Option 2: TE uses fixed value i2 = 0 or 1 during the test*   + *Option 3: Leave TE implementation to use random i2 or fixed i2 = 0 or 1*   ***Issue 4-4: SNR points***   * *Option 1: [4,5] dB and [10,11] dB* * *Option 2: [7,8] dB for 64QAM, [1,2] dB for 16QAM* * *Other options are not precluded* |

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

* Proposals
  + Option 1: TE sets random i2 (1 out of 2 possibilities) during the test (Huawei, Ericsson)
  + Option 2: TE uses fixed value during the test (Qualcomm, Nokia, MTK, Huawei)
    - Option 2a: i2 = 0 or 1
    - Option 2b: i2 = 0 (Nokia, MTK)
    - Option 2c: i2 = 1
* Recommended WF
  + TBA

**Issue 4-2: SNR points**

* Proposals
  + Option 1: [4,5] dB and [10,11] dB (Qualcomm, MTK, Huawei)
  + Option 2: [1, 2] dB and [7,8] dB (Nokia, Ericsson)
  + Option 3: [2,3] dB and [8, 9] dB (Apple)
* Recommended WF
  + TBA

**Issue 4-3: TxEVM**

*Background: Agreements in last meeting in R4-2305888:*

|  |
| --- |
| ***Issue 4-3: Tx EVM assumption for derivation of SNR values for CQI test***   * *No need to discuss if simulation results are well aligned* |

* Proposals
  + Option 1: Maintain the same TxEVM assumption as the values used for PDSCH demodulation performance requirements.(Apple)
  + Option 2: keep EVM = 3% since we are using Table 2 for CQI reporting.(Ericsson)
* Recommended WF
  + Most companies think EVM has no impact on results in previous meeting discussion, maybe we can come back to this if simulation results are not well aligned.

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
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## Summary for 1st round

### Open issues

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|  | **Status summary** |
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## Discussion on 2nd round

# Topic #5: CR split

|  |  |  |
| --- | --- | --- |
|  |  | **Companies** |
| Applicabaility rules for performance requirements for 8Rx | PDSCH test applicability rules | Apple |
| PDCCH test applicability rules | Nokia |
| PDSCH performance requirements | PDSCH performance requirements | Samsung |
| SDR requirements | SDR tests | Ericsson |
| Applicabaility rules for CSI requirements for 8Rx | Applicabaility rules | Huawei |
| CQI requirements | CTC |
| Reference measurement channels | FRC | MediaTek |
| Static propagation condition |  | ZTE |
| MIMO channel correlation matrices | MIMO Correlation Matrices using Uniform Linear Array (ULA) | Nokia |

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |  |
| --- | --- | --- | --- |
| **New Tdoc number** | **Title** | **Source** | **Comments** |
|  | WF on … | YYY |  |
|  | LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |  |

**Existing tdocs**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Tdoc number** | **Revised to** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-22xxxxx |  | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Tdoc number** | **Revised to** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-22xxxxx |  | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-22xxxxx |  | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-22xxxxx |  | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents