**3GPP TSG-RAN WG4 Meeting #112 R4-2411180**

**Maastricht, NL, 19-23 Aug 2024**

**Agenda item:** 5.19.4

**Source:** Moderator (China Telecom)

**Title:** Topic summary for [112][320] NR\_demod\_enh3\_Part1

**Document for:** Information

# Introduction

This contribution summarizes the open issues, candidate options as well as the recommended WF for the advanced receiver for MU-MIMO part of the maintenance part for Rel-18 NR demodulation requirement evolution WI under agenda 5.19.

# Topic #1: Open issues

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2411180 | China Telecom | Proposal 1: Capture both UE capabilities in TS38.101-4 and clearly state which tests are applicable for which capabilities:

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| R-ML (reduced complexity ML) receivers with enhanced inter-user interference suppression for MU-MIMO for 2 layers across target and co-scheduled UEs with 2RX and 4RX in FR1 when the co-scheduled UE information with DCI index 6 or 7 in Table 7.3.1.2.2-12 of TS 38.212 [10] is signalled. | FR1 FDD | PDSCH | Clause 5.2.2.1.16(Test 2-2)Clause 5.2.3.1.16(Test 3-2) |  |
| FR1 TDD | PDSCH | Clause 5.2.2.2.17(Test 2-2)Clause 5.2.3.2.17(Test 3-2) |  |
| R-ML (reduced complexity ML) receivers with enhanced inter-user interference suppression for MU-MIMO for 2 layers across target and co-scheduled UEs with 2RX and maxNumberMIMO-LayersPDSCH layers across target and co-scheduled UEs with 4RX in FR1 when the co-scheduled UE information with DCI index 6 in Table 7.3.1.2.2-12 of TS 38.212 [10] is signalled. | FR1 FDD | PDSCH | Clause 5.2.2.1.16(Test 2-2)Clause 5.2.3.1.16(Test 3-2, Test 4-2) |  |
| FR1 TDD | PDSCH | Clause 5.2.2.2.17(Test 2-2)Clause 5.2.3.2.17(Test 3-2, Test 4-2) |  |

Proposal 2: Keep the current capability and add additional note that rank 2+2 tests are only applicable for UEs supporting ‘MU-MIMO Interference Mitigation advanced receiver with modulation order detection Enh’.

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| Support for MU-MIMO Interference Mitigation advanced receiver (R-ML), when the co-scheduled UE information with DCI index 6 or 7 in Table 7.3.1.2.2-12 of TS38.212 [10] is signalled. | FR1 FDD | PDSCH | Clause 5.2.2.1.16(Test 2-2)Clause 5.2.3.1.16(Test 3-2, Test 4-2) | Test 4-2 is only applicable for UE supporting ‘MU-MIMO Interference Mitigation advanced receiver with modulation order detection Enh’ in TS38.306. |
| FR1 TDD | PDSCH | Clause 5.2.2.2.17(Test 2-2)Clause 5.2.3.2.17(Test 3-2, Test 4-2) |

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| R4-2412753 | Huawei,HiSilicon | CR for 38.101-4 Corrections on applicability rules for advanced receiver for MU-MIMO |
| R4-2412754 | Huawei,HiSilicon | Observation 1: Current applicability rules for tests with modulation order detection in 38.101-4 don’t conform with UE capabilities definition in 38.306.Proposal 1: Applicability rules for modulation order detection should be modified to the following:

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| Support for MU-MIMO Interference Mitigation advanced receiver (R-ML) receiver with enhanced inter-user interference suppression for MU-MIMO for 2 layers across target and co-scheduled UEs with 2RX and 4RX when the co-scheduled UE information with DCI index 6 or 7 in Table 7.3.1.2.2-12 of TS38.212 [10] is signalled. | FR1 FDD | PDSCH | Clause 5.2.2.1.16(Test 2-2)Clause 5.2.3.1.16(Test 3-2) |  |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.17(Test 2-2)Clause 5.2.3.2.17(Test 3-2) |  |
| Support for MU-MIMO Interference Mitigation advanced receiver (R-ML) receiver with enhanced inter-user interference suppression for MU-MIMO for 2 layers across target and co-scheduled UEs with 2RX and maxNumberMIMO-LayersPDSCH layers across target and co-scheduled UEs with 4RX when the co-scheduled UE information with DCI index 6 in Table 7.3.1.2.2-12 of TS38.212 [10] is signalled. | FR1 FDD | PDSCH | Clause 5.2.2.1.16(Test 2-2)Clause 5.2.3.1.16(Test 3-2, Test 4-2) |  |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.17(Test 2-2)Clause 5.2.3.2.17(Test 3-2, Test 4-2) |  |

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| R4-2411381 | Apple | Observation #1: For assumptions of precoding granularity RAN1 spec is limited to PRG=2,4 for target and co-schedule UE same CDM group.Observation #2: RAN4 discussion/ agreements in WF as well as RAN2 RRC based NWA is also limited to PRG=2,4Observation #3: There is no assumption for wideband precoding. Proposal #1: Extend the default assumption on precoding granularity to wideband precoding for advanced receiver for MU-MIMO. Proposal #2: If the target UE is configured with wideband precoding, the default assumption for advanced receiver with MU-MIMO is that the co-scheduled UE is also configured with wideband precoding.Proposal #3: Send LS to RAN2 to update the field precodingAndResourceAllocation in IE AdvancedReceiver-MU-MIMO.Proposal #4: Send LS to RAN1 to seek clarification on UE assumption of precoding granularity for co-scheduled UEs when target UE is configured for wideband precoder. |

## Open issues summary

**Issue 1: Proposed updates to the test applicability rule**

* UE capability definition and test applicability rule agreed in RAN4#111

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| *UE capability definition for UE supporting MO BD with enhanced receiver type 2 in TS38.306:*

| ***MU-MIMO Interference Mitigation advanced receiver with modulation order detection****R-ML (reduced complexity ML) receivers with enhanced inter-user interference suppression for MU-MIMO for 2 layers across target and co-scheduled UEs with 2RX and 4RX in FR1 when the co-scheduled UE information with DCI index 6 or 7 in Table 7.3.1.2.2-12 of TS 38.212 [10] is signalled.**UE supporting the feature is required to indicate the support of advReceiver-MU-MIMO-r18.* |
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| ***MU-MIMO Interference Mitigation advanced receiver with modulation order detection Enh****R-ML (reduced complexity ML) receivers with enhanced inter-user interference suppression for MU-MIMO for 2 layers across target and co-scheduled UEs with 2RX and maxNumberMIMO-LayersPDSCH layers across target and co-scheduled UEs with 4RX in FR1 when the co-scheduled UE information with DCI index 6 in Table 7.3.1.2.2-12 of TS 38.212 [10] is signalled.**UE supporting the feature is required to indicate the support of advReceiver-MU-MIMO-r18.* |

*Test applicability rule for enhanced receiver type 2 in TS38.101-4:*

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| *Support for MU-MIMO Interference Mitigation advanced receiver (R-ML), when the co-scheduled UE information with DCI index 6 or 7 in Table 7.3.1.2.2-12 of TS38.212 [10] is signalled.* | *FR1 FDD* | *PDSCH* | *Clause 5.2.2.1.16**(Test 2-2)**Clause 5.2.3.1.16**(Test 3-2, Test 4-2)* |  |
| *FR1 TDD* | *PDSCH* | *Clause 5.2.2.2.17**(Test 2-2)**Clause 5.2.3.2.17**(Test 3-2, Test 4-2)* |  |

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* Proposals:
	+ Option 1 (China Telecom’ second choice, Huawei): Capture both UE capabilities in TS38.101-4 and clearly state which tests are applicable for which capabilities

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| R-ML (reduced complexity ML) receivers with enhanced inter-user interference suppression for MU-MIMO for 2 layers across target and co-scheduled UEs with 2RX and 4RX in FR1 when the co-scheduled UE information with DCI index 6 or 7 in Table 7.3.1.2.2-12 of TS 38.212 [10] is signalled. | FR1 FDD | PDSCH | Clause 5.2.2.1.16(Test 2-2)Clause 5.2.3.1.16(Test 3-2) |  |
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| R-ML (reduced complexity ML) receivers with enhanced inter-user interference suppression for MU-MIMO for 2 layers across target and co-scheduled UEs with 2RX and maxNumberMIMO-LayersPDSCH layers across target and co-scheduled UEs with 4RX in FR1 when the co-scheduled UE information with DCI index 6 in Table 7.3.1.2.2-12 of TS 38.212 [10] is signalled. | FR1 FDD | PDSCH | Clause 5.2.2.1.16(Test 2-2)Clause 5.2.3.1.16(Test 3-2, Test 4-2) |  |
| FR1 TDD | PDSCH | Clause 5.2.2.2.17(Test 2-2)Clause 5.2.3.2.17(Test 3-2, Test 4-2) |  |

* + Option 2 (China Telecom’ first choice): Keep the current capability and add additional note that rank 2+2 tests are only applicable for UEs supporting ‘MU-MIMO Interference Mitigation advanced receiver with modulation order detection Enh’

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| Support for MU-MIMO Interference Mitigation advanced receiver (R-ML), when the co-scheduled UE information with DCI index 6 or 7 in Table 7.3.1.2.2-12 of TS38.212 [10] is signalled. | FR1 FDD | PDSCH | Clause 5.2.2.1.16(Test 2-2)Clause 5.2.3.1.16(Test 3-2, Test 4-2) | Test 4-2 is only applicable for UE supporting ‘MU-MIMO Interference Mitigation advanced receiver with modulation order detection Enh’ in TS38.306. |
| FR1 TDD | PDSCH | Clause 5.2.2.2.17(Test 2-2)Clause 5.2.3.2.17(Test 3-2, Test 4-2) |

* Recommended WF
	+ Encourage feedback on the above proposals.

**Issue 2: Potential extension of RAN4 default assumption on co-UE precoding granularity**

* *RAN1 spec limitation in TS38.214:*

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| *The UE does not expect the precoding of the potential co-scheduled UE(s) in other DM-RS ports of the same CDM group to be different in the PRG-level grid configured to this UE with PRG =2 or 4.**The UE does not expect the resource allocation of the potential co-scheduled UE(s) in other DM-RS ports of the same CDM group to be misaligned in the PRG-level grid to this UE with PRG=2 or 4.* |

* *Agreed RAN4 default assumptions in TR38.878:*

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| *Information* | *RAN4 Default assumption**(If N/A, how could be obtained by the UE)* | *Signalling if RAN4 default assumption not valid* |
| *PRB bundling size for the co-scheduled UE**Frequency domain resource allocation for the co-UE within each PRG of the target UE* | *For the target and any co-scheduled UEs in different CDM groups and with the same DMRS sequence, the target UE assumes the precoding and resource allocation of the co-scheduled UE are the same in the PRG-level grid configured to the target UE when PRG=2 or 4.* | *Introduce dedicated RRC signalling to indicate whether the default assumptions valid or not* |
| *…* | *…* | *…* |

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* Apple’s observation:
	+ In RAN4 discussion, RAN1 limitation and RAN2 NWA signaling the assumption has only focused on PRG granularity=2,4, but there was no assumption when precoding granularity is set to wideband.
* Proposals:
	+ Proposal 1: (Apple) Extend the default assumption on precoding granularity to wideband precoding for advanced receiver for MU-MIMO:
* If the target UE is configured with wideband precoding, the default assumption for advanced receiver with MU-MIMO is that the co-scheduled UE is also configured with wideband precoding.
* Send LS to RAN2 for NWA update if the above assumption can be agreed.
* Send LS to RAN1 to seek clarification on UE assumption of precoding granularity for co-scheduled UEs when target UE is configured for wideband precoder.
* Recommended WF
	+ Encourage feedback on the above proposal.
* Whether we can extend the current RAN4 default assumptions from PRG = 2 or 4 to PRG = 2, 4 **or wideband**.
* Whether we need to seek RAN1 for further clarifications.

# Topic #2: Maintenance CRs and simulation results updates

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2411380 | Apple | CR to 38.101-4 on FDD 4Rx requirements for advanced receiver for MU-MIMO |
| R4-2411661 | Nokia | CR for 38.101-4 on RMC corrections for MU-MIMO |
| R4-2411664 | Nokia | CR for 38.878 on corrections of description and summary |
| R4-2412147 | Ericsson | CR to 38.101-4: Correction on FDD 2Rx PDSCH requirements for advanced receiver for MU-MIMO |
| R4-2412327 | MediaTek inc | CR on TDD 4Rx requirements for advanced receiver for MU-MIMO |
| R4-2411382 | Apple | Simulation result collection for MU-MIMO with advanced receiver |
| R4-2411772 | Qualcomm Technologies Ireland | MU-MIMO enhancement simulation results |
| R4-2412755 | Huawei, HiSilicon | Updates on simulation results for MU-MIMO |

## Open issues

**Issue 3: CR review and simulation results**

* Companies to update simulation results in R4-2411382 provided by Apple
* Companies to provide comments and response under e-mail thread [111][320] NR\_demod\_enh3\_Part1 – CR review.