**3GPP TSG-RAN WG4 Meeting #99-e R4-2108698**

**Electronic Meeting, May. 19th – 27th, 2021**

**Agenda item:** 9.11.3

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

**Title:** Email discussion summary for [99-e][332] NR\_perf\_enh2\_Demod\_Part3\_NWM

**Document for:** Information

# Introduction

As per the discussion on BS PUSCH demodulation requirements for FR1 256QAM in last RAN4#98-bis-e, great progress was achieved as listed in the approved WF R4-2106120, still some open issues are left for further discussion:

|  |
| --- |
| * *MCS: Evaluate {MCS24, MCS22} as starting point for next meeting, based on the simulation results to decide if MCS24 is feasible, otherwise to check lower MCS22 is feasible or not.*
* *Additional DM-RS (dmrsAdditionalPosition): pos1, FFS pos2*
	+ *Decide based on interesting companies’ feedback for next meeting*
* *PT-RS configuration: FFS configure PT-RS.*
	+ *Further discuss and decide whether to configure PT-RS or not based on feedback from interesting companies in next meeting.*
* *Phase Noise modelling:*
	+ *Realistic phase noise modelling is left up to the contributing entities.*
	+ *FFS how to consider phase noise impact based on further discussion and evaluations.*
	+ *Interesting company is welcome to do investigation on the PN impact on 256QAM performance for next meeting.*
* *Tx EVM:*
	+ *Interesting companies are welcome to check the performance difference with and without Tx EVM (3.5% as baseline) impact considered.*
	+ *RAN4 will discuss and decide whether additional margin should be considered in alignment results if no Tx EVM modelling in next meeting as per the evaluations results.*
* *Number of Tx:*
	+ *Option 1: Only 1Tx*
	+ *Option 2: Both 1Tx and 2Tx*
* *Number of Rx:*
	+ *Option 1: 2/8 Rx*
	+ *Option 2: 2/4/8 Rx*
* *Number of layers:*
	+ *Option 1: Only 1 layer*
	+ *Option 2: Both of 1 and 2 layers*
* *SCS and bandwidth*
	+ *15kHz SCS:*
* *Option 1:5MHz and 10MHz*
* *Option 2: 5MHz, 10MHz and 20MHz.*
	+ *30kHz SCS*
* *Option 1:10MHz and 40MHz*
* *Option 2:10MHz, 20MHz, 40MHz and 100MHz.*
* *Applicability rule for different antenna configurations*
	+ *Option 1: Reuse the existing test applicability rule defined in clause 8.1.2.0 of TS38.141-1*
	+ *Other options*
* *Applicability rules for different SCS and CBW*
	+ *Option 1:  Reuse the existing applicability rules defined in sections 8.1.2.1.1 and 8.1.2.1.2 of TS 38.141-1*
	+ *Other options*
 |

1st round discussion:

Based on companies’ inputs by contributions, collect companies’ view on those left open issues and some new issues raised in this meeting, and try to reach some consensus.

2nd round discussion:

Try to find some way forward by certain compromise among companies.

The left open issues for discussion in the 2nd round:

# Topic #1: Test parameters

## Companies’ contributions summary

|  |  |  |  |
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| **T-doc number** | **Company** | **Title** | **Proposals / Observations** |
| [**R4-2109104**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109104.zip) | CATT | Simulation results for PUSCH 256QAM performance requirement | Simulation results |
| [**R4-2109105**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109105.zip) | CATT | Discussion on PUSCH demodulation requirements for FR1 256QAM | Proposal 1: To adopt MCS index =22 for 256QAM demodulation.Proposal 2: To adopt pos1 additional DM-RS position for 256QAM demodulation.Proposal 3: Not to configure PTRS for 256QAM demodulation.Proposal 4: To adopt Option 1: Only 1Tx for 256QAM demodulation.Proposal 5: To adopt Option 1: Only 1 layer for 256QAM demodulation. Proposal 6: To adopt Option 2: 2/4/8 Rx for 256QAM demodulation. Proposal 7: To adopt Option 1: Reuse the existing test applicability rule defined in clause 8.1.2.0 of TS38.141-1 for 256QAM demodulation.Proposal 8: To adopt 15 kHz SCS: Option 2: 5MHz, 10MHz, 20MHz and 30 kHz SCS: Option 2:10MHz, 20MHz, 40MHz, 100MHz for 256QAM demodulation.Proposal 9: To adopt Option 1: Reuse the existing applicability rules defined in sections 8.1.2.1.1 and 8.1.2.1.2 of TS 38.141-1 for 256QAM demodulation.Observation 1: Additional margin due to TX EVM is dependent with MCS. |
| [**R4-2109136**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109136.zip) | China Telecom | Discussion on PUSCH FR1 256QAM demodulation requirements | Proposal 1: Cover both 1Tx 1 Layer and 2Tx 2 Layer transmission configuration for PUSCH 256QAM demodulation test requirements.Proposal 2: Reuse the same test applicability for different antenna configurations for Rel-15 PUSCH demod in clause 8.1.2.0 of TS38.141-1.Proposal 3: Cover 2/4/8 Rx antenna configurations for PUSCH 256QAM demodulation test requirements.Proposal 4: Use MCS 24 (R = 841/1024) in MCS Table 2 for NR PUSCH 256QAM test cases.Proposal 5: Only consider pos1 for the DMRS additional position.Proposal 6: Reuse the existing test applicability rule defined in clause 8.1.2.1.1 and 8.1.2.1.2 of TS38.141-1.Proposal 7: Reuse the same CBW configurations for Rel-15 PUSCH demodulation tests, i.e., option 2 for both 15kHz SCS and 30kHz SCS.Proposal 8: Not to consider PT-RS for the PUSCH 256QAM demodulation test.Proposal 9: Not to consider PN model for the PUSCH 256QAM test to align with the agreements in the WID.Proposal 10: Reuse the existing MU and TT values for PUSCH demodulation test cases defined in TS38.141-1. |
| [**R4-2109201**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109201.zip) | Intel Corporation | Discussion on PUSCH requirements for FR1 256QAM | Proposal 1: Don’t consider phase noise impact for FR1 PUSCH 256QAM requirements definition.Proposal 2: Don’t configure PT-RS for FR1 PUSCH 256QAM requirements definition.Proposal 3: Consider only scenario with 1 additional DMRS for FR1 PUSCH 256QAM requirements definition.Proposal 4: Consider 3.5% Tx EVM modelling for FR1 PUSCH 256QAM alignment simulation results.Proposal 5: Define FR1 PUSCH requirements with 256QAM modulation for scenarios with 1 TX antenna and 1 MIMO layerProposal 6: Define FR1 PUSCH requirements with 256QAM modulation for scenarios with 2 and 8 receive antennas and use the following applicability rules:• BS with higher than 8 receive antennas: Reuse applicability rule in clause 8.1.2.0 of TS38.141-1. • BS with higher 4 receive antennas: Unless otherwise stated, for a BS supporting 4 antenna connectors (for BS type 1-C) or TAB connectors (for BS type 1-H), the performance requirement tests for 2 RX antennas shall apply, and the specific connectors used for testing are based on manufacturer declaration.Proposal 7: Define FR1 PUSCH requirements with 256QAM modulation for CBWs 5MHz and 10MHz for 15 kHz SCS and for CBWs 10MHz and 40MHz for 30 kHz SCS. Reuse applicability rules defined in sections 8.1.2.1.1 and 8.1.2.1.2 of TS 38.141-1.Observation 1: Introduction of 3.5% Tx EVM leads to 0.6 – 0.9 dB degradation depending on scenario.Observation 2: Introduction of phase noise does not degrade the performance. |
| [**R4-2109491**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109491.zip) | CMCC | Discussion on BS demodulation enhancement for FR1 256QAM | Proposal 1: For Tx, use both 1Tx and 2TxProposal 2: For Rx, use 2Rx, 4Rx and 8RxProposal 3: Use 1 layer for 1Tx and 2 layers for 2Tx.Proposal 4: For the antenna configuration applicability rule, reuse the existing test applicability rule defined in clause 8.1.2.0 of TS 38.141-1.Proposal 5: For 15kHz SCS, define 5MHz, 10MHz and 20MHz bandwidth configuration test cases.Proposal 6: For 30kHz SCS, define 10MHz, 20MHz, 40MHz and 100MHz bandwidth configuration test cases.Proposal 7: Reuse the existing applicability rules defined in clause 8.1.2.1.1 and 8.1.2.1.2 of TS38.141-1 |
| [**R4-2109609**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109609.zip) | Ericsson | Discussion on PUSCH demodulation with 256QAM | Proposal 1: PUSCH demodulation performance requirements for 256QAM is defined for 2, 4 and 8 Rx antennas.Proposal 2: For different antenna configurations, the existing test applicability rule defined in clause 8.1.2.0 of TS38.141-1 is reused.Proposal 3: Only 1 layer is considered for the PUSCH demodulation performance requirements for 256QAM.Proposal 4: Only 1 Tx antenna is considered for the PUSCH demodulation performance requirements for 256QAM.Proposal 5: A small set of bandwidths for each SCS, i.e. 5/10MHz for 15kHz SCS and 10/40MHz for 30kHz SCS, can be defined for the PUSCH demodulation performance requirements for 256QAM.Proposal 6: The applicability rules for different SCS and CBW can be reused for the PUSCH demodulation performance requirements for 256QAM.Proposal 7: For 256QAM, the PUSCH demodulation performance requirements is defined based on MCS#24. |
| [**R4-2109610**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109610.zip) | Ericsson | Simulation results for PUSCH demodulation with 256QAM | Simulation results |
| [**R4-2109712**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109712.zip) | NTT DOCOMO, INC. | Views on FR1 PUSCH 256QAM | Number of RxObservation 1: The number of Rx are 2/4/8 for PUSCH with transform precoding disabled for 64QAM.Observation 2: 4Rx is typical configuration. If there is no requirement for 4Rx, 4Rx base stations would be tested with only 2Rx based on the existing applicability rules.Proposal 1: RAN4 consider 2/4/8 as the number of Rx (Option 2).SCS and bandwidthObservation 3: 15kHz SCS for 20MHz CBW and 30kHz SCS for 100MHz CBW are also typical cases.Observation 4: A wider bandwidth requires more data to be sent at the same time, which increases the amount of processing required and increases the load compared to a narrower bandwidth.Proposal 2: For FR1 PUSCH 256QAM performance tests, RAN4 should consider the following combinations of SCS and CBW (Option 2 for both 15kHz SCS and 30kHz SCS):* 15kHz SCS: 5MHz, 10MHz, 20MHz CBW
* 30kHz SCS: 10MHz, 20MHz, 40MHz and 100MHz CBW

Applicability rule for different antenna connectorProposal 3: RAN4 reuse the existing test applicability rule defined in clause 8.1.2.0 of TS38.141-1 as an applicability rule for different antenna connector (Option 1).Applicability rules for different SCS and CBWProposal 4: RAN4 reuse the existing test applicability rules defined in sections 8.1.2.1.1 and 8.1.2.1.2 of TS 38.141-1 as applicability rules for different SCS and CBW (Option 1). |
| [**R4-2109794**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109794.zip) | Samsung | View on PUSCH demodulation requirement with FR1 256QAM | Proposal 1: Only define FR1 PUSCH 256QAM requirement with DMRS configuration 1+1. Proposal 2: Only define FR1 PUSCH 256QAM requirement with 1 Tx and 1 layerProposal 3: Only define FR1 PUSCH 256QAM requirement with 2Rx and 8RxProposal 4: Only define FR1 PUSCH 256QAM requirement with 5MHz and 10MHz for 15 KHz SCS, and 10MHz and 40MHz for 30 KHz SCS.Proposal 5: Reuse the existing test applicability rule defined in clause 8.1.2.0 of TS 38.141-1 for different antenna configuration, and reuse the existing test applicability rule defined in section 8.1.2.1.1 and 8.1.2.1.2 of TS 38.141-1 for different SCS and BW.Proposal 6: Do not configure PTRS for PUSCH requirement with 256QAM in FR1Proposal 7: Do not model phase noise modelling for ideal simulation results, the PN impact can be considered in the implementation margin.Observation 1: large performance degradation can be observed with considering TxEVM as 3.5% with MCS 24. Proposal 8: Additional margin should be considered for performance requirement derived for FR1 256QAM PUSCH |
| [**R4-2110569**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2110569.zip) | Huawei, HiSilicon | Discussion on PUSCH demodulation requirements for FR1 256QAM | Proposal 1: We propose the following configurations:Number of Tx: 1.Number of Rx: 2/8Rx.Number of layer: 1.Proposal 2: We propose to define SCS and bandwidth of 10 MHz/15 kHz and 40 MHz/30 kHz for PUSCH 256QAM.Proposal 3: We propose to reuse the existing test applicability rule for different antenna configurations.Proposal 4: We propose to reuse the existing test applicability rule for different SCS and CBW. Proposal 5: We propose to use MCS22. |
| [**R4-2110593**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2110593.zip) | Nokia, Nokia Shanghai Bell | On PUSCH demodulation requirements for FR1 256QAM | Concerning MCS1. Using MCS24 the SNR requirements are >20dB, even for the rank1 only cases.
2. RAN4 to use MCS22 in order to keep SNR requirements within reasonable levels.

Concerning DM-RS3 DM-RS (i.e., addPos=2) does not offer signification performance improvements over 2 DM-RS but reduces absolute TPUT.1. RAN4 to only have requirements for DM-Rs 1+1 (addPos=1).

Concerning PT-RSPhase noise has a limited impact on 256QAM FR1 performance (<0.3dB for all tested cases). The “puncturing losses” from configuring PT-RS configuration (K=2, L=1) overwhelm the gains from PN compensation.1. RAN4 to not configure PT-RS in FR1 256QAM.

Phase noise impact consideration and Tx EVM1. RAN4 to take PN models into account for final impaired results.

A 3.5% EVM limits the max achievable SNR to approx. 29.1dB, but has little performance impact below this threshold, which is not in line with the PN performance impact observed in our simulations.1. RAN4 to not use TxEVM to approximate PN.

Concerning layersUsing 2 layers increases the SNR requirements up to 36 dB and 32dB, for MCS 24 and MCS22 respectively1. RAN4 to not cover 2 layer requirements to keep SNR requirements in testable and practical ranges.

Concerning number of TX/RX1. RAN4 to cover 1/2 TX and 2/4/8 RX

TDD pattern impactThe difference between the aligned TDD pattern and FDD, in terms of performance requirements, is negligible.CBWs1. RAN4 to include CBWs 5MHz, 10MHz and 20MHz for 15kHZ, and 10MHz, 20MHz, 40MHz and 100MHz, for 30kHz.
 |
| [**R4-2110594**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2110594.zip) | Nokia, Nokia Shanghai Bell | Simulation results for PUSCH demodulation requirements for FR1 256QAM | Simulation results |
| [**R4-2110994**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2110994.zip) | ZTE Wistron Telecom AB | Demodulation performance requirements for NR PUSCH 256QAM | Proposal 1: Take Option 2 for the number of Tx in order to include 2Tx configuration.Proposal 2: Take Option 2 for the number of Rx, number of layers, SCS and bandwidth.Proposal 3: Take Option 1 to reuse existing applicability rules for antenna configurations and SCS and CBW. |

## Open issues summary

In this section, test parameters for PUSCH 256QAM demodulation performance requirements will be discussed.

*Open issues and candidate options before e-meeting:*

### MCS

*The agreement in last RAN4#98-bis-e as captured in the approved WF R4-2106120:*

*MCS: Evaluate {MCS24, MCS22} as starting point for next meeting, based on the simulation results to decide if MCS24 is feasible, otherwise to check lower MCS22 is feasible or not.*

**Issue 1: MCS**

* Proposals
	+ Option 1: MCS 22 (CATT, Huawei, Nokia)
	+ Option 2: MCS 24 (CTC, Ericsson)
* Recommended WF
	+ Both conducted and radiated performance requirements need to be defined as per the existing requirements for other modulation orders for 2Rx, testable SNR point (20dB) for OTA test needs to be considered?
	+ For conducted test, how to judge a reasonable and testable SNR point?

### Additional DM-RS

*The agreement in last RAN4#98-bis-e as captured in the approved WF R4-2106120:*

* *Additional DM-RS (dmrsAdditionalPosition): pos1, FFS pos2*
	+ *Decide based on interesting companies’ feedback for next meeting*

**Issue 2: Additional DMRS (*dmrs-AdditionalPosition*):**

* Proposals
	+ Option 1: pos1 (CATT, CTC, Intel, Samsung, Nokia)
	+ Option 2: pos1 and pos2 ()
* Recommended WF
	+ As per inputs, pos1 for additional DMRS configuration is agreeable

### PT-RS configuration

*The agreement in last RAN4#98-bis-e as captured in the approved WF R4-2106120:*

* *PT-RS configuration: FFS configure PT-RS.*
	+ *Further discuss and decide whether to configure PT-RS or not based on feedback from interesting companies in next meeting.*

**Issue 3: PT-RS configuration**

* Proposals
	+ Option 1: Not configure PT-RS (CATT, CTC, Intel, Samsung, Nokia)
	+ Option 2:
* Recommended WF
	+ As per inputs, not configure PT-RS is agreeable.

### Phase noise modelling

*The agreement in last RAN4#98-bis-e as captured in the approved WF R4-2106120:*

* *Phase Noise modelling:*
	+ *Realistic phase noise modelling is left up to the contributing entities.*
	+ *FFS how to consider phase noise impact based on further discussion and evaluations.*
	+ *Interesting company is welcome to do investigation on the PN impact on 256QAM performance for next meeting.*

**Issue 4: Phase noise modelling**

* Proposals
	+ Option 1: Not consider phase noise impact for performance requirement definition (CTC, Intel)
	+ Option 2: Consider PN impact for final impaired results (Samsung, Nokia)
* Recommended WF
	+ As per companies’ evaluation, phase noise has very minor performance impact for FR1 PUSCH 256QAM, recommend not to consider it for performance requirement definition. Whether consider it in the impairment results, it is up to company?

### Tx EVM

*The agreement in last RAN4#98-bis-e as captured in the approved WF R4-2106120:*

* *Tx EVM:*
	+ *Interesting companies are welcome to check the performance difference with and without Tx EVM (3.5% as baseline) impact considered.*
	+ *RAN4 will discuss and decide whether additional margin should be considered in alignment results if no Tx EVM modelling in next meeting as per the evaluations results.*

**Issue 5: Tx EVM**

* Proposals
	+ Option 1: Consider 3.5%Tx EVM modelling for alignment results (Intel)
	+ Option 2: Consider Tx EVM impact by additional margin for performance requirement derivation (Samsung)
	+ Option 3: Not use TxEVM to approximate PN (Nokia)
* Recommended WF
	+ TBD

### Number of Tx, Rx and layer

*The agreement in last RAN4#98-bis-e as captured in the approved WF R4-2106120:*

* *Number of Tx:*
	+ *Option 1: Only 1Tx*
	+ *Option 2: Both 1Tx and 2Tx*
* *Number of Rx:*
	+ *Option 1: 2/8 Rx*
	+ *Option 2: 2/4/8 Rx*
* *Number of layers:*
	+ *Option 1: Only 1 layer*
	+ *Option 2: Both of 1 and 2 layers*
* *Applicability rule for different antenna configurations*
	+ *Option 1: Reuse the existing test applicability rule defined in clause 8.1.2.0 of TS38.141-1*
	+ *Other options*

**Issue 6: Number of Tx**

* Proposals
	+ Option 1: Only 1Tx (CATT, Intel,Ericsson, Samsung, Huawei)
	+ Option 2: Both 1Tx and 2Tx (CTC, CMCC, Nokia, ZTE)
* Recommended WF
	+ TBD

**Issue 7: Number of layer**

* Proposals
	+ Option 1: Only 1 layer (CATT, Intel, Ericsson, Samsung, Huawei, Nokia)
	+ Option 2: Both 1 layer and 2 layers (CTC, CMCC, ZTE)
* Recommended WF
	+ Moderator’s observation: as per the evaluations shared by one company (R4-2110593), very high SNR is required for 2 layers.

**Issue 8: Number of Rx**

* Proposals
	+ Option 1: 2/8 Rx (Intel, Samsung, Huawei)
	+ Option 2: 2/4/8 Rx (CATT, CTC, CMCC, Ericsson, DCM, Nokia, ZTE)
* Recommended WF
	+ Moderator’s observation:
	+ There is very huge simulation campion conducted for NR Rel-15 performance requirements for different CBW/SCS combinations, 1Tx/2Tx, 2/4/8Rx, PUSCH mapping Type A/B, different MCS 4/16/20, about several hundreds of simulation results. If companies carefully check the existing requirements defined in TS 38.104, there is minor performance difference for different CBW/SCS.
	+ Only performance requirements for typical CBW/SCS combinations are defined for NR UE demodulation requirements
	+ The total simulation efforts will be PUSCH mapping Type A/B, 1Tx/2Tx, 2/4/8Rx, 1layer/2layers, 5/10/20MHz/15kHz SCS, 10/20/40/100MHz/30kHz SCS, 216 simulation cases for one MCS, very heavy simulation burden for all companies?

**Issue 9: Applicability rule for different antenna configurations**

* Proposals
	+ Option 1: Reusing the existing test applicability rule defined in *cl*ause 8.1.2.0 of TS38.141-1 with 2/4/8 Rx agreed. (CATT, CTC, CMCC, Ericsson, DCM, ZTE)
	+ Option 2: Reusing the existing test applicability rule defined in *cl*ause 8.1.2.0 of TS38.141-1 with 2/8 Rx agreed. (Samsung, Huawei)
	+ Option 3: (Intel) with 2/8 Rx agreed,

BS with higher than 8 receive antennas: Reuse applicability rule in clause 8.1.2.0 of TS38.141-1.

BS with higher 4 receive antennas: Unless otherwise stated, for a BS supporting 4 antenna connectors (for BS type 1-C) or TAB connectors (for BS type 1-H), the performance requirement tests for 2 RX antennas shall apply, and the specific connectors used for testing are based on manufacturer declaration.

* Recommended WF
	+ Discuss this open issue after Issue 6/7/8 are concluded

### SCS and bandwidth

*The agreement in last RAN4#98-bis-e as captured in the approved WF R4-2106120:*

* *SCS and bandwidth*
	+ *15kHz SCS:*
* *Option 1:5MHz and 10MHz*
* *Option 2: 5MHz, 10MHz and 20MHz.*
	+ *30kHz SCS*
* *Option 1:10MHz and 40MHz*
* *Option 2:10MHz, 20MHz, 40MHz and 100MHz.*
* *Applicability rules for different SCS and CBW*
	+ *Option 1:  Reuse the existing applicability rules defined in sections 8.1.2.1.1 and 8.1.2.1.2 of TS 38.141-1*
	+ *Other options*

**Issue 10: SCS and bandwidth**

* Proposals
	+ 15kHz SCS:
* Option 1: 5MHz and 10MHz (Intel, Ericsson, Samsung, Huawei)
* Option 2: 5MHz, 10MHz and 20MHz (CATT, CTC, CMCC, DCM, Nokia, ZTE)
	+ 30kHz SCS:
* Option 1: 10MHz and 40MHz (Intel, Ericsson, Samsung, Huawei)
* Option 2: 10MHz, 20MHz, 40MHz and 100MHz (CATT, CTC, CMCC, DCM, Nokia, ZTE)
* Recommended WF
	+ TBD

**Issue 11: Applicability rules for different SCS and CBW**

* Proposals
	+ Option 1: Reuse the existing applicability rules defined in 8.1.2.1.1 and 8.1.2.1.2 in TS 38.141-1 (CATT, CTC, Intel, CMCC, Ericsson, DCM, Samsung, Huawei, ZTE)
* Recommended WF
	+ Moderator’s observation: either options for different SCS and CBW are agreed, the existing applicability rule can be reused.

### MU and TT

*New issue is raised for this meeting.*

**Issue 12: MU and TT for 256QAM PUSCH tests in TS 38.141-1:**

* Proposals
	+ Option 1: Reuse the existing MU and TT values for PUSCH demodulation test cases defined in TS38.141-1 (CTC)
* Recommended WF
	+ How about the MU and TT for tests in TS 38.141-2 if radiated tests are agreed to define?

### Performance requirements for FDD and TDD with different TDD patterns

*New issue is raised for this meeting.*

**Issue 13: Applicability of performance requirements for FDD and TDD with different TDD patterns**

* Proposals
	+ Option 1: The difference between the aligned TDD patterns and FDD, in terms of performance requirements, is negligible. One set of performance requirements can be defined for FDD and TDD with different TDD patterns. (Nokia)
* Recommended WF
	+ Moderator: based on the evaluation from Nokia in this meeting and the similar evaluations for other modulation orders did for NR Rel-15, this is feasible.

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
| **Sub-topic#** | **Status summary**  |
| **Sub-topic #1: MCS** | *Tentative agreements:**Candidate options:** Option 1: MCS 22 (Samsung, CATT, Huawei, Nokia, Ericsson, ZTE)
* Option 2: MCS 24 (CTC)
* Option 3: MCS 20 or MCS 21 if there is testability issue for OTA test (Samsung)

*Recommendations for 2nd round:* Continue discussion in the 2nd round* Whether both conducted and OTA testing need to be considered? One company commented to consider conducted testing only like LTE did
* If consider OTA testing, what is the feasible SNR point for BS type 1-O testing in Rel-17, still 20dB like agreed for NR Rel-15 BS performance requirements? TE vendors’ feedback is needed.
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| **Sub-topic #2: Additional DM-RS** | *Tentative agreements: all interesting companies are OK to only consider additional DM-RS configuration pos1 (i.e. DM-RS 1+1)**Pos1* |
| **Sub-topic #3: PT-RS configuration** | *Tentative agreements:* Not configure PT-RS |
| **Sub-topic #4: Phase Noise modelling** | *Tentative agreements:** *Not consider explicit phase noise modelling in the alignment results.*
* *The phase noise impact can be included in the impairment results, but it is left up to companies.*
 |
| **Sub-topic #5: Tx EVM** | *Tentative agreements:**Candidate options:** Option 1: Consider 3.5%Tx EVM modelling for alignment results (Intel)
* Option 2: Consider Tx EVM impact in the impairment results
	+ Option 2a: add a certain margin on top of the averaged impairment results (Samsung)
	+ Option 2b: consider it in the impaired results submitted by companies (Nokia)
* Option 3: Not consider Tx EVM impact if the target SNR is 20dB or less (CTC, ZTE, Ericsson)

*Recommendations for 2nd round:** Continue discussion in the 2nd round
* As per Option 3, this issue discussion is related to the MCS and the target SNR value.
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| **Sub-topic #6: Number of Tx, Rx and layer, the corresponding test applicability rule** | *Tentative agreements:** Number of layer: Only 1 layer

*Candidate options:*Number of Tx- Option 1: Only 1Tx (CATT, Intel, Ericsson, Samsung, Huawei, CTC, CMCC, ZTE) - Option 2: Both 1Tx and 2Tx (Nokia)Issue 8: Number of Rx- Option 1: 2/8 Rx (Intel, Samsung, Huawei)- Option 2: 2/4/8 Rx (CATT, CTC, CMCC, Ericsson, DCM, Nokia, ZTE, Intel)*Recommendations for 2nd round:*As per the first discussion and based on majority’s view, moderator would like to propose the following way forward, it can be confirmed by companies in the 2nd round discussion:* Number of Tx: Only 1Tx
* Number of Rx: 2/4/8 with reusing the existing test applicability rule for testing of supported different number of Rx antenna
 |
| **Sub-topic #7: SCS and bandwidth and test applicability rule** | *Tentative agreements:*Reuse the existing applicability rules defined in 8.1.2.1.1 and 8.1.2.1.2 in TS 38.141-1 for different SCS and bandwidth combination.*Candidate options:*15kHz SCS: - Option 1: 5MHz and 10MHz (Intel, Ericsson, Samsung, Huawei, Nokia, ZTE) - Option 2: 5MHz, 10MHz and 20MHz (CATT, CTC, CMCC, DCM, Nokia, ZTE)30kHz SCS: - Option 1: 10MHz and 40MHz (Intel, Ericsson, Samsung, Huawei, Nokia, ZTE) - Option 2: 10MHz, 20MHz, 40MHz and 100MHz (CATT, CTC, CMCC, DCM, Nokia, ZTE)*Recommendations for 2nd round:** Continue discussion in the 2nd round
* Companies are welcome to check the performance difference for different channel bandwidths defined for NR Rel-15
* Simulation burden can be considered by companies for the sake of progress
 |
| **Sub-topic #8: MU and TT** | *Tentative agreements:*Reuse the existing MU and TT values for PUSCH demodulation test cases defined in TS 38.141-1, but with square brackets for TE vendors’ checking.*Candidate options:* None*Recommendations for 2nd round:* None |
| **Sub-topic #9: Performance requirements for FDD and TDD with different TDD patterns** | *Tentative agreements:*One set of performance requirements can be defined for FDD and TDD with different TDD patterns.*Candidate options:* None*Recommendations for 2nd round:* None |

## Discussion on 2nd round

### Open issues summary

Continue discussion on those left open issues after the 1st round email discussion.

#### Performance requirements for BS type 1-O with 2Rx

**Issue 2-4-1: Performance requirements for *BS type 1-O* with 2Rx**

* Proposals
	+ Option 1: Both conducted and radiated performance requirements need to be defined
	+ Option 2: Only define conducted performance requirements
* Recommended WF
	+ Moderator: NR Rel-15 defined both conducted and radiated performance requirements for *BS type 1-O* with 2Rx

#### MCS

**Issue 2-4-2: MCS**

* Proposals
	+ Option 1: MCS 22 (Samsung, CATT, Huawei, Nokia, Ericsson, ZTE)
	+ Option 2: MCS 24 (CTC)
	+ Option 3: MCS 20 or MCS 21 if there is testability issue for OTA test (Samsung)
* Recommended WF
	+ If RAN4 agrees to define both conducted and radiated performance requirements for *BS type 1-O* for 2Rx as discussed in Issue 1-5-1, maybe the OTA testability issue needs to be considered like discussed for NR Rel-15 PUSCH performance requirements.
	+ If consider OTA testing, what is the feasible SNR point for *BS type 1-O* testing in Rel-17, still 20dB like agreed for NR Rel-15 BS performance requirements? TE vendors’ feedback is highly appreciated.
	+ If consider 20dB or other SNR points for OTA testability, simulations for MCS 20 ~ MCS 24 may be needed to find a feasible MCS value?, or
	+ Do not consider the testability issue, choose MCS 22 for performance requirements definition?

#### Tx EVM

**Issue 2-4-3: Tx EVM**

* Proposals
	+ Option 1: Consider 3.5%Tx EVM modelling for alignment results (Intel)
	+ Option 2: Consider Tx EVM impact in the impairment results
		- Option 2a: add a certain margin on top of the averaged impairment results (Samsung)
		- Option 2b: consider it in the impaired results submitted by companies (Nokia)
	+ Option 3: Not consider Tx EVM impact if the target SNR is 20dB or less (CTC, ZTE, Ericsson)
* Recommended WF
	+ Consider Option 3, this issue is related to Issue 1-5-2 MCS

#### Number Tx, Rx and CBW/SCS

**Issue 2-4-4: Number of Tx**

* Proposals
	+ Option 1: Only 1Tx (CATT, Intel, Ericsson, Samsung, Huawei, CTC, CMCC, ZTE)
	+ Option 2: Both 1Tx and 2Tx (Nokia)
* Recommended WF
	+ TBD

**Issue 2-4-5: Number of Rx**

* Proposals
	+ Option 1: 2/8 Rx (Intel, Samsung, Huawei)
	+ Option 2: 2/4/8 Rx (CATT, CTC, CMCC, Ericsson, DCM, Nokia, ZTE, Intel)
* Recommended WF

**Issue 2-4-6: SCS and bandwidth**

* Proposals
	+ 15kHz SCS:
* Option 1: 5MHz and 10MHz (Intel, Ericsson, Samsung, Huawei, Nokia, ZTE)
* Option 2: 5MHz, 10MHz and 20MHz (CATT, CTC, CMCC, DCM, Nokia, ZTE)
	+ 30kHz SCS:
* Option 1: 10MHz and 40MHz (Intel, Ericsson, Samsung, Huawei, Nokia, ZTE)
* Option 2: 10MHz, 20MHz, 40MHz and 100MHz (CATT, CTC, CMCC, DCM, Nokia, ZTE)
* Recommended WF
	+ Considering the simulation burden and minor performance difference between different SCS and bandwidth combination, to move forward, moderator would like to companies give your compromise and recommend the following WF:
		- Tx: Only 1Tx
		- Rx: 2/4/8 Rx
		- SCS and bandwidth:
			* 15kHz SCS: 5MHz and 10MHz
			* 30kHz SCS: 10MHz and 40MHz

#### Applicability for different antenna configurations

**Issue 2-4-7: Applicability rule for different antenna configurations**

Moderator recommendation:

- If companies agree to define performance requirements for 2/4/8 Rx as discussed for Issue 2-4-5: Number of Rx, reuse the existing test applicability rule defined in clause 8.1.2.0 of TS 38.141-1 is feasible.

- Firstly focus on Issue 2-4-5: Number of Rx. Discuss this issue after agreement is reached for Issue 2-4-5.

## Summary for 2nd round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
| **Sub-topic#** | **Status summary**  |
| **Sub-topic #1: Performance requirements for BS type 1-O with 2Rx** | *Tentative agreements:*Define both conducted and radiated performance requirements for BS type 1-O with 2Rx  |
| **Sub-topic #2: MCS** | *Tentative agreements: None**Candidate options:** Option 1: MCS 22
* Option 2: MCS 24
* Option 3: MCS 20 or MCS 21 if there is testability issue for OTA test

*Recommendations for next meeting:* Companies are not sure whether 20dB OTA testability limitation is still applicable to NR Rel-17.TE vendors’ feedback is highly appreciated to confirm the OTA test limitation.Further discussion is needed based on the evaluations on MCS 20, MCS 21, MCS 22 and MCS 24 for next meeting |
| **Sub-topic #3: Tx EVM** | *Tentative agreements:**Candidate options:** Option 1: Consider 3.5%Tx EVM modelling for alignment results (Intel, Samsung)
* Option 2: Consider 3.5% Tx EVM impact in the impairment results
	+ Option 2a: add a certain margin on top of the averaged impairment results (Samsung, Intel)
	+ Option 2b: consider it in the impaired results submitted by companies (Nokia)
* Option 3: Not consider 3.5% Tx EVM impact if the target SNR is 20dB or less (CTC, ZTE, Ericsson, CATT, Samsung)
* Option 4: Not consider 3.5% Tx EVM impact if the target SNR is [20-29] dB or less (CTC)

*Recommendations for next meeting:** Whether consider Tx EVM impact can based on the selected MCS and SNR point that is lower or higher than 20dB for next meeting
* Most companies are OK to not consider Tx EVM if MCS 20 or MCS 21 is selected and the target SNR with impairment is less than 20dB.
 |
| **Sub-topic #6: Number of Tx, Rx and channel bandwidth/SCS** | *Tentative agreements:*Number of Tx: Only 1 TxNumber Rx: 2/4/8 with reusing the existing test applicability rule for testing of supported different number of Rx antennaCBW/SCS* 15kHz SCS:
* 5MHz and 10MHz
* FFS 20MHz
* 30kHz SCS:
* 10MHz and 40MHz
* FFS 20MHz and 100MHz
 |

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on FR1 PUSCH 256QAM performance requirements | Huawei, HiSilicon |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-210xxxx | 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** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-2108667 | WF on FR1 PUSCH 256QAM performance requirements | Huawei, HiSilicon | Agreeable |  |

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