**3GPP TSG-RAN WG4 Meeting # 98-e R4-2103763**

**Electronic Meeting, 25 Jan – 5 Feb., 2021**

**Agenda item:** 7.9.4

**Source:** Moderator (Samsung)

**Title:** Email discussion summary for [98e][324] NR\_eMIMO\_Demod

**Document for:** Information

# Introduction

The scope of this email discussion, mainly focuses to finalize the requirements for identified performance requirements include demodulation and CSI, and introduce corresponding requirement into specifications

List of candidate target of email discussion for 1st round and 2nd round

* 1st round: finalize the remaining test parameters and introduce corresponding requirement into specifications
* 2nd round: Focus on the CRs to finish the WI in this meeting

# Topic #1: PDSCH demodulation

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2100210 | Apple | CR for applicability rule  |
| R4-2100211 | Apple | Simulation results for multi-DCI (eMBB) |
| R4-2100898 | Samsung | Simulation results for single-DCI (eMBB) |
| R4-2100899 | Samsung | Simulation results for multi-DCI (eMBB) |
| R4-2100900(need to be revised) | Samsung | Simulation results for single-DCI (URLLC) |
| R4-2100903 | Samsung | Simulation result summary for PDSCH requirement and CSI requirement |
| R4-2101256 | Intel | Simulation results for single-DCI (eMBB) |
| R4-2101257 | Intel | Simulation results for multi-DCI (URLLC) |
| R4-2101258 | Intel | Simulation results for single-DCI (URLLC) |
| R4-2101259 | Intel, Samsung, Ericsson , Huawei, HiSilicon | CR for single-DCI based multi-TRP repetition scheme |
| R4-2101312 | Huawei, HiSilicon | Simulation results for multi-DCI (eMBB) |
| R4-2101313 | Huawei, HiSilicon | Simulation results for single-DCI (eMBB) |
| R4-2101314 | Huawei, HiSilicon | Simulation results for single-DCI (URLLC) |
| R4-2101315 | Huawei, HiSilicon, Ericsson, Intel, Samsung | CR for single-DCI based multi-TRP for eMBB |
| R4-2101316 | Huawei, HiSilicon | CR for multi-DCI based multi-TRP for eMBB |
| R4-2101448 | Ericsson, Huawei, HiSilicon Intel ,Samsung | FRC for PDSCH requirement |
| R4-2101449 | Ericsson | Correction of simulation assumption for PDSCH requirement single-DCI/multi-DCI based  |
| R4-2101450 | Ericsson | Simulation results for single-DCI (eMBB) |
| R4-2101451 | Ericsson | Simulation results for multi-DCI (eMBB) |
| R4-2101452 | Ericsson | Simulation results for single-DCI (URLLC) |
| R4-2102083 | MTK | Simulation results for multi-DCI (eMBB) |

## Open issues summary

Last RAN4 meeting agreements the WF R4-2017529

List of open issues

* Sub-Topic 1-1: General
	+ Issue 1-1-1: FRC for single-DCI for FDM scheme A
	+ Issue 1-1-2: FRC for single-DCI for inter-slot TDM scheme
	+ Issue 1-1-3: Abbreviation of TRP in 38.101-4
* Sub-topic 1-2: Test parameters Correction for PDSCH requirement
	+ Issue 1-2-1: Antenna port index for FDM scheme A
	+ Issue 1-2-2: Antenna port index for inter-slot TDM scheme
* Sub-topic 1-3: Requirement of PDSCH demodulation
	+ Issue 1-3-1: Simulation results summary
	+ Issue 1-3-1: Requirements definition for 38.101-4

### Sub-topic 1-1: General

**Issue 1-1-1: FRC for single-DCI for FDM scheme A**

* Proposals
	+ Option 1: Add a note in FRC of single-DCI for FDM scheme A to clarify the TBS determinate
	+ Option 2: TBA
* Recommended WF
	+ Encourage feedback from companies for solution of FRC definition for FDM scheme A

**Issue 1-1-2: FRC for single-DCI for inter-slot TDM scheme**

* Proposals
	+ Option 1: Apply the same FRC table as Rel-16 URLLC aggregation factor 2, with additional note to differentiate Rel-16 URLLC with single TRP transmission and Rel-16 NR eMIMO with single-DCI based inter-slot TDM scheme as
* Option 1a: Note 4: Throughput is calculated under assumption of repetition number 2 (Samsung)
* Option 1b: Note 3: Throughput is calculated under assumption of aggregation factor 2 or repetition number 2 depending on Tx scheme (Intel, Samsung )
	+ Option 2: TBA
* Recommended WF
	+ Encourage feedback from companies for additional note for FRC with Table A.3.2.1.1-11 for FDD and Table A.3.2.2.2-16 for TDD in 38.101-4 spec.

As indicated in 38.214 spec, if a UE is configured with higher layer parameter repetitionNumber or if the UE is configured by repetitionScheme set to one of ' fdmSchemeA', ' fdmSchemeB' and 'tdmSchemeA', the UE does not expect to be configured with pdsch-AggregationFactor. Therefore, aggregation factor is not available for UE with inter slot-TDM scheme

**Issue 1-1-3: Abbreviation of TRP in 38.101-4**

* Proposals
	+ Option 1: Modify TRP to TRxP, and add the abbreviation into the subclause 3.3 of 38.101-4 spec as “Transmission and Reception Point”
	+ Option 2: TBA
* Recommended WF
	+ Encourage feedback from companies. To avoid the confusion with TRP (Total Radiated Power) in RAN4 RF spec, whether to use another terminology for “TRP”.

From RAN1 spec, “multi-TRP” is not used in 38.214, while it was aligned with RAN1 NR eMIMO UE feature group and used in 38.331 spec for UE capability indication.

### Sub-topic 1-2: Test parameters Correction for PDSCH requirement

**Issue 1-2-1: Antenna port index for FDM scheme A**

* Proposals
	+ Option 1: {1000, 1001} DMRS antenna port index for TCI state #1 and TCI state #2
* Recommended WF
	+ Option 1. Based on offline checking, the same DMRS ports are indicated in DCI for both TRPs for sDCI-based URLLC transmission schemes. Option 1 is the correction of agreement in the last meeting, confirmed by companies before meeting.

**Issue 1-2-2: Antenna port index for inter-slot TDM scheme**

* Proposals
	+ Option 1: {1000} DMRS antenna port for TCI state #1 and TCI state #2
* Recommended WF
	+ Option 1. Based on offline checking, the same DMRS ports are indicated in DCI for both TRPs for sDCI-based URLLC transmission schemes. Option 1 is the correction of agreement in the last meeting, confirmed by companies before meeting.

### Sub-topic 1-3: Requirement of PDSCH demodulation

Alignment and impairment summary for PDSCH demodulation requirement for single DCI/multi-DCI based multi-TRP transmission, based on summary of R4-2100903. The detail simulation cases can be referred R4-2017530

**Issue 1-3-1: Simulation results summary**

* Proposals

Table 1: alignment results

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Schemes and reference point | Simulation case  | Samsung | Intel | Huawei | Ericsson | MTK | QC | Apple | AVG | SPAN |
| Multi-DCI SDM schemeSNR [dB] at 70% TP | 1-1 (FDD 2Rx) | 16.7 | 17.1 | 18.78 | 16.4 | 18.41 |  | 18 | 17.43167 | 2.01 |
| 1-2 (FDD 4Rx) | 11.6 | 11 | 11.85 | 10.4 | 11.85 |  | 11.9 | 11.29833 | 1.5 |
| 2-1 (TDD 2Rx) | 16.2 | 17.1 | 18.4 | 16.9 |  |  | 17.6 | 17.08 | 1.4 |
| 2-2 (TDD 4Rx) | 11.7 | 11 | 11.87 | 10.6 |  |  | 11.5 | 11.172 | 1.1 |
| Single-DCI SDM scheme (Test 1a)SNR [dB] at 70% TP | 3-1 (FDD 2Rx) | 16.4 | 15.2 | 17.75 | 14.2 |  |  |  | 15.69 | 2.76 |
| 3-2 (FDD 4Rx) | 10.7 | 8.9 | 11.59 | 7.9 |  |  |  | 9.5725 | 2.89 |
| 4-1 (TDD 2Rx) | 16 | 14.9 | 17.59 | 15.1 |  |  |  | 15.705 | 1.92 |
| 4-2 (TDD 4Rx) | 10.4 | 8.9 | 11.47 | 8.2 |  |  |  | 9.5475 | 2.49 |
| Single-DCI SDM scheme (Test 1b)SNR [dB] at 70% TP | 3-1 (FDD 2Rx) | 15.7 | 16.6 | 17.46 | 13.2 |  |  |  | 15.16667 | 3.4 |
| 3-2 (FDD 4Rx) | 9.8 | 10 | 11.28 | 6.9 |  |  |  | 8.9 | 3.1 |
| 4-1 (TDD 2Rx) | 15.1 | 16 | 17.31 | 13.6 |  |  |  | 14.9 | 2.4 |
| 4-2 (TDD 4Rx) | 9.6 | 9.6 | 11.18 | 7.1 |  |  |  | 8.766667 | 2.5 |
| Single-DCI based FDM Scheme ASNR [dB] at 70% TP | 5-1 (FDD 2Rx) | 15 | 15.1 | 　 | 13.3 |  |  |  | 12.3 | 6.6 |
| 5-2 (FDD 4Rx) | 9 | 8.1 | 　 | 6.9 |  |  |  | 6.633333 | 3.2 |
| 6-1 (TDD 2Rx) | 15.2 | 14.8 | 　 | 13.2 |  |  |  | 12.13333 | 6.4 |
| 6-2 (TDD 4Rx) | 7.9 | 7.7 | 　 | 6.6 |  |  |  | 6.466667 | 2.6 |
| Single-DCI based inter-slot TDM SchemesSNR [dB] with 1% BLER | 7-1 (FDD 2Rx) | 0.1 | 0.5 | -1.2 | -0.6 |  |  |  | -0.3 | 1.7 |
| 7-2 (FDD 4Rx) | -2.9 | -3.1 | -5.3 | -5 |  |  |  | -4.075 | 2.4 |
| 8-1 (TDD 2Rx) | -0.4 | 0.7 | -1 | -1.1 |  |  |  | -0.45 | 1.8 |
| 8-2 (TDD 4Rx) | -3.5 | -2.9 | -5.8 | -5.7 |  |  |  | -4.475 | 2.9 |

Table 2: impairment results

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Schemes and reference point | Simulation case  | Samsung | Intel | Huawei | Ericsson | MTK | QC | Apple | AVG | Extra Margin | Requirement  |
| Multi-DCI SDM schemeSNR [dB] at 70% TP | 1-1 (FDD 2Rx) | 19.2 | 19.6 | 20.78 | 18.4 | [20.41] |  | 20 | 19.68167 | 0.8 | 20.1 |
| 1-2 (FDD 4Rx) | 14.1 | 13.5 | 13.85 | 12.4 | [13.85] |  | 13.9 | 13.54833 | 0.8 | 14.3 |
| 2-1 (TDD 2Rx) | 18.7 | 19.6 | 20.4 | 18.9 |  |  | 19.6 | 19.38 | 0.8 | 20.2 |
| 2-2 (TDD 4Rx) | 14.2 | 13.5 | 13.87 | 12.6 |  |  | 13.5 | 13.472 | 0.8 | 14.3 |
| Single-DCI SDM scheme (Test 1a)SNR [dB] at 70% TP | 3-1 (FDD 2Rx) | 18.9 | 17.7 | 19.75 | 16.2 |  |  |  | 18.065 | 0.8 | 18.9 |
| 3-2 (FDD 4Rx) | 13.2 | 11.4 | 13.59 | 9.9 |  |  |  | 11.9475 | 0.8 | 12.7 |
| 4-1 (TDD 2Rx) | 18.5 | 17.4 | 19.59 | 17.1 |  |  |  | 18.08 | 0.8 | 18.9 |
| 4-2 (TDD 4Rx) | 12.9 | 11.4 | 13.47 | 10.2 |  |  |  | 11.9225 | 0.8 | 12.7 |
| Single-DCI SDM scheme (Test 1b)SNR [dB] at 70% TP | 3-1 (FDD 2Rx) | 18.2 | 19.1 | 19.46 | 15.2 |  |  |  | 17.5 | 0.8 | 18.3 |
| 3-2 (FDD 4Rx) | 12.3 | 12.5 | 13.28 | 8.9 |  |  |  | 11.23333 | 0.8 | 12.0 |
| 4-1 (TDD 2Rx) | 17.6 | 18.5 | 19.31 | 15.6 |  |  |  | 17.23333 | 0.8 | 18.0 |
| 4-2 (TDD 4Rx) | 12.1 | 12.1 | 13.18 | 9.1 |  |  |  | 11.1 | 0.8 | 11.9 |
| Single-DCI based FDM Scheme ASNR [dB] at 70% TP | 5-1 (FDD 2Rx) | 17 | 17.1 | 　 | 15.3 |  |  |  | 14.46667 | 0.8 | 15.3 |
| 5-2 (FDD 4Rx) | 11 | 10.1 | 　 | 8.9 |  |  |  | 8.8 | 0.5 | 9.3 |
| 6-1 (TDD 2Rx) | 17.2 | 16.8 | 　 | 15.2 |  |  |  | 14.3 | 0.5 | 14.8 |
| 6-2 (TDD 4Rx) | 9.9 | 9.7 | 　 | 8.6 |  |  |  | 8.633333 | 0.5 | 9.1 |
| Single-DCI based inter-slot TDM SchemesSNR [dB] with 1% BLER | 7-1 (FDD 2Rx) | 2.6 | 2.5 | 0.8 | 1.4 |  |  |  | 1.825 | 0.5 | 2.3 |
| 7-2 (FDD 4Rx) | -0.4 | -1.1 | -3.3 | -3 |  |  |  | -1.95 | 0.5 | -1.5 |
| 8-1 (TDD 2Rx) | 2.1 | 2.7 | 1 | 0.9 |  |  |  | 1.675 | 0.5 | 2.2 |
| 8-2 (TDD 4Rx) | -1 | -0.9 | -3.8 | -3.7 |  |  |  | -2.35 | 0.5 | -1.9 |

* Recommended WF
	+ Encouraged companies to double check whether your results are captured correctly or not in summary and excel files based on companies’ contribution. If there is something wrong, the results summary will be updated based on results summary excel file.

**Issue 1-3-1: Requirements definition for 38.101-4**

* Proposals
	+ Option 1: SNR = average of IM results +extra margin
* extra margin
* 64QAM 0.8 dB
* 16QAM 0.5 dB
* Recommended WF
	+ Define tentative SNR requirements for the agreed test cases as much as possible and update CR including SNR requirements for test cases with []
	+ Introduce requirement as table summarized for test cases which the ideal results span among companies’ results within [2.5dB] (mark with blue colour), using the same extra margin values
	+ For test cases which the span among companies’ results larger [2.5dB] (mark with yellow colour) further checking the details of simulation assumptions and results and extra margin cases by cases if needed
	+ MTK: Please indicate the impairment results for test 1-1 and 1-2 with FDD
	+ Encourage interested companies to double check your simulation results, if there is any issue identified, companies can update the simulation results in this meeting
	+ Encourage interested companies to check whether have a plan to update your results or provide new results in this meeting or future RAN4 meeting?

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Company | **Sub-Topic 1-1: General*** Issue 1-1-1: FRC for single-DCI for FDM scheme A
* Issue 1-1-2: FRC for single-DCI for inter-slot TDM scheme
* Issue 1-1-3: Abbreviation of TRP in 38.101-4

**Sub-topic 1-2: Test parameters Correction for PDSCH requirement*** Issue 1-2-1: Antenna port index for FDM scheme A
* Issue 1-2-2: Antenna port index for inter-slot TDM scheme

**Sub-topic 1-3: Requirement of PDSCH demodulation*** Issue 1-3-1: Simulation results summary
* Issue 1-3-2: Requirements definition for 38.101-4
 |
| Ericsson | **Sub-Topic 1-1: General*** Issue 1-1-1: FRC for single-DCI for FDM scheme A
* Issue 1-1-2: FRC for single-DCI for inter-slot TDM scheme
* Issue 1-1-3: Abbreviation of TRP in 38.101-4

We think these issues are related to CRs. **Sub-topic 1-2: Test parameters Correction for PDSCH requirement*** Issue 1-2-1: Antenna port index for FDM scheme A
* Issue 1-2-2: Antenna port index for inter-slot TDM scheme

We think these issues are related to CRs. **Sub-topic 1-3: Requirement of PDSCH demodulation*** Issue 1-3-1: Simulation results summary

Issue 1-3-2: Requirements definition for 38.101-4The sheet ‘R4-21xxxx\_Simulation results summary for Rel-16 eMIMO WI\_v0’ captures our simulation results.Basically we support the option 1, but need double check after collecting all the simulation results in the 1st round.  |
| Huawei | **Sub-Topic 1-1: General*** Issue 1-1-1: FRC for single-DCI for FDM scheme A
* Issue 1-1-2: FRC for single-DCI for inter-slot TDM scheme
* Issue 1-1-3: Abbreviation of TRP in 38.101-4

**Sub-topic 1-2: Test parameters Correction for PDSCH requirement*** Issue 1-2-1: Antenna port index for FDM scheme A

Support recommended WF* Issue 1-2-2: Antenna port index for inter-slot TDM scheme

Support recommended WF**Sub-topic 1-3: Requirement of PDSCH demodulation*** Issue 1-3-1: Simulation results summary

We have updated our simulation results on the summary sheet. * Issue 1-3-2: Requirements definition for 38.101-4

We are ok with the way of adding extra margin (Option1). But companies need to further check and find a way to deal with the possible huge gap among companies’ results on some of the cases. |
| Intel | **Sub-Topic 1-1: General*** Issue 1-1-1: FRC for single-DCI for FDM scheme A

In general, we think it is enough to have TBS determination procedure in RAN1 spec. Same time we are fine to add some clarification note if companies have strong preference.* Issue 1-1-2: FRC for single-DCI for inter-slot TDM scheme

No need to add additional notes in FRC tables. Based on offline discussion, in CR for inter-slot TDM requirements the parameter “PDSCH aggregation factor” should be changed to “PDSCH repetition number”. In this case it is better to modify Note 3 in RMCs for inter-slot TDM scheme from “Throughput is calculated under assumption of aggregation factor 2” to “Throughput is calculated under assumption of aggregation factor 2 **or repetition number 2 depending on Tx scheme**”* Issue 1-1-3: Abbreviation of TRP in 38.101-4

Agree, but it should be also changed in CR for applicability rule.**Sub-topic 1-2: Test parameters Correction for PDSCH requirement*** Issue 1-2-1: Antenna port index for FDM scheme A
* Issue 1-2-2: Antenna port index for inter-slot TDM scheme

**Sub-topic 1-3: Requirement of PDSCH demodulation*** Issue 1-3-1: Simulation results summary
* Issue 1-3-2: Requirements definition for 38.101-4

We are fine with recommended WF. Same time we need to discuss how to resolve large span in single-DCI based scheme.  |
| Qualcomm | Issue 1-3-2: We are ok with the proposed margins. We will try to provide preliminary results in this meeting but we will probably have to update our results in the next meeting. |
| Apple | **Sub-Topic 1-1: General****Issue 1-1-1 , 1-1-2**We should distinguish between single TRP and multi TRP transmission in the FRC tables, otherwise it is very confusing and unclear. **Issue 1-1-2: FRC for single-DCI for inter-slot TDM scheme** For TDM scheme A we need not specify repetition factor in our understanding. TDM Sceme A is intra-slot repetition, but we are defining requirements for inter-slot TDM in my understanding. **Issue 1-1-3: Abbreviation of TRP in 38.101-4**We are fine with option 1. **Sub-topic 1-2: Test parameters Correction for PDSCH requirement**Issue 1-2-1, 1-2-2We are fine with the recommended WF.**Sub-topic 1-3: Requirement of PDSCH demodulation****Issue 1-3-1: Requirements definition for 38.101-4**We are fine with the margins. We don’t plan to update any results in this meeting and may bring in results for single DCI schemes in the next meeting. |
| Samsung | **Sub-Topic 1-1: General*** Issue 1-1-1: FRC for single-DCI for FDM scheme A

If companies have the same understanding for TBS determination for FDM scheme A based on RAN1 spec, we are fine either with or without additional note.@appleFor FRC table, it is defined per DCI, nor per TRP. For FDM scheme and inter-slot/SDM, it is scheduled by single-DCI. Therefore, one FRC should be clear. As for multi-DCI transmission, two FRC is defined in current CR, considered it is scheduled by two DCI.* Issue 1-1-2: FRC for single-DCI for inter-slot TDM scheme

@apple, we agree to reuse FRC table defined for Rel-16 URLLC with aggregation level 2 for inter-slot TDM scheme, considering same assumption for resource allocation are used. While, different with URLLC WI, for UE is configured is configured with higher layer parameter repetitionNumber or if the UE is configured by repetitionScheme set to one of ' fdmSchemeA', ' fdmSchemeB' and 'tdmSchemeA', the UE does not expect to be configured with pdsch-AggregationFactor. Therefore, aggregation factor is not available for UE with inter slot-TDM scheme, we prefer to make some modification, we are also fine with intel’s proposal to modified the existing note* Issue 1-1-3: Abbreviation of TRP in 38.101-4

We are fine with the abbreviation of TRP with instead of TRxP **Sub-topic 1-2: Test parameters Correction for PDSCH requirement*** Issue 1-2-1: Antenna port index for FDM scheme A
* Issue 1-2-2: Antenna port index for inter-slot TDM scheme

We are fine with the recommended WF**Sub-topic 1-3: Requirement of PDSCH demodulation*** Issue 1-3-1: Simulation results summary

Our simulation results has been updated and uploaded in the excel file, we will ask the tdoc revision to update our results * Issue 1-3-2: Requirements definition for 38.101-4

We are fine with the recommend WF to requirement definition.For SNR requirement, we can discuss the large span case by case after 1st round simulation collection. |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2100210(CR to 38.101-4 for eMIMO demod requirements - General and Applicability rule) | Intel: TRP abbreviation should be changed on TRxP if we agree on it. |
| Apple: Will update it to TRxP following the changes in other CRs. |
|  |
| R4-2101259(CR to TS 38.101-4: Performance requirements single-DCI based multi-TRP Repetition Tx schemes) | Samsung: For inter-slot TDM scheme, as indicated in spec, in case of As indicated in 38.214 spec, if a UE is configured with higher layer parameter repetitionNumber or if the UE is configured by repetitionScheme set to one of ' fdmSchemeA', ' fdmSchemeB' and 'tdmSchemeA', the UE does not expect to be configured with pdsch-AggregationFactor. Therefore, aggregation factor is not available for UE with inter slot-TDM schemeWe suggest to modify the PDSCH aggregation factor as to repetition number in table 5.2.2.1.14-2/5.2.2.2.14-2/5.2.3.1.14-2/5.2.3.2.14-2 Regarding the PRB bundling size, we suggest o change “WB” to “wideband” for FDM schemeA |
| Company B |
|  |
| R4-2101315(CR for 38.101-4 Introduction of PDSCH requirement with Single-DCI based SDM scheme) | Company A |
| Company B |
| Intel: “PDSCH aggregation factor” for Inter-slot TDM simulation assumption should be changed to “PDSCH repetition number”.  |
| R4-2101316(CR for 38.101-4 Introduction of PDSCH requirement with Multi-DCI based multi-TRP transmission schemes) | Company A |
| Company B |
| Qualcomm: Number of TRS ports should be 1 for 2Rx FDD and TDD. |
| R4-2101448(CR: FRC for eMIMO sDCI/mDCI-based PDSCH transmission) | Ericsson: Wrong PRB numbers for R.PDSCH.1-3.3 FDD and R.PDSCH.1-3.4 FDD in Table A.3.2.1.1-3: Note 3:        PDSCH is scheduled in PRB numbers from 0 to 25.Note 4:        PDSCH is scheduled in PRB numbers from 26 to 51.  |
| Samsung: The PDSCH is scheduled in PRB numbers from 0 to 26 for TRP 1 and from 27 to 51 should be changed as 0 to 25 and 26 to 51 in Table A.3.2.1.1-3:And The PDSCH is scheduled in PRB numbers from 0 to 52 for TRP 1 and from 53 to 106 for TRP 2 should be changed as 0 to 52 and 53 to 105 in Table A.3.2.2.2-3:For inter-slot TDM scheme, we agree to apply the same FRC with Rel-16 URLLC WI. While, some additional note should be added to differentiate Rel-16 URLLC WI and NR eMIMO, since aggregation factor is not available for inter-slot TDM based on RAN1 spec. Therefore, we suggest to the modification in Table A.3.2.1.1-11: PDSCH Reference Channel for FDD and Table A.3.2.2.2-16: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-1 with additional note as Note 3: Throughput is calculated under assumption of aggregation factor 2.Note 4: Throughput is calculated under assumption of repetition number 2We are also fine Intel’s proposal as Note 3: Throughput is calculated under assumption of aggregation factor 2 or repetition number 2 depending on Tx scheme |
|  |

## 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.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic#1** | *The agreement make during GTW session** Issue 1-1-1: FRC for single-DCI for FDM scheme A

Agreement:It’s RAN4 common understanding, TBS determination for FRC of single DCI FDM scheme A based on full resource allocation BW.-FFS for how to introduce the test set-up into specification with clear differentiation of multi-TRP and single-TRP, companies will further discuss based on drafting CR * Issue 1-1-2: FRC for single-DCI for inter-slot TDM scheme

Throughput is calculated under assumption of aggregation factor 2 for URLLC slot aggregation schemes or repetition number 2 for inter-slot repetition scheme.* Issue 1-3-1: Requirements definition for 38.101-4
	+ SNR = average of IM results +extra margin
* extra margin
* 64QAM 0.8 dB
* 16QAM 0.5 dB

Companies are encouraged to further align the results and aims to introduce requirements with SNR values in [ ] in this meeting, Further update the results and the values in future RAN4 meetings not excluded. * Issue 1-1-3: Abbreviation of TRP in 38.101-4

*Tentative agreements:*Modify TRP to TRxP, and add the abbreviation into the subclause 3.3 of 38.101-4 spec as “Transmission and Reception Point”*Recommendations for 2nd round:** + Update the CR based on this abbreviation of TRP
* Issue 1-2-1: Antenna port index for FDM scheme A

*Tentative agreements:*{1000, 1001} DMRS antenna port index for TCI state #1 and TCI state #2* Issue 1-2-2: Antenna port index for inter-slot TDM scheme

*Tentative agreements:*{1000} DMRS antenna port for TCI state #1 and TCI state #2 |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 | WF on NR eMIMO demodulation and CSI requirements | Samsung |
|  |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| R4-2100210 | *to be revised* * TRP abbreviation should be changed on TRxP
 |
| R4-2101259 | *to be revised* * modify the PDSCH aggregation factor as to repetition number in table 5.2.2.1.14-2/5.2.2.2.14-2/5.2.3.1.14-2/5.2.3.2.14-2;
* suggest to change “WB” to “wideband” for FDM schemeA based on 38.331
* update the requirement with [] based on simulation summary
 |
| R4-2101315 | *To be revised** update the requirement with [] based on simulation summary
 |
| R4-2101316 | *to be revised** update the number of TRS ports should be 1 for 2Rx FDD and TDD
* update the requirement with [] based on simulation summary
 |
| R4-2101448 | *to be revised** update the RB allocation for multi-DCI based on TRP in FRC table,
* update the note defined in FRC table for URLLC
* FFS for how to introduce the test set-up into specification with clear differentiation of multi-TRP and single-TRP, companies will further discuss based on drafting CR
 |
| R4-2101449(correction of simulation assumption for PDSCH) | *agreeable* |
| R4-2100900 (Samsung) | *to be revised** including the updated simulation results
 |
| R4-2101313(Huawei) | *to be revised** including the updated simulation results
 |
| New Tdoc request(Qualcomm) | *New Tdoc Request** Simulation results for single and multi-DCI based transmission scheme
 |

## Discussion on 2nd round (if applicable)

**Issue 1-3-1: Simulation results summary**

Alignment and impairment summary for PDSCH demodulation requirement for single DCI/multi-DCI based multi-TRP transmission, based on summary of R4-2100903. The detail simulation cases can be referred R4-2017530

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Schemes and reference point | Simulation case  | Samsung | QC | Huawei | Ericsson | MTK | Apple | Intel | AVG | SPAN |
| Multi-DCI SDM schemeSNR [dB] at 70% TP | 1-1 (FDD 2Rx) | 16.7 | 17.7 | 18.78 | 16.4 | 18.41 | 18 | 17.1 | 17.58429 | 2.38 |
| 1-2 (FDD 4Rx) | 11.6 | 12.16 | 11.85 | 10.4 | 11.85 | 11.9 | 11 | 11.53714 | 1.76 |
| 2-1 (TDD 2Rx) | 16.2 | 18 | 18.4 | 16.9 |  | 17.6 | 17.1 | 17.36667 | 2.2 |
| 2-2 (TDD 4Rx) | 11.7 | 12.16 | 11.87 | 10.6 |  | 11.5 | 11 | 11.47167 | 1.56 |
| Single-DCI SDM scheme (Test 1a)SNR [dB] at 70% TP | 3-1 (FDD 2Rx) | 16.4 | 17.16 | 17.75 | 14.2 |  |  | 15.2 | 16.142 | 3.55 |
| 3-2 (FDD 4Rx) | 10.7 | 12 | 11.59 | 7.9 |  |  | 8.9 | 10.218 | 4.1 |
| 4-1 (TDD 2Rx) | 16 | 17.63 | 17.59 | 15.1 |  |  | 14.9 | 16.244 | 2.73 |
| 4-2 (TDD 4Rx) | 10.4 | 12.09 | 11.47 | 8.2 |  |  | 8.9 | 10.212 | 3.89 |
| Single-DCI SDM scheme (Test 1b)SNR [dB] at 70% TP | 3-1 (FDD 2Rx) | 15.7 | 　 | 17.46 | 13.2 |  |  | 16.6 | 15.74 | 4.26 |
| 3-2 (FDD 4Rx) | 9.8 | 　 | 11.28 | 6.9 |  |  | 10 | 9.495 | 4.38 |
| 4-1 (TDD 2Rx) | 15.1 | 　 | 17.31 | 13.6 |  |  | 16 | 15.5025 | 3.71 |
| 4-2 (TDD 4Rx) | 9.6 | 　 | 11.18 | 7.1 |  |  | 9.6 | 9.37 | 4.08 |
| Single-DCI based FDM Scheme ASNR [dB] at 70% TP | 5-1 (FDD 2Rx) | 15 | 15.68 | 　 | 13.3 |  |  | 15.1 | 14.77 | 2.38 |
| 5-2 (FDD 4Rx) | 9 | 9.38 | 　 | 6.9 |  |  | 8.1 | 8.345 | 2.48 |
| 6-1 (TDD 2Rx) | 15.2 | 　 | 　 | 13.2 |  |  | 14.8 | 14.4 | 2 |
| 6-2 (TDD 4Rx) | 7.9 | 　 | 　 | 6.6 |  |  | 7.7 | 7.4 | 1.3 |
| Single-DCI based inter-slot TDM SchemesSNR [dB] with 1% BLER | 7-1 (FDD 2Rx) | 0.1 | 　 | -1.2 | -0.6 |  |  | 0.5 | -0.3 | 1.7 |
| 7-2 (FDD 4Rx) | -2.9 | 　 | -5.3 | -5 |  |  | -3.1 | -4.075 | 2.4 |
| 8-1 (TDD 2Rx) | -0.4 | 　 | -1 | -1.1 |  |  | 0.7 | -0.45 | 1.8 |
| 8-2 (TDD 4Rx) | -3.5 | 　 | -5.8 | -5.7 |  |  | -2.9 | -4.475 | 2.9 |

Observation:

* + For the test cases with multi-DCI SDM schemes, the results can be aligned well with span [2.5dB]
	+ For the test cases with single-DCI based FDM scheme A and inter-slot TDM schemes, the results can be aligned with span [2.5dB], excepting for case 8-2, the span is [2.9dB]
	+ For the test cases with single-DCI SDM scheme, the results have large span than [2.5dB]
* Recommended WF

Encourage interested companies to double check your simulation results for the test cases which ideal results span among companies’ results larger than [2.5dB] (remarked as yellow), if there is any issue identified, companies can update the simulation results in this meeting (Deadline Wednesday 11pm UTC, Feb.3)

**Issue 1-3-2: Requirements definition for 38.101-4**

* Proposals
	+ Option 1:
* For the test cases which ideal results span among companies’ results within [2.5dB] based on the simulation summary updated in this meeting (Deadline Wednesday 11pm UTC, Feb.3), introduce requirements with SNRs in [] in this meeting based on agreed SNR definition
* For the test cases which ideal results span among companies’ results larger than [2.5dB] based on the simulation summary updated in this meeting (Deadline Wednesday 11pm UTC, Feb.3), the results farthest from the AVERAGE value are taken out for the AVERAGE and SPAN (re-)calculation until the ideal span within [2.5dB]. The AVERAGE impairment results with corresponding ideal span with [2.5dB] can be used for requirements with SNRs in [] in this meeting based on agreed SNR definition.
* Further update the results and the values in future RAN4 meetings not excluded.
* Recommended WF
	+ Considering the targeting of this meeting aims to finish the demodulation requirement of eMIMO WI, introduce requirements with SNR values in [ ] in this meeting, further update the results and the values in future RAN4 meetings not excluded.

**R4-2103826 CR to 38.101-4 for eMIMO demod requirements - General and Applicability rule**

 *Type: CR For: Agreement
 38.101-4 v16.3.0 CR-0128 Cat: B (Rel-16)

 Source: Apple*

**Discussion:**

[report of discussion]

**Decision: Return to.**

**R4-2103830 CR: FRC for eMIMO sDCI/mDCI-based PDSCH transmission**

 *Type: CR For: Agreement
 38.101-4 v16.3.0 CR-0159 Cat: B (Rel-16)

 Source: Ericsson, Huawei, HiSilicon, Intel, Samsung*

**Abstract:**

This CR provides the FRCs used for sDCI/mDCI-based PDSCH transmission.

**Discussion:**

[report of discussion]

**Decision: Return to.**

**R4-2103828 CR for 38.101-4 Introduction of PDSCH requirement with Single-DCI based SDM scheme**

 *Type: CR For: Agreement
 38.101-4 v16.3.0 CR-0147 Cat: B (Rel-16)

 Source: Huawei, HiSilicon*

**Discussion:**

[report of discussion]

**Decision: Return to.**

**R4-2103829 CR for 38.101-4 Introduction of PDSCH requirement with Multi-DCI based multi-TRP transmission schemes**

 *Type: CR For: Agreement
 38.101-4 v16.3.0 CR-0148 Cat: B (Rel-16)

 Source: Huawei, HiSilicon*

**Discussion:**

[report of discussion]

**Decision: Return to.**

**R4-2103827 CR to TS 38.101-4: Performance requirements single-DCI based multi-TRP Repetition Tx schemes**

 *Type: CR For: Agreement
 38.101-4 v16.3.0 CR-0143 Cat: B (Rel-16)

 Source: Intel Corporation, Samsung, Ericsson, Huawei, HiSilicon*

**Discussion:**

[report of discussion]

**Decision: Return to.**

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |
| R4-2103826 | *Agreeable* |
| R4-2103830 | *Agreeable**With minor typo for “*Throughtput*” and “*repettion*”, it can be fixed in the next meeting*Note 4: Throughtput is calculated under assumption of repettion number 2 in Table A.3.2.2.2-16 |
| R4-2103828 | *Agreeable* |
| R4-2103829(revised to R4-2103986) | *To be revised* *There is no agreement for scaling factor for multi-DCI* Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2 with scaling factor as 1/sqrt(2) for transmitted signal from each TRxP |
| R4-2103827 | *Agreeable* |
| R4-2103825 | *Need to check the view of companies during GTW session.* |

# Topic #2: CSI requirements (Rel-16 Type II codebook)

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2100212 | Apple | Proposal 1: Define PMI reporting requirements with eType II codebook at 90% Max TP |
| R4-2100585 | Nokia | Observation 1: A Type I precoder represented in eType II format is characterised by: constant envelope, spatial beam symmetry between polarisations, phase symmetry between layers and layer orthogonalityObservation 2: A Type I PMI obtained with codebookMode=1 can be represented in eType II format. A Type I PMI obtained with codebookMode=2 can only be represented in eType II format if the beam selected in the cluster is the same for all subbands, in which case codebookMode=2 boils down to codebookMode=1.Observation 3: A rank-2 eType II PMI corresponds to a Type I SP PMI if the following conditions are fulfilled* Only one frequency domain component per nonzero beam is nonzero and has amplitude coefficient 1 (nonzero beams have constant unit amplitude for all subbands)
* Only one and the same beam for each polarisation is nonzero, for each layer.
* The phase coefficients in the weaker polarisations are in opposition and are associated to the same FD component index

These conditions can be verified, for example, by checking that: * $K^{NZ}=4$ (2 nonzero coefficients per layer, one per polarisation)
* $i\_{2,3,l}=[\begin{matrix}15&15\end{matrix}]$, for $l=1,2$ (reference amplitude for the weaker polarisation is 1, hence the nonzero coefficient in the weaker polarisation is also 1)
* $k\_{l,(i\_{l}^{\*}+L) mod 2L,f}^{(3)}=1$, for $l=1,2$, and one value of $f\in \{0,1,…,M\_{ν}-1\}$ (the nonzero beams in the two polarisation are the same for each layer and the corresponding nonzero coefficient is in the same FD component index $f$ for both layers
* $c\_{1,\left(\left⌊\frac{i\_{1}^{\*}}{L}\right⌋+1\right)mod 2,f}=\left(c\_{2,\left(\left⌊\frac{i\_{2}^{\*}}{L}\right⌋+1\right)mod 2,f}+8 \right)mod 16$, (phase coefficients in the weaker polarisation are in opposition in the two layers)

Observation 4: If the total number of reported nonzero coefficients in eType II PMI is $K^{NZ}\geq 2ν$, there are not enough nonzero coefficients to ensure that all polarisations are active, hence these PMI reports should not be considered as valid.Proposal 1: Introduce a performance requirement for eType II PMI reporting that $K^{NZ}\geq 2ν$, for any rank $ν=1,2,3,4$ Proposal 2: Introduce an additional test requirement in performance testing if $K^{NZ}=4$. In this case a UE fails the test if all the following conditions are satisfied with probability $p>ϵ$ (for example: $ϵ=10^{-3}$)* $i\_{2,3,l}=[\begin{matrix}15&15\end{matrix}]$, for $l=1,2$
* $k\_{l,(i\_{l}^{\*}+L) mod 2L,f}^{(3)}=1$, for $l=1,2$, and one value of $f\in \{0,1,…,M\_{ν}\}$
* $c\_{1,\left(\left⌊\frac{i\_{1}^{\*}}{L}\right⌋+1\right)mod 2,f}=\left(c\_{2,\left(\left⌊\frac{i\_{2}^{\*}}{L}\right⌋+1\right)mod 2,f}+8 \right)mod 16$
 |
| R4-2102282 | Nokia | Not available  |
| R4-2100622 | Qualcomm | Proposal 1: Use 90% test point for defining Enhanced Type II reporting tests casesObservation 1: There is a significant difference in throughput rations when following enhanced Type II vs Type I codebooksProposal 2: Use the test metric of throughput ratio between following eType 2 and random Type I for defining Enhanced Type II PMI reporting tests and no need to check whether UE reported codebook is not only within Type I codebook setProposal 3: Use XP Medium correlation for defining Enhanced Type II PMI reporting tests |
| R4-2100896(Revised to R4-2102938) | Samsung | CR for introduce etype II codebook requirement  |
| R4-2100901 | Samsung | Observation 1: The performance gap between following eType II and Type I is more obvious under MIMO-Medium correlation compared with MIMO-Custom Low correlationObservation 2: The performance gap between eType II and Type I is larger under 70% relative TP points compared to 90% and 95% relative TP pointsObservation 3: There is obvious performance gap between eType II and Type I to discriminate UE behaviour under current test set-up under XP-Medium correlation * The SNR gap is 7dB around between following PMI with eType II and following PMI with Type I at 70%, 90% and 95% relative TP points
* The performance under 90% relative TP point is more stable to introduce requirements
* The relative TP ratio at 90% at points:
	+ Type I (following Type I PMI /random Type I PMI): For FDD mode, TP gain is 2.0 around; TDD mode TP gain is 1.8 around;
	+ eType II (following eType II PMI /random Type I PMI): For FDD mode, TP gain is 6.0 around; TDD mode TP gain is 4.0 around

Observation 4: There is enough performance gap between eType II and Type I with current agreed test set-up, MIMO correlation (XP Medium) and test metric (relative TP ratio with following eTypeII /random Type I); and it’s feasible to introducing proper test requirements to ensure UE reporting eTypeII properly i.e. UE reporting Type I codebook only will fail the test cases.Proposal 1: Introduce eType II codebook PMI test cases with following test set-up* SU-MIMO set-up
* MIMO correlation : XP-Medium
* Test metric: following eType II PMI/random PMI with Type I codebook
* Test point : 90% Relative TP ratio with following PMI (slight preference), 70% acceptable

Proposal 2: Introduce following test requirements (with 90% relative TP point assumption)* FDD mode: 2Rx, 3.0; 4Rx, 3.0
* TDD mode: 2Rx, 2.5; 4Rx, 2.5
 |
| R4-2101310 | Huawei, HiSilicon | Observation 1: There is enough performance difference among the results while using test metric of eType II PMI follow PMI/Type I random PMIProposal 1: Use 95% maximum throughput to be the test point for eType II codebook |
| R4-2101311 | Huawei, HiSilicon | Simulation results for PMI with eType II |
| R4-2101443 | Ericsson | Simulation results for PMI with eType II |
| R4-2101444 | Ericsson | Proposal 1: Define performance requirements with eType II codebook using low antenna correlationProposal 2: Set the SNR test point 70% of the maximum throughput with followed eType-II PMI reporting where the gain ratio should be calculated Proposal 3: Set the required throughput ratio larger than **γType-I, i.e.,**

|  |  |  |
| --- | --- | --- |
|  | 2Rx | 4Rx |
| FDD  | 2.5 | 1.9 |
| TDD | 2.8 | 1.9 |

 |

## Open issues summary

Last RAN4 meeting agreements captured in WF R4-2017531

List of open issues

* Sub-topic 2-1: Test parameters for eType II codebook
	+ Issue 2-1-1: Test Metric
	+ Issue 2-1-2: MIMO Correlation
	+ Issue 2-1-3: Test point
	+ Issue 2-1-4: gamma value

### Sub-topic 2-1: Test parameters for eType II codebook

**Issue 2-1-1: Test Metric for eType II codebook**

* Proposals
	+ Option 1: Only introduce relative TP between following eType-II/random PMI with Type I codebook (Samsung, Huawei, Ericsson, QC, Apple)
	+ Option 2 (Nokia): Besides relative TP ratio, introduce one additional test metric as following
* Introduce a performance requirement for eType II PMI reporting that $K^{NZ}\geq 2ν$,, for any rank V= 1,2,3,4
* Introduce an additional test requirement in performance testing if$ K^{NZ}=4$. In this case a UE fails the test if all the following conditions are satisfied with probability p>ϵ (for example $ϵ=10^{-3}$)
* $i\_{2,3,l}=[\begin{matrix}15&15\end{matrix}]$**, for** $l=1,2$
* $k\_{l,(i\_{l}^{\*}+L) mod 2L,f}^{(3)}=1$**, for** $l=1,2$**, and one value of** $f\in \{0,1,…,M\_{ν}\}$
* $c\_{1,\left(\left⌊\frac{i\_{1}^{\*}}{L}\right⌋+1\right)mod 2,f}=\left(c\_{2,\left(\left⌊\frac{i\_{2}^{\*}}{L}\right⌋+1\right)mod 2,f}+8 \right)mod 16$
* Recommended WF

The performance for eType II codebook is summarized in following tables (5 companies provided results) in this meeting.

**Note:**

TP ratio 1: following eType II PMI/random Type I PMI

TP ratio 2: following Type I PMI/random Type I PMI

**XP medium**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Antenna configuration | Company | SNR Point [dB 90% max TP] | Gamma [90% max TP] | SNR Point [dB 70% max TP] | Gamma [70% max TP] |
| eType II | Type I | TP ratio1 | TPratio 2 | eType II | Type I | TP ratio1 | TP ratio 2 |
| 16Tx / 2Rx FDD | Samsung | 6.3 | 13.2 | 6.5 | 2.1 | 3.5 | 9.4 | 18 | 2.55 |
| QC |  |  | 6.12 | 2.19 |  |  |  |  |
| Huawei | 7.48 |  | 7.4 | 2.1 | 5.84 |  | 217 |  |
| Ericsson | 10.1 | 15.8 | 2.3 | 1.5 | 6.3 | 11 | 2.9 | 1.6 |
| Apple | 9.53 | 14.58 | 3.4 | 2.01 |  |  |  |  |
| Minimum TP raio1 / maximum TP ratio 2  |  |  | 2.3 | 2.19 |  |  | 2.9 | 2.55 |
| 16Tx / 4RxFDD | Samsung | 2.6 | 8.8 | 6.05 | 2.01 | 0.9 | 6.8 | 8.45 | 1.93 |
| QC |  |  | 3.69 | 2.12 |  |  |  |  |
| Huawei | 4.45 |  | 7.1 | 2.12 | 2.99 |  | 108.5 |  |
| Ericsson | 5.8 | 9.1 | 2.3 | 1.7 | 3.4 | 6.6 | 2.4 | 1.6 |
| Apple | 7.05 | 9.71 | 2.85 | 2.11 |  |  |  |  |
| Minimum TP raio1/maximum TP ratio2 |  |  | 2.3 | 2.12 |  |  | 2.4 | 1.93 |
| 16Tx / 2RxTDD | Samsung | 6.7 | 13.2 | 4.05 | 1.83 | 3.3 | 10 | 10.25 | 1.86 |
| QC |  |  | 4.18 | 2.05 |  |  |  |  |
| Huawei | 7.49 |  | 5.8 | 2.2 | 6.09 |  | 336 |  |
| Ericsson | 7.3 | 10.5 | 3 | 2.2 | 4.6 | 8.2 | 5.5 | 2.1 |
| Apple | 9.41 | 14.33 | 3.49 | 2.03 |  |  |  |  |
| Minimum TP ratio1/Maximum TP ratio 2 |  |  | 3 | 2.2 |  |  | 5.5 | 2.1 |
| 16Tx / 4RxTDD | Samsung | 3 | 9.1 | 4.15 | 1.76 | -0.1 | 6.9 | 17.98 | 1.7 |
| QC |  |  | 3.1 | 2.01 |  |  |  |  |
| Huawei | 4.77 |  | 5.73 | 2.3 | 3.46 |  | 224 |  |
| Ericsson | 3.8 | 5.2 | 2.4 | 2.2 | 2.1 | 2.9 | 2.8 | 2.3 |
| Apple | 6.4 | 8.94 | 3 | 2.31 |  |  |  |  |
| Minimum TP ratio 1/Maximum TP ratio 2 |  |  | 2.4 | 2.31 |  |  | 2.8 | 2.3 |

**XP low**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Antenna configuration | Company | SNR Point [dB 90% max TP] | Gamma [90% max TP] | SNR Point [dB 70% max TP] | Gamma [70% max TP] |
| eType II | Type I | TP ratio1 | TP ratio 2 | eType II | Type I | TP ratio1 | TP ratio 2 |
| 16Tx / 2Rx FDD | Samsung | 7.8 | 10.8 | 3.46 | 2.37 | 4.6 | 7.9 | 8.74 | 2.62 |
| QC |  |  | 4.01 | 2.16 |  |  |  |  |
| Huawei |  |  |  |  |  |  |  |  |
| Ericsson | 9.7 | 11.9 | 2.1 | 1.7 | 5.9 | 8.6 | 2.8 | 1.7 |
| Apple |  |  |  |  |  |  |  |  |
| Minimum TP raio1/maximum TP ratio2 |  |  | 2.1 | 2.37 |  |  | 2.8 | 2.62 |
| 16Tx / 4RxFDD | Samsung | 3.8 | 6 | 3.19 | 2.32 | 1.8 | 3.19 | 4.3 | 2.3 |
| QC |  |  | 2.62 | 2.02 |  |  |  |  |
| Huawei |  |  |  |  |  |  |  |  |
| Ericsson | 5.8 | 8.7 | 2.1 | 1.6 | 3.7 | 6.0 | 2.2 | 1.6 |
| Apple |  |  |  |  |  |  |  |  |
| Minimum TP raio1/maximum TP ratio2 |  |  | 2.1 | 2.32 |  |  | 2.2 | 2.3 |
| 16Tx / 2RxTDD | Samsung | 8.9 | 11.1 | 2.35 | 1.83 | 5.2 | 8.0 | 3.20 | 1.98 |
| QC |  |  | 2.89 | 1.93 |  |  |  |  |
| Huawei |  |  |  |  |  |  |  |  |
| Ericsson | 7.2 | 9.1 | 2.4 | 2.0 | 4.6 | 6.6 | 3.1 | 2.0 |
| Apple |  |  |  |  |  |  |  |  |
| Minimum TP raio1/maximum TP ratio2 |  |  | 2.35 | 2.0 |  |  | 3.1 | 2.0 |
| 16Tx / 2RxTDD | Samsung | 3.8 | 7.6 | 2.74 | 1.78 | 1.78 | 5.4 | 3.42 | 1.74 |
| QC |  |  | 2.16 | 1.84 |  |  |  |  |
| Huawei |  |  |  |  |  |  |  |  |
| Ericsson | 4.0 | 5.8 | 2.2 | 1.7 | 2.3 | 3.4 | 2.2 | 1.8 |
| Apple |  |  |  |  |  |  |  |  |
| Minimum TP raio1/maximum TP ratio2 |  |  | 2.16 | 1.84 |  |  | 2.2 | 1.8 |

Result observations

From the simulation results from all the companies’ results, we can see that eType II show enough performance gap over than Type I with test metric of TP ratio between following eType II and random Type I, which is enough to discriminate UE behaviour to ensure proper UE processing for eType II.

Therefore, it is feasible to introduce proper test requirements to ensure UE reporting eType II properly, i.e UE reporting Type I codebook only will fail the test cases. There is no need additional test metric to check UE reported codebook not only within Type I codebook set.

As recommended WF:

* + Introduce Rel-16 Type II codebook requirements only with test metric as following PMI (eType II)/Random PMI (Type I codebook)

**Issue 2-1-2: MIMO Correlation**

* Proposals
	+ Option 1: XP Medium (Samsung, QC, Apple, [Huawei], Ericsson, Nokia)
	+ Option 2: XP low (Ericsson)
* Recommended WF

From most of companies’ results, the performance gap between following eType II and Type I is more obvious under MIMO-Medium correlation compared with MIMO-Custom Low correlation. Based on majority view

As recommended WF:

* + Option 1: XP Medium

**Issue 2-1-3: Test point**

* Proposals
	+ Option 1: 70% of TP (Ericsson)
	+ Option 2: 90% of TP (Samsung, Apple, Qc, [Ericsson], Nokia, [Huawei] )
	+ Option 3: 95% of TP (Huawei)
* Recommended WF

From most of companies results submitted, the performance under 90% relative TP point is more stable to introduce requirement. Based on majority view

As recommended WF:

* + Option 2: 90% of TP

**Issue 2-1-4: gamma value**

* Proposals
	+ Option 1(Samsung, QC): With XP medium and 90% relative TP ratio point preference
* FDD
* 2Rx: 3.0
* 4Rx: 3.0
* TDD
* 2Rx: 2.5
* 4Rx: 2.5
	+ Option 2(Ericsson): With XP low and 70% relative TP ratio point preference
* FDD
* 2Rx: 2.5
* 4Rx: 1.9
* TDD
* 2Rx: 2.8
* 4Rx: 1.9
* Recommended WF

For the baseline parameter combination, i.e., Medium correlation + 90% max TP, companies provided simulation results, and the SPAN of the SNR point is quite large for some cases, e.g., 3.8 for FDD 16T2R, 4.5 for FDD 16T4R, 2.7 for TDD 16T2R and 3.4 for TDD 16T4R. Encourage companies to double check your results.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Company | **Sub-topic 2-1: Test parameters for eType II codebook*** Issue 2-1-1: Test Metric
* Issue 2-1-2: MIMO Correlation
* Issue 2-1-3: Test point
* Issue 2-1-4: gamma value
 |
| Ericsson | **Sub-topic 2-1: Test parameters for eType II codebook*** Issue 2-1-1: Test Metric

We are generally fine with Option 1. However, addressing the concern UE which employ Type-I reporting may pass the test case, the gamma (TP ratio of following eType-II and random Type-I) should be tighter than the TP ratio of following Type-I and random Type-I), which is related to Issue 2-1-4. * Issue 2-1-2: MIMO Correlation

We are fine with Option 1: XP medium.* Issue 2-1-3: Test point

First we propose to review the simulation summary after the 1st round. If we observe the enough gain of TP ratio 1 compared with TP ratio 2, we are also fine to set SNR to 90% of the maximum throughput with the followed eType-II PMI. * Issue 2-1-4: gamma value

Same comments as Issue 2-1-3. We propose to review the simulation summary after the 1st round. We propose to set gamma value tighter than TP ratio 2.  |
| Huawei | **Sub-topic 2-1: Test parameters for eType II codebook*** Issue 2-1-1: Test Metric

We prefer option 1. We have observed performance difference between eType II and Type I based on the agreed simulation assumption and test metric. Thus, it can reflect the enhancement brought by eType II codebook. In the meanwhile, candidate test metric: follow eType II TP over random eType II TP suffers from the uncertainty of random eType II implementation among companies. Another candidate test metric: follow eType II TP over follow Type I TP will mix two optional feature into one test. Thus, we choose to stick to the agreement.Besides, we don’t think it is necessary to add any restrictions or verifications into the original Type II or eType II test. First reason is that adding restrictions or verifications will make the test more complicated, which is not friendly to TE vendor. Second reason is that candidate ways of verifications (to verify whether faking the test using Type I codebook) need more time for evaluating and discussing, which will cost a lot of time. Considering we are approaching the deadline for this WI, it would be challenging to find and agreed on a verifying method in a very short time. In the same time, we can set more higher TP ratio as the required gamma value, way better than TP ratio of Type I single panel, to avoid potential faking test. * Issue 2-1-2: MIMO Correlation

Prefer XP medium. Since there is no issue has been found yet using XP medium, we prefer to stick to the previous agreement.* Issue 2-1-3: Test point

Option 2 and option 3 are both fine for us. We have updated our simulation results for 90% maximum TP. Option 2 is also fine for us since there is reasonable gap between two performances.* Issue 2-1-4: gamma value

We have updated our simulation results in the table and summary sheet. Currently, the span is quite large so it’s kind of difficult to discuss the specific required TP ratio.Encourage further checking and to see if there is a need for updating the results before starting to align. In addition, we propose to set the required throughput ratio significantly larger than γType-I. |
| Qualcomm | **Sub-topic 2-1: Test parameters for eType II codebook*** Issue 2-1-1: Test Metric

Ok with recommended WF. * Issue 2-1-2: MIMO Correlation

Ok with recommended WF. * Issue 2-1-3: Test point

Ok with recommended WF. * Issue 2-1-4: gamma value

Ok with option 1.  |
| Samsung | * Issue 2-1-1: Test Metric

In the last meeting, it was agreed to introduce an SU-MIMO setup to test performance requirements for Rel-16 eType II PMI reporting, under the condition that the test parameters, metric, requirements and procedure are such that a UE employing Type I reporting would fail the test.Regarding the test metric, we agree to use following PMI (eType II)/Random PMI (Type I codebook) (gamma values) based on the assumption that there are ensure enough performance difference over than Type I i.e. UE which employ Type I reporting will fail in the test caseBased on the simulation results, we can see that eType II show enough performance gap over than Type I with test metric of TP ratio between following eType II and random Type I, which is enough to discriminate UE behaviour to ensure proper UE processing for eType II codebookTake the baseline assumption (XP medium and 90% TP point) as example, we can observe that the minimum TP ratio with eType II following PMI/random Type I PMI is also larger than the maximum TP ratio with Type I following PMI/random Type I PMI from all the companies’ results.We think it is feasible to introduce proper test requirements to ensure UE reporting eType II properly, i.e UE reporting Type I codebook only will fail the test cases with agreed test metric in the last meeting. Regarding to introduce one additional test metric, the feasibility and complexity from performance requirement and test aspect need to be further confirmed from companies, more time is needed. It will bring the uncertainty of completing eType II codebook test cases in Rel-16 timelineGiven this meeting is the targeting to finalize the Rel-16 eMIMO WI, from rapporteur perspective, we see the risk to completion the WI in Rel-16 timeframe, if additional test metric is considered.Therefore, from the performance gap based on agreed test metric and time frame of Rel-16 eMIMO WI, we think there is no need to introduce additional test metric to check UE reported codebook not only within Type I codebook set* Issue 2-1-2: MIMO Correlation

We are ok with recommended WF Based on the simulation results, the performance gap between following eType II and Type I is more obvious under MIMO-Medium correlation compared with MIMO-Custom Low correlation* Issue 2-1-3: Test point

The performance under 90% relative TP point is more stable to introduce requirement* Issue 2-1-4: gamma value

Based on the simulation results, our proposal is close to the minimum results of TP ratio with following eType II and random Type I PMI, which means that all the UE which employ eType II can meet the requirement, is more larger then Type I. We can discuss the gamma value after 1st round simulation summary. |
| Nokia/NSB | **Sub-topic 2-1: Test parameters for eType II codebook*** Issue 2-1-1: Test Metric

To summarise the motivation behind Option 2, we proposed two verifications:* The first one applies to any eType II PMI report of rank $ν$, and it ensures the total number of reported nonzero coefficients is large enough such that all polarisations are active. If this minimal condition is not satisfied the PMI report should not be considered as valid as some polarizations are not transmitting.
* The second verification is specific to the performance test for rank 2 and it ensures that the reported PMI is not in the Type I SP subset with probability larger than $ϵ$. The conditions provided are expressed in terms of the actual indicator values (details are found in our tdoc)

The conditions are very simple to check as they are expressed in terms of indicator values received in the UCI fields. It should also be possible for other codebook experts to check relatively quickly, without need for simulations, if these verifications achieve their intended purpose.However, if all other interested companies are satisfied with Option 1, we are also fine to accept Option 1.* Issue 2-1-2: MIMO Correlation

Ok with XP Medium* Issue 2-1-3: Test point

We are fine with the majority view of Option 2* Issue 2-1-4: gamma value

We agree with Ericsson and Huawei in setting the required throughput ratio significantly larger than TP ratio 2, after further cross checks of results. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2100896(Revised to R4-2102938)(Introduction of PMI test cases with Rel-16 eType II codebook) | Company A |
| Company B |
|  |
| R4-2101323(CR for 38.101-4 Applicability of PMI reporting test of eType II codebook) | Company A |
| Company B |
|  |

## 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.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic#1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:**The agreement made in the GTW session Jan.28th 2021***Issue 2-1-1: Test Metric for eType II codebook**Introduce Rel-16 Type II codebook requirements with test metric as following PMI (eType II)/Random PMI (Type I codebook) **Issue 2-1-2: MIMO Correlation**XP medium **Issue 2-1-3: Test point**90% of TP**Issue 2-1-4: gamma value** FDD: 16X2 ->[2.2] ,16x4 -> [2.2]TDD: 16x2->[2.2], 16x4->[ 2.2]Companies are encouraged to further align the results and aims to introduce requirements with SNR values in [ ] in this meeting, Further update the results and the values in future RAN4 meetings not excluded.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Cases | TP ratio (Following PMI/Rand PMI) | Samsung | Qualcomm | Huawei | Ericsson | Apple |  |
| FDD 16x2  | eType II/ Random Type I at 90% point | 6.5 | 6.16 | 7.4 | 2.3 | 3.41 | 2.2 |
| Type I/ Random Type I at 90% point | 2.1 | 2.19 | 2.1 | 1.5 | 2.01 |  |
| FDD 16x4  | eType II/ Random Type I at 90% point | 6.05 | 3.69 | 7.1 | 2.3 | 2.85 | 2.2 |
| Type I/ Random Type I at 90% point | 2.01 | 2.12 | 2.12 | 1.7 | 2.11 | 　 |
| TDD 16x2  | eType II/ Random Type I at 90% point | 4.05 | 4.18 | 5.82 | 3 | 3.49 | 2.2 |
| Type I/ Random Type I at 90% point | 1.83 | 2.05 | 2.2 | 2.2 | 2.03 | 　 |
| TDD 16x4 | eType II/ Random Type I at 90% point | 4.15 | 3.1 | 5.73 | 2.4 | 3 | 2.2 |
| Type I/ Random Type I at 90% point | 1.76 | 2.01 | 2.3 | 2.2 | 2.31 | 　 |

 |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |
| R4-2102938 |  *To be revised* |
| R4-2101323 | *To be revised* *this CR contains context (not marked as new change to spec) that are not agreed and discussed in Rel-16 Perf Enh WI* |
| R4-2100212 | *To be revised**Including the updated results for PMI test* |
| R4-2101311 | *To be revised**Including the updated results for PMI test* |
| R4-2100622 | *To be revised* *Including the updated results for PMI test*  |

## Discussion on 2nd round (if applicable)

**Issue 2-1-4: gamma value**

FDD: 16X2 ->[2.2] ,16x4 -> [2.2]

TDD: 16x2->[2.2], 16x4->[ 2.2]

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Cases | TP ratio (Following PMI/Rand PMI) | Samsung | Qualcomm | Huawei | Ericsson | Apple |  |
| FDD 16x2  | eType II/ Random Type I at 90% point | 6.5 | 6.16 | 7.4 | 2.3 | 3.41 | 2.2 |
| Type I/ Random Type I at 90% point | 2.1 | 2.19 | 2.1 | 1.5 | 2.01 |  |
| FDD 16x4  | eType II/ Random Type I at 90% point | 6.05 | 3.69 | 7.1 | 2.3 | 2.85 | 2.2 |
| Type I/ Random Type I at 90% point | 2.01 | 2.12 | 2.12 | 1.7 | 2.11 | 　 |
| TDD 16x2  | eType II/ Random Type I at 90% point | 4.05 | 4.18 | 5.82 | 3 | 3.49 | 2.2 |
| Type I/ Random Type I at 90% point | 1.83 | 2.05 | 2.2 | 2.2 | 2.03 | 　 |
| TDD 16x4 | eType II/ Random Type I at 90% point | 4.15 | 3.1 | 5.73 | 2.4 | 3 | 2.2 |
| Type I/ Random Type I at 90% point | 1.76 | 2.01 | 2.3 | 2.2 | 2.31 | 　 |

* Recommended WF

Companies are encouraged to further align the results and aims to introduce requirements with SNR values in [ ] in this meeting, Further update the results and the values in future RAN4 meetings not excluded.

**R4-2103833 Introduction of PMI test cases with Rel-16 eType II codebook**

 *Type: CR For: Agreement
 38.101-4 v16.3.0 CR-0135 Cat: B (Rel-16)

 Source: Samsung*

**Abstract:**

Introduction of eType II codebook PMI test cases

**Discussion:**

[report of discussion]

**Decision: Return to.**

**R4-2103954 CR for 38.101-4 Applicablity of PMI reporting test of eType II codebook**

 *Type: CR For: Agreement
 38.101-4 v16.3.0 CR-0150 Cat: B (Rel-16)

 Source: Huawei, HiSilicon*

**Discussion:**

[report of discussion]

**Decision: Return to.**

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |
| R4-2103833 | *agreeable* |
| R4-2103954 | *agreeable* |