**3GPP TSG-RAN WG4 Meeting # 95e R4-200xxxx**

**Electronic Meeting, May.25-June.5, 2020**

**Agenda item:** 6.11.3

**Source:** Moderator (Samsung)

**Title:** Email discussion summary for [95e][319] NR\_eMIMO\_Demod

**Document for:** Information

# Introduction

As agreed in previous RAN4 meeting, the overall impact on RAN4 Performance requirements on Rel-16 eMIMO WI as summarized in below table:

|  |  |  |
| --- | --- | --- |
| Sub-items | BS Demod  | UE Performance |
| UE Demod | CSI |
| Item 1: CSI enhancement for Type II codebook | No | NO | Yes |
| Item 2: Multi-TRP/Panel transmission | Single DCI based transmission schemes | No | FFS | No |
| Multi-DCI based transmission scheme | No | Yes | No |
| Item3:Beam management enhancement | Item3a: L1-SINR measurement | No | No | No |
| Item3b: BFR for Scell | No | No | No |
| Item3c: DL/UL beam indication with reduced latency and overhead | No | No | No |
| Item4: Full TX power UL transmission | No | No | No |
| Item5: Low PAPR RS | NO | NO | No |

The scope of this email discussion mainly focuses to identify the test scope of performance requirements include demodulation and CSI, decide the test set-up including detailed test parameters and introduce corresponding test cases into specifications.

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

* 1st round: Discuss and identify the potential impact on UE/BS performance requirement based on RAN1 feature, and discuss the details test parameters to facilitate the test case setup for requirements. In order to make the discussion more concentrative, some open issues suggested to be deferred into 2nd round.
	+ For detailed test set-up, suggest to focused on FR1 first in this meeting
* 2nd round: Further discuss the left open issue, pending on the progress on 1st round, some open issues maybe further deferred into future meetings.

# Topic #1: PDSCH demodualtion requirements (Multi-Panel/TRP transmission schemes)

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2006314**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_95_e/Docs/R4-2006314.zip) | Samsung | **Test Scope****Proposal 1: Introducing PDSCH demodulation requirements for transmission schemes related to URLLC operation*** Detailed selection on transmission schemes can be further discussed to differentiate with the test case introduced for single –DCI based on transmission with eMBB operation.

**Proposal 2: Deprioritize detailed test case design for URLLC test cases pending on the progress on test case design for eMBB based NCJT Multi-TRP/Panel transmission test cases and normal URLLC test cases under Rel-16 URLLC WI.*** For URLLC relevant test cases, RAN4 only focused on test scope discussion in Q2 2020.

**Proposal 3: Introducing PDSCH demodulation requirements for single DCI based transmission scheme with eMBB operation (Single-DCI based SDM scheme)*** Test applicable rules can be further discussed among single DCI-based on transmission test cases (eMBB) and multi-DCI based on transmission test cases (eMBB).

**Proposal 4: Introduce PDSCH demodulation requirements with Multi-Panel/TRP transmission schemes (eMBB) in FR2 with single wide Rx beam assumption.****Test set-up (eMBB)****Proposal 5-TCI state: TCI state configuration for FR2:**

|  |  |  |
| --- | --- | --- |
| TCI index | Information | FR2 |
| TCI state #0 | Type 1 QCL information  | SSB index | SSB #0 |
| QCL Type | Type C |
| Type 2 QCL information | SSB index | SSB #0 |
| QCL Type | Type D |
| TCI state #1 | Type 1 QCL information  | CSI-RS resource | CSI-RS resource 1 from ‘CSI-RS for tracking’ configuration |
| QCL Type | Type A |
| Type 2 QCL information | CSI-RS resource | CSI-RS resource 1 from ‘CSI-RS for tracking’ configuration |
| QCL Type | Type D |
| TCI state #2 | Type 1 QCL information  | CSI-RS resource | CSI-RS resource 2 from ‘CSI-RS for tracking’ configuration |
| QCL Type | Type A |
| Type 2 QCL information | CSI-RS resource | CSI-RS resource 1 from ‘CSI-RS for tracking’ configuration |
| QCL Type | Type D |

**Proposal 6: Timing offset between 2 TPs/Panels:** $∆t=2^{-μ}∆t\_{1} , ∆t\_{1}=\{\left[2 us\right],[-0.5 us]\}$**Proposal 7: Frequency offset between 2 TPs/Panels:** * FR1 FDD (15kHz SCS): [200Hz]
* FR1 TDD (30kHz SCS): [300Hz]
* FR2 TDD (120kHz SCS): FFS

**Proposal 8: For PDSCH scheduling** * Single DCI based transmission : full overlapping
* Multi-DCI based on transmission: introduce test cases for both Non overlapping and full overlapping
* FFS for the detailed test applicable rules

**Proposal 9: Don’t consider to configure colliding TRS/CSI-RS for eMIMO multi-Panel/TRP PDSCH demodulation requirements.** **Overall Test cases (eMBB):****Proposal 10: Introduce below test cases for Mutil-TRP/Pannel transmission schemes (eMBB basis) as in section above.** * Test 1a Single DCI with frequnecy offset and overlapping scheduling
* Test 1b Single DCI with postive time offset and overlapping scheduling
* Test 1c Single DCI with negative time offset and overlapping scheduling
* Test 2a Multi- DCI with frequnecy offset and Non-overlapping scheduling
* Test 2b Multi DCI with postive time offset and Non-overlapping scheduling
* Test 2c Multi DCI with negative time offset and overlapping scheduling

**Proposal 11: Test applicable rules for UEs with different capability**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| UE Type  | Test 1a single DCIFrequency offsetOverlapping  | Test 1b single DCIPositive time offsetOverlapping | Test 1cSingle DCINegative time offsetOverlapping | Test 2aMulti DCIFrequency offsetNon-Overlapping | Test 2bMulti DCIPositive time offsetNon-Overlapping | Test 2cMulti DCINegative time offsetOverlapping |
| Only support single DCI  | Yes | Yes | Yes |  |  |  |
| Only support multi-DCI without overlapping  |  |  |  | Yes | Yes |  |
| Only support multi-DCI and also support overlapping |  |  |  | Yes | Yes | Yes |
| Support both single DCI and multi-DCI |  |  | Yes | Yes | Yes |  |

 |
| [**R4-2006316**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_95_e/Docs/R4-2006316.zip) | Samsung | **Observation 1: The performance gap between Non-Overlap and Full-Overlap is 3dB based on same information bit payload configuration.****Observation2: With 200Hz frequency offset, there is 2.5 dB performance gap to distinguish different UE behaviour with MCS13 (16QAM).****Observation 3: With 2us time offset, the performance gap is <1 dB under MCS 13 (16QAM)****Observation 4: With -0.5 us frequency offset, no much performance difference for MCS13 (16QAM).**In order to ensure proper UE behavior, higher MCS i.e. 64QAM need to be considered for further evaluation |
| [**R4-2006539**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_95_e/Docs/R4-2006539.zip) | Intel Corporation | **Proposal 1: Do not define FR2 requirements for simultaneous reception from multi-TRP/Panel for eMBB.****Proposal 2: Study testability for FR2 single-DCI based multi-TRP schemes 3 and 4.****Proposal 3: Define performance requirements for single-DCI based eMBB multi-TRP Tx scheme for FR1.****Proposal 4: Define performance requirements for single-DCI based URLLC multi-TRP Tx schemes 1a, 2a, 2b for FR1, and 3 and 4 at least for FR1. Further discuss applicability rule between them if UE supports several.****Proposal 5: Use 1% BLER as a test metric for single-DCI based URLLC multi-TRP Tx schemes performance requirements.****Proposal 6: Define PDSCH performance requirements with multi-DCI scheduling only for non-overlapped resource allocation approach.****Proposal 7: Further study performance degradation for configuration with colliding TRS/CSI-RS in multi-TRP/panel operation compare to non-colliding configuration.****Proposal 8: Do not define performance requirements for multi-DCI based multi-TRP with UE rate-matching around configured CRS pattern.****Proposal 9: Further study reference receiver assumptions on multi-TRP time tracking implementation in NR. Appropriate TO value for requirements definition should be derived based on performance analysis and analysis on typical TO distributions.****Proposal 10: For multi-TRP/panel requirements definition use 300-400 Hz and 600-800 Hz FO for 15 kHz SCS and 30 kHz SCS respectively.** |
| [**R4-2006627**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_95_e/Docs/R4-2006627.zip) | Qualcomm Incorporated | **Proposal 1: Amongst single DCI multi-TRP schemes, define performance requirements only for SDM scheme. Do not define requirements for URLLC multi-TRP schemes.** **Proposal 2: Do not define multi-TRP requirements for FR2.****Proposal 3: Define multi-DCI multi-TRP requirements only for non-overlapping PDSCH scheduling.****Proposal 4: Do not define requirements for UE rate matching for multi-DCI multi-TRP scheme.****Proposal 5: Do not consider the scenario that the TRSs/CSI-RSs collide between 2 TRP.****Proposal 6: Differentiate the PDSCH configuration for multi-DCI and single-DCI scenario for SDM.** |
| [**R4-2006814**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_95_e/Docs/R4-2006814.zip) | MediaTek inc. | ***Proposal 1***: Set timing offset of first path from two TRPs by scaled with SCS: $∆t=2^{-μ}∆t\_{1}$, $∆t\_{1} $= [-0.5, 2]μs***Proposal 2***: Do not set frequency offset by linearly scaled with SCS***Proposal 3***: Set frequency offset between two TRPs as* FR1 FDD (15kHz SCS): 200Hz
* FR1 TDD (30kHz SCS): 300Hz

***Proposal 4***: Define only non-overlapping PDSCH scheduling for multi-DCI based multi-TRP transmission***Proposal 5***: Do not consider the scenario with TRS/CSI-RS collide between 2 TRPs***Proposal 6***: Do not define PDSCH performance requirement for FR2 |
| [**R4-2007198**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_95_e/Docs/R4-2007198.zip) | Huawei, HiSilicon | ***Proposal 1: Option 2, i.e. Define multi-DCI based PDSCH requirements only for non-overlapping scheduling*** ***Proposal 2: Not to define PDSCH requirement for UE rate-matching around a configured CRS patterns.******Proposal 3: Configure 8 HARQ processes for each TRP with TDD 30kHz SCS with TDD pattern 7DS2U, FR1******Proposal 4: Not consider negative timing offset, and set timing offset by scaled with SCS*** $∆t=2^{-μ}∆t\_{1}$***, TO = 2us for 15 kHz SCS, and TO = 1us for 30 kHz SCS******Proposal 5: Two TRPs are assumed with transmission the same SSB, UE tracks 2 active TCI states with the assumption that PDSCH has the same TCI state as PDCCH.******Proposal 6: No need to set the frequency offset by scaled with SCS, set FO = 200Hz for 15 kHz SCS and FO = 300Hz for 30 kHz SCS.*** ***Proposal 7: Agree the following additional test parameters for PDCCH and PDSCH for non-overlapping resource allocation :**** ***PDSCH configuration for each TRP***
	+ ***PDSCH resource mapping type: Type A***
	+ ***Resource allocation type: Type 1***
	+ ***DM-RS: DM-RS configuration type 1 with single-symbol DM-RS: 1+1***
	+ ***Antenna configuration: 2x2 and 2x4 and/or 4x2, 4x4 for FR1 depends on the specific MIMO layers***
	+ ***Antenna ports indexes: such as {1000,1001} and {1002,1003}, i.e. different CDM groups for two TRPs***
	+ ***Starting symbol (S): 2***
	+ ***Time duration (L): 12***
	+ ***Frequency domain: half of the maximum bandwidth by indicating the start resource block , the allocated resource blocks***
* ***PDCCH configuration***
	+ ***K0 = 0***
	+ ***AL = 8***
 |
| [**R4-2007199**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_95_e/Docs/R4-2007199.zip) | Huawei, HiSilicon | ***Proposal 1: Ok to define PDSCH requirement scheduled by single-DCI for multi-TRP/Panel transmission with test applicability rule******Proposal 2: Not to define PDSCH requirements for URLLC multi-TRP transmission schemes in eMIMO WI******Proposal 3: Only define requirements for FR1 eMBB******Proposal 4: Not consider the scenario with TRS/CSI-RS collide*** |
| [**R4-2007385**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_95_e/Docs/R4-2007385.zip) | Ericsson | **Proposal 1: RAN4 should discuss further whether to introduce multi-TRP PDSCH demodulation requirements scheduled by multi-DCI for UE capable of simultaneous reception with different QCL type-D.****Proposal 2: For FR2, do not define multi-TRP PDSCH demodulation requirements scheduled by multi-DCI for UE not capable of simultaneous reception with different QCL type-D.** **Proposal 3: Set timing offset between TRPs to:*** **2us for SCS=15kHz,**
* **1us for SCS=30kHz, and**
* **0.25us for SCS=120kHz if RAN4 will define multi-TRP requirements for FR2.**

**Proposal 4: Set frequency offset between two TRPs to:*** **200Hz for SCS=15kHz,**
* **400Hz for SCS=30kHz, and**
* **FFS for FR2 if RAN4 will define multi-TRP requirements for FR2**

**Proposal 5: Do not define multi-TRP PDSCH demodulation requirements scheduled by multi-DCI for the rate-matching around a configured CRS pattern.****Proposal 6: Non-overlapping in frequency (but partially/fully overlapping in time) only if the single-DCI based multi-TRP test with full-overlapping transmission is defined.** **Proposal 7: For Multi-TRP PDSCH transmission requirements, RAN4 should consider the scenario that the TRSs/CSI-RSs are collided between two TRPs.****Proposal 7a: Alternatively RAN4 will define the PDSCH demodulation requirements assuming TRS/CSI-RS are collided by a neighboring cell in TEI15/TEI16 or Rel-17.** |
| [**R4-2007386**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_95_e/Docs/R4-2007386.zip) | Ericsson | **Proposal 1: RAN4 defines PDSCH demodulation requirements for Single-DCI based SDM scheme.** **Proposal 2: RAN4 defines PDSCH demodulation requirements for Single-DCI based FDM Scheme A.****Proposal 3: RAN4 uses the 70% of maximum throughput as the test metric of PDSCH demodulation requirements for single-DCI based multi-TRP transmission.**  |

## Open issues summary

Last RAN4 meeting agreements in WF R4-2005529 as captured in Annex.

List of open issues:

* Sub-Topic 1-1: Test Scope
	+ Issue 1-1-1: Necessity of introducing test case(s) for single DCI-based multi-panel/TRP transmission schemes (eMBB)
	+ Issue 1-1-2: Necessity of introducing test case(s) for single DCI-based multi-panel/TRP transmission schemes (URLLC)
	+ Issue 1-1-3: Necessity of introducing test case(s) for multi-panel/TRP transmission schemes in FR2
* Sub-Topic 1-2: Generic test set-up
	+ Issue 1-2-1: Timing offset among multi-panel/TRP (FR1 only)
	+ Issue 1-2-2: Frequency offset among multi-panel/TRP (FR1 only)
	+ Issue 1-2-3: TRS/CSI-RS configuration
	+ Issue 1-2-4: TCI state configuration for FR2 (Postpone to 2nd round)
	+ Issue 1-2-5: Test applicable rules (Postpone to future meetings)
* Sub-Topic 1-3: Test parameters for Test parameters for Multi-DCI based multi-TRP/Panel transmission schemes (eMBB)
	+ Issue 1-3-1: Resource allocation
	+ Issue 1-3-2: CRS ratemacthing
	+ Issue 1-3-3: PDCCH configuration
	+ Issue 1-3-4: PDSCH configuration
	+ Issue 1-3-5: Number of Test cases (Postpone to 2nd round)
* Sub-Topic 1-4: Test parameters for Test parameters for Single-DCI based multi-TRP/Panel transmission schemes (eMBB)
	+ Issue 1-4-1: Resource allocation
	+ Issue 1-4-2: PDSCH configuration
	+ Issue 1-4-3: Number of Test cases (Postpone to 2nd round)
* Sub-Topic 1-5: Test parameters for Test parameters for Single-DCI based multi-TRP/Panel transmission schemes (URLLC)
	+ Issue 1-5-1: Tranmission schmes
	+ Issue 1-5-2: Test metric

### Sub-topic 1-1: Test scope

**Issue 1-1-1: Necessity of introducing test case(s) for single DCI-based multi-panel/TRP transmission schemes (eMBB)**

* Proposals
	+ Option 1: Introducing PDSCH demodulation requirements for Single-DCI based SDM scheme (eMBB operation (Samsung, Intel, Qualcomm, Huawei, Ericsson)
* Recommended WF
	+ Introducing PDSCH demodulation requirements for Single-DCI based SDM scheme (eMBB operation) and further discuss the test applicable rules

**Issue 1-1-2: Necessity of introducing test case(s) for single DCI-based multi-panel/TRP transmission schemes (URLLC)**

Note: detailed selection of transmission schemes will be discussed under sub-topic 1-5.

* Proposals
	+ Option 1: Yes (Intel, Samsung, Ericsson ?)
	+ Option 2: NO (Qualcomm, Huawei)
* Recommended WF
	+ Companies’ views quite diverse for whether to introduce PDSCH requirements for URLLC single DCI based transmission schemes and the detailed selection of transmission schemes; suggest to discuss and identify any new behaviour from UE processing aspect which not verified by existing URLLC test cases (URLLC WI) and eMBB operation multi-panel/TRP transmission scheme test cases

**Issue 1-1-3: Necessity of introducing test case(s) for multi-panel/TRP transmission schemes in FR2**

* Proposals
	+ Option 1: No (Huawei, Qualcomm, MTK)
	+ Option 2: Do not define FR2 requirements for simultaneous reception from multi-TRP/Panel (eMBB) and Study testability for FR2 single-DCI based multi-TRP schemes 3 and 4 (Intel)
	+ Option 3: Introduce PDSCH demodulation requirements with Multi-Panel/TRP transmission schemes (eMBB) in FR2 with single wide Rx beam assumption. (Samsung)
	+ Option 4: Don’t define multi-TRP PDSCH demodulation requirements scheduled by multi-DCI for UE not capable of simultaneous reception with different QCL type-D. RAN4 should discuss further whether to introduce multi-TRP PDSCH demodulation requirements scheduled by multi-DCI for UE capable of simultaneous reception with different QCL type-D. (Ericsson)
* Recommended WF
	+ There are 3 sub-issues need to be discussed:
		- Whether to introduce test cases with simultaneous transmission under single Rx beam assumption (only one QCL type –D) -> Majority view, no as it’s not practical.
		- Whether to introduce test cases with non-simultaneous transmission (single-DCI based multi-TRP schemes 3 and 4) -> Test feasibility need to be further discussed
		- Whether introduce test case with simultaneous transmission under multi- beam assumption (different QCL type –D) -> It’s conflicted with last RAN4 meeting agreements and the baseline assumption in Rel-16 RF and RRM requirements

### Sub-topic 1-2: Generic test set-up

**Issue 1-2-1: Timing offset among multi-panel/TRP (FR1 only)**

* Proposals
	+ Option 1: Set timing offset of first path from two TRPs by scaled with SCS: $∆t=2^{-μ}∆t\_{1}$, $∆t\_{1} $= [-0.5, 2]μs (MTK, Samsung)
	+ Option 2: Not consider negative timing offset, and set timing offset by scaled with SCS $∆t=2^{-μ}∆t\_{1}$, TO = 2us for 15 kHz SCS, and TO = 1us for 30 kHz SCS (Huawei, Ericsson)
	+ Option 3: Further study reference receiver assumptions on multi-TRP time tracking implementation in NR. Appropriate TO value for requirements definition should be derived based on performance analysis and analysis on typical TO distributions. (Intel)
* Recommended WF
	+ Clarify the reference receiver assumption for multi-TRP time tracking; introducing timing offset which scaled with SCS $∆t=2^{-μ}∆t\_{1}$
		- Derive candidate t1 values for further evaluation and simulation purpose

**Issue 1-2-2: Frequency offset among multi-panel/TRP (FR1 only)**

* Proposals
	+ Option 1: 200Hz for FR1 FDD, 300Hz for FR1 TDD (Samsung, Huawei, MTK)
	+ Option 2: 200Hz for FR1 FDD, 400Hz for FR1 TDD (Ericsson)
	+ Option 3: 300-400 Hz for FR1 FDD and 600-800 Hz for FR1 TDD (Intel)
* Recommended WF
	+ From companies’ result, 200Hz already fulfil test purpose even company propose larger values. Combined option 1 and option 2; for FR1 FDD 200Hz, for FR1 TDD further decide among 300Hz and 400Hz

**Issue 1-2-3: TRS/CSI-RS configuration**

* Proposals
	+ Option 1: No confliction among multi-Panel/TRP (Qualcomm, Samsung, MTK, Huawei)
	+ Option 2: Further study performance degradation for configuration with colliding TRS/CSI-RS in multi-TRP/panel operation compare to non-colliding configuration. (Intel)
	+ Option 3: RAN4 should consider the scenario that the TRSs/CSI-RSs are collided between two TRPs. (Ericsson)
		- Proposal 3a: RAN4 will define the PDSCH demodulation requirements assuming TRS/CSI-RS are collided by a neighbouring cell in TEI15/TEI16 or Rel-17.
* Recommended WF
	+ Taking non-colliding TRS/CSI-RS in multi-TRP/panel as baseline assumption meanwhile interested companies are encouraged to bring more analysis and evaluation results for non-colliding and colliding cases.

**Issue 1-2-4: TCI state configuration for FR2 (deferred to 2nd round)**

* Proposals
	+ Option 1: Single Type D (Samsung)

|  |  |  |
| --- | --- | --- |
| TCI index | Information | FR2 |
| TCI state #0 | Type 1 QCL information  | SSB index | SSB #0 |
| QCL Type | Type C |
| Type 2 QCL information | SSB index | SSB #0 |
| QCL Type | Type D |
| TCI state #1 | Type 1 QCL information  | CSI-RS resource | CSI-RS resource 1 from ‘CSI-RS for tracking’ configuration |
| QCL Type | Type A |
| Type 2 QCL information | CSI-RS resource | CSI-RS resource 1 from ‘CSI-RS for tracking’ configuration |
| QCL Type | Type D |
| TCI state #2 | Type 1 QCL information  | CSI-RS resource | CSI-RS resource 2 from ‘CSI-RS for tracking’ configuration |
| QCL Type | Type A |
| Type 2 QCL information | CSI-RS resource | CSI-RS resource 1 from ‘CSI-RS for tracking’ configuration |
| QCL Type | Type D |

* Recommended WF
	+ Postpone to 2nd round pending on discussion status on issue 1-1-3:

**Issue 1-2-5: Test applicable rules (deferred to future meetings)**

* Proposals
	+ Option 1: Test applicable rules for UEs with different capability (Samsung)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| UE Type  | Test 1a single DCIFrequency offsetOverlapping  | Test 1b single DCIPositive time offsetOverlapping | Test 1cSingle DCINegative time offsetOverlapping | Test 2aMulti DCIFrequency offsetNon-Overlapping | Test 2bMulti DCIPositive time offsetNon-Overlapping | Test 2cMulti DCINegative time offsetOverlapping |
| Only support single DCI  | Yes | Yes | Yes |  |  |  |
| Only support multi-DCI without overlapping  |  |  |  | Yes | Yes |  |
| Only support multi-DCI and also support overlapping |  |  |  | Yes | Yes | Yes |
| Support both single DCI and multi-DCI |  |  | Yes | Yes | Yes |  |

* Recommended WF
	+ Postpone to future RAN4 meetings pending on the progress on RAN1 feature list and RAN4 test scope

### Sub-topic 1-3: Test parameters for Multi-DCI based multi-TRP/Panel transmission schemes (eMBB)

**Issue 1-3-1: Resource allocation**

* Proposals
	+ Option 1: Only non-overlapping cases (Huawei, Qualcomm, MTK, Intel)
	+ Option 2: Both non-overlapping and full-overlapping cases (Samsung)
		- FFS for test applicable rules
	+ Option 3: Non-overlapping and full-overlapping if no requirements for single-DCI based multi-TRP will be introduced, Otherwise only non-overlapping (Ericsson)
* Recommended WF
	+ At least introduce non-overlapping case(s), FFS whether full-overlapping test cases needed or not pending on the decision of introducing single –DCI based on SDM schemes test case(s) (Issue 1-1-1)

**Issue 1-3-2: CRS rate-matching**

* Proposals
	+ Option 1: Do not define performance requirements for multi-DCI based multi-TRP with UE rate-matching around configured CRS pattern. (MTK, Ericsson, Huawei, Intel, Qualcomm, Samsung)
* Recommended WF
	+ Agree option 1

**Issue 1-3-3: PDCCH configuration**

* Proposals
	+ Option 1: K0 = 0, AL = 8 (Huawei)
* Recommended WF
	+ Companies’ feedback needed for above proposal

**Issue 1-3-4: PDSCH configuration**

* Proposals
	+ Option 1: PDSCH configuration for each TRP (Huawei)
		- * + PDSCH resource mapping type: Type A
				+ Resource allocation type: Type 1
				+ DM-RS: DM-RS configuration type 1 with single-symbol DM-RS: 1+1
				+ Antenna configuration: 2x2 and 2x4 and/or 4x2, 4x4 for FR1 depends on the specific MIMO layers
				+ Antenna ports indexes: such as {1000,1001} and {1002,1003}, i.e. different CDM groups for two TRPs
				+ Starting symbol (S): 2
				+ Time duration (L): 12
				+ Frequency domain: half of the maximum bandwidth by indicating the start resource block , the allocated resource blocks 
* Recommended WF
	+ Companies’ feedback needed for above proposal

**Issue 1-3-5: Number of test cases (Postpone to 2nd round)**

* Proposals
	+ Option 1: 3 test cases per duplex mode (Samsung)
	+ Test 2a Multi- DCI with frequnecy offset and Non-overlapping scheduling
	+ Test 2b Multi DCI with postive time offset and Non-overlapping scheduling
	+ Test 2c Multi DCI with negative time offset and overlapping scheduling
* Recommended WF
	+ Companies’ feedback needed for above proposal, also pending on decision on issue: 1-3-1 (resource allocation) and 1-2-1 (time offset)

### Sub-topic 1-4: Test parameters for Single-DCI based multi-TRP/Panel transmission schemes (eMBB)

**Issue 1-4-1: Resource allocation**

* Proposals
	+ Option 1: full overlapping in frequency domain (Samsung)
* Recommended WF
	+ Companies’ feedback needed for above proposal

**Issue 1-4-2: PDSCH configuration for overlapping**

* Proposals
	+ Option 1: (Samsung)
		- Layer combination: 1+1 for both 2Rx and 4Rx
		- Number of TCI state: Two TCI states configuration
* Recommended WF
	+ Companies’ feedback needed for above proposal

**Issue 1-4-3: Number of test cases (Postpone to 2nd round)**

* Proposals
	+ Option 1: 3 test cases per duplex mode (Samsung)
	+ Test 1a Single DCI with frequnecy offset and overlapping scheduling
	+ Test 1b Single DCI with postive time offset and overlapping scheduling
	+ Test 1c Single DCI with negative time offset and overlapping scheduling
* Recommended WF
	+ Companies’ feedback needed for above proposal, also pending on decision on issue: 1-3-1 (resource allocation) and 1-2-1 (time offset)

### Sub-topic 1-5: Test parameters for Single-DCI based multi-TRP/Panel transmission schemes (URLLC)

**Issue 1-5-1: Transmission schemes**

* Proposals
	+ Option 1: Define performance requirements for single-DCI based URLLC multi-TRP Tx schemes 1a, 2a, 2b for FR1, and 3 and 4 at least for FR1. Further discuss applicability rule between them if UE supports several. (Intel)
	+ Option 2: RAN4 defines PDSCH demodulation requirements for Single-DCI based FDM Scheme A (2a) (Ericsson)
	+ Option 3: RAN4 define test case with selection of schemes which differiate with single-DCI test cases with eMBB operation (Samsung)
* Recommended WF
	+ Related to discussion on issue 1-1-2, suggest to discuss and identify any new behaviour from UE processing aspect for each transmission schemes which not verified by existing URLLC test cases (URLLC WI) and eMBB operation multi-panel/TRP transmission scheme test cases

**Issue 1-5-2: Test Metric**

* Proposals
	+ Option 1: 70% TP (Ericsson)
	+ Option 2: 1% BLER (Intel)
* Recommended WF
	+ Companies’ feedback needed for above proposal

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub-Topic 1-1: Test Scope* Issue 1-1-1: Necessity of introducing test case(s) for single DCI-based multi-panel/TRP transmission schemes (eMBB)
* Issue 1-1-2: Necessity of introducing test case(s) for single DCI-based multi-panel/TRP transmission schemes (URLLC)
* Issue 1-1-3: Necessity of introducing test case(s) for multi-panel/TRP transmission schemes in FR2

Sub-Topic 1-2: Generic test set-up* Issue 1-2-1: Timing offset among multi-panel/TRP (FR1 only)
* Issue 1-2-2: Frequency offset among multi-panel/TRP (FR1 only)
* Issue 1-2-3: TRS/CSI-RS configuration
* ~~Issue 1-2-4: TCI state configuration for FR2 (Postpone to 2nd round)~~
* ~~Issue 1-2-5: Test applicable rules (Postpone to future meetings)~~

Sub-Topic 1-3: Test parameters for Test parameters for Multi-DCI based multi-TRP/Panel transmission schemes (eMBB)* Issue 1-3-1: Resource allocation
* Issue 1-3-2: CRS ratemacthing
* Issue 1-3-3: PDCCH configuration
* Issue 1-3-4: PDSCH configuration
* ~~Issue 1-3-5: Number of Test cases (Postpone to 2nd round)~~

Sub-Topic 1-4: Test parameters for Test parameters for Single-DCI based multi-TRP/Panel transmission schemes (eMBB)* Issue 1-4-1: Resource allocation
* Issue 1-4-2: PDSCH configuration
* ~~Issue 1-4-3: Number of Test cases (Postpone to 2nd round)~~
* Sub-Topic 1-5: Test parameters for Test parameters for Single-DCI based multi-TRP/Panel transmission schemes (URLLC)
* Issue 1-5-1: Tranmission schmes
* Issue 1-5-2: Test metric

Others: |

### 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** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

*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:* |

*Recommendations on WF/LS assignment*

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

## Discussion on 2nd round (if applicable)

## 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”* |

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2006315**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_95_e/Docs/R4-2006315.zip) | Samsung | **Proposal 1: Use SU-MIMO test setup to introduce test case under eMIMO WI.****Proposal 2-codebook construction: Introduce PMI test cases with enhanced Type II codebook with below parameters:*** Number of CSI-RS ports: 16 ports with (N1,N2) = (4,2) and (O1, O2) = (4,4)
* numberOfPMISubbandsPerCQISubband: R =1
* paramCombination-r16: 6, with L =4, pv =1/2, $β=1/2$

**Proposal 3-Beam steering: Introduce a generic beam steering model into specification in a future proof manner which the number of beams configurable:** * + beam index
	+ ， relative power of the l beam compared to first beam
	+ , total power scaling factor

**Proposal 4-Propagation condition: Introduce test case with MIMO correlation -XP Medium (option2).****Proposal 5-Test metric: It's feasible to introduce test case with test metric - relative throughput ratio among following PMI and random PMI** **Proposal 6-MCS&Rank: It’s feasible to use MCS20 (64QAM), Rank2 for introducing test cases.** |
| [**R4-2006317**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_95_e/Docs/R4-2006317.zip) | Samsung | **Observation 1: The enhanced type II CSI with”paramCombination-r16=6” could bring significant gain and it is recommended as simulation parameter to achieve the type II CSI’s potential advantage.** **Observation2: The performance gain of enhanced type II is more obviously in XP Medium correlation channel model than in XP high correlation case. In brief, XP medium model is proposed for enhanced type II CSI reporting test.** **Observation 3: Based on our simulation results, 16Tx case is enough to define test set-up.** |
| [**R4-2007200**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_95_e/Docs/R4-2007200.zip) | Huawei, HiSilicon | Proposal 1: Prefer to use SU-MIMO for test setup Proposal 2: Only introduce 16 Tx ports for enhanced Type II codebook test casesProposal 3: Use (N1, N2) = (4, 2) and (O1, O2) = (4, 4) for 16 Tx portsProposal 4: Consider 8 for FDD with 15kHz SCS, 10MHz CBW and 16 for TDD with 30kHz SCS, 40MHz CBWProposal 5: Extend the original beam steering model in TS 36.101 to L>2 beams Proposal 6: Prefer not to cover CSI-RS interference from neighboring cells and/or sectors in test case design |
| [**R4-2007936**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_95_e/Docs/R4-2007936.zip) | Ericsson | Proposal 1: Use same test setup for eMIMO CSI – PMI testing as proposed in R4-2007934.Extracted proposals from T-doc R4-2007934**Proposal 2: Design Type II tests to ensure UE CSI reporting with substantially better performance than Type I reporting for MU-MIMO, in line with the big performance benefits shown in RAN1 evaluations.****Proposal 3: If RAN4 agree to use multi-user scheduling for type-II PMI reporting test, RAN4 study further how to derive precoder based on the type-II PMI feedback from UE under test.** **Proposal 4: Test parameters for Type II codebook may need to be tuned to properly suit MU-MIMO based test setup proposed.** |
| [**R4-2006627**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_95_e/Docs/R4-2006627.zip) | Qualcomm Incorporated | Proposal 7: Define PMI reporting test cases for Enhanced Type II codebook under similar assumptions as that of the test cases for Rel-15 Type II Codebook.Proposal 8: Use SU-MIMO test setup for defining Enhanced Type II PMI reporting tests.Proposal 9: Do not extend the beam steering model beyond 2 clusters and reuse the dual cluster beam steering defined in 36.101.Proposal 10: Define enhanced Type II PMI reporting tests only for 16 or 32 Tx ports.Proposal 11: Use smaller sub-band size, i.e., 4 for FDD 10MHz and 8 for TDD 40MHz, for defining PMI reporting tests for enhanced Type II codebook.Proposal 12: Use R = 1 in PMI reporting requirements for enhanced Type II codebook. |

## Open issues summary

Last RAN4 meeting agreements captured in WF R4-2005530 which also summarized in Annex.

List of open issues:

* Sub-Topic 2-1: Test set-up
	+ Issue 2-1-1: SU-MIMO VS MU-MIMO Setup
* Sub-Topic 2-2: Test parameters
	+ Issue 2-2-1: Number of ports
	+ Issue 2-2-2: Number of PMI Sub-bands per CQI Sub-band
	+ Issue 2-2-3: paramCombination-r16
	+ Issue 2-2-4: Sub-band Size
	+ Issue 2-2-5: Beam steering model
	+ Issue 2-2-6: Channel Model
	+ Issue 2-2-7: MIMO Correlation
	+ Issue 2-2-8: MCS and Rank

### Sub-Topic 2-1: Test setup

**Issue 2-1-1: SU-MIMO VS MU-MIMO Setup**

* Proposals
	+ Option 1: SU-MIMO Set-up (Samsung, Intel, Huawei, Qualcomm)
	+ Option 2: MU-MIMO Set-up (Ericsson)
* Recommended WF
	+ Using SU-MIMO Set-up to introduce Rel-16 Type II codebook requirements, RAN4 can further discuss and introduce PMI test cases with MU-MIMO Set-up if needed in the future release

### Sub-Topic 2-2: Test parameters

**Issue 2-2-1: Number of ports**

* Proposals
	+ Option 1: 16 ports with (N1,N2) = (4,2) and (O1,O2)=(4,4) (Samsung, Huawei, Qualcomm)
	+ Option 2 : 32 ports with (N1,N2) = (4,4) and (O1,O2)=(4,4) (Qualcomm)
* Recommended WF
	+ Option 1, introduce requirements with 16 ports only

**Issue 2-2-2: Number of PMI Sub-bands per CQI Sub-band**

* Proposals
	+ Option 1: R=1 (Qualcomm, Samsung)
	+ Option 2 : R=2
* Recommended WF
	+ Option 1, R=1

**Issue 2-2-3: paramCombination-r16**

* Proposals
	+ Option 1: paramCombination-r16: 6, with L =4, *pν* =1/2, β=1/2 (Samsung)
* Recommended WF
	+ Keep option 1 as baseline for simulation, other options not excluded;

**Issue 2-2-4: Sub-band Size**

* Proposals
	+ Option 1: (Qualcomm)
		- 4 for FDD with 15kHz SCS, 10MHz CBW
		- 8 for TDD with 30kHz SCS, 40MHz CBW
	+ Option 2: (Huawei)
		- 8 for FDD with 15kHz SCS, 10MHz CBW
		- 16 for TDD with 30kHz SCS, 40MHz CBW
* Recommended WF
	+ N.A., discussion and views from other companies needed

**Issue 2-2-5: Beam steering model: Take beam steering approach as specified in B.2.3B.4A of TS 36.101**

* Proposals
	+ Option 1: Extend it to L > 2 beams (Huawei, Ericsson, Samsung)
	+ Option 2: Use it as it is with L = 2 beams (Qualcomm)
* Recommended WF:
	+ Only configure two beams (L=2) for Rel-16 Type II requirements, meanwhile introduce beam steering model into specification with configurable number of beams in a future proof manner (i.e. L can configured as 1, 2 or >2)

**Issue 2-2-6: Channel Model**

* Proposals
	+ Option 1: TDLA30-5
* Recommended WF:
	+ Lack of simulation results from companies, take option 1 as baseline and other options not excluded; companies are encouraged to bring evaluation results in future RAN4 meetings

**Issue 2-2-7: MIMO Correlation**

* Proposals
	+ Option 1: XP High
	+ Option 2: XP Medium (Samsung)
* Recommended WF:
	+ Lack of simulation results from companies, take option 2 as baseline and other options not excluded; companies are encouraged to bring evaluation results in future RAN4 meetings

**Issue 2-2-8: MCS and Rank**

* Proposals
	+ Option 1: MCS 20 (64QAM Table), Rank 2 (Samsung)
* Recommended WF:
	+ Lack of simulation results from companies, take option 1 as baseline and other options not excluded; companies are encouraged to bring evaluation results in future RAN4 meetings

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 2-1-1: SU-MIMO VS MU-MIMO Setup Issue 2-2-1: Number of portsIssue 2-2-2: Number of PMI Sub-bands per CQI Sub-bandIssue 2-2-3: paramCombination-r16Issue 2-2-4: Sub-band Size Issue 2-2-5: Beam steering modelIssue 2-2-6: Channel ModelIssue 2-2-7: MIMO CorrelationIssue 2-2-8: MCS and RankOthers:  |

### 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** |
| XXX | Company A |
| Company B |
|  |
| YYY | 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:* |

*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”* |

## Discussion on 2nd round (if applicable)

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1: Sub topic 1-2…. |

## 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”* |

# Annex

*Agreements for PDSCH requirements in last RAN4 meeting:*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test scope:* FFS to define PDSCH requirement scheduled by single-DCI based multi-TRP/Panel transmission for eMBB
* Applicability rule
	+ FFS on test applicability rule between single-DCI and multi-DCI based multi-TRP/Panel transmission for conducting the tests based on UE capability

General Test set-up* Test scenario
	+ FR1: Define PDSCH requirement with cover scenarios with simultaneous reception from multi-TRP/Panel for eMBB
	+ FR2:
		- No PDSCH requirements with serval impendent Rx beam and simultaneous reception from multi-TRP/Panel for eMBB in FR2
		- FFS on define PDSCH with covering scenarios with only 1 Rx beam with and simultaneous reception from multi-TRP/Panel for eMBB
* SCS and CBW
	+ FR1
		- FDD SCS =15KHz, 10 MHz
		- TDD SCS =30KHz, 40 MHZ
	+ FFS for FR2
		- TDD SCS =120KHz, 100 MHz
* TCI state configuration and QCI-info for FR1

|  |  |  |
| --- | --- | --- |
| **TCI index** | **Information** | **FR1** |
| **TCI state #0** | Type 1 QCL information  | SSB index | SSB #0 |
| QCL Type | Type C |
| Type 2 QCL information | SSB index | N/A |
| QCL Type | N/A |
| **TCI state #1** | Type 1 QCL information  | CSI-RS resource | CSI-RS resource 1 from ‘CSI-RS for tracking’ configuration |
| QCL Type | Type A |
| Type 2 QCL information | CSI-RS resource | N/A |
| QCL Type | N/A |
| **TCI state #2** | Type 1 QCL information  | CSI-RS resource | CSI-RS resource 2 from ‘CSI-RS for tracking’ configuration |
| QCL Type | Type A |
| Type 2 QCL information | CSI-RS resource | N/A |
| QCL Type | N/A |

* Assumption for UE receiver implementation
	+ The test case design should be ensure receiver implementation agnostic with assumption of single FFT operation
* Set BS antenna correlation between two TRPs as 0
* Separate decoding of each PDSCH scheduled by multi-DCI
* FFS on consider the scenario with TRS/CSI-RS collide between
* Timing offset configuration
	+ Define with timing offset between two TRPs, the timing offset setting should be ensured that all paths from TRPs are within CP
	+ FFS on Set timing offset by scaled with SCS $∆t=2^{-μ}∆t\_{1}$
* Frequency offset configuration
	+ FFS on set frequency offset by scaled with SCS
	+ Study suitable frequency offset configuration with considering [0.1]ppm frequency error. The following values can be used a starting point
		- FR1
			* FDD (15KHz SCS) :
				+ Option 1: 200 Hz
				+ Option 2: 300Hz
				+ Other options are not precluded
			* TDD (30KHz SCS):
				+ Option 1 :300 Hz
				+ Option 2: 600 Hz
				+ Other options are not precluded
		- FFS on FR2
			* TDD (120KHz SCS): (0~600 Hz)
			* Other options are not precluded
* TDD pattern
	+ FR1
		- TDD (30KHz SCS): 7DS2U
	+ FFS for FR2
* Number of HARQ process
	+ FR1
		- FDD (15KHz SCS): 4
		- TDD (30KHz SCS)
			* Option 1: The total number of HARQ process should be limited and not larger then 16
				+ TDD (30KHz SCS) 7DS2U : 8; 8+8=16
			* Other options are not precluded
	+ FFS for FR2

Test Set-up for Multi-DCI based* HARQ-ACK
	+ Both separate and joint HARQ-ACK feedback can be used in the test setup based on UE capability
	+ PDCCH scheduling
	+ Configure 2 CORSET pool index for multi-DCI on multi-TRP
		- Two CORSET pool index with 0 and 1, each TRP PDCCH with symbol #0 and symbol #1 in time domain and FDMed half bandwidth
	+ Configure different scrambling sequences for PDSCH scheduled by Multi-DCI
* UE rate-matching behavior
	+ FFS on define PDSCH requirement for UE rate-matching around a configured CRS pattern
* Whether to define PDSCH requirements for other scheduling schemes
	+ Option 1: at least partial overlapping
		- * Option 1a: Both partial overlapping and full-overlapping
	+ Option 2: only non-overlapping
	+ Option 3: Non-overlapping and full-overlapping if no requirements for single-DCI based multi-TRP will be introduced, Otherwise only non-overlapping
	+ Option 4: Non-overlapping and partial overlapping if overlapping requirements for single-DCI based on multi-TRP will be introduced, Otherwise both partial and full-overlapping

Test configuration for non-overlapping case* Layer combination
	+ 2 Rx UE
		- 2+2
	+ 4 RX UE
		- 2+2
* PDCCH configuration
	+ Option 1:
		- CORESETPoolIndex =0, 1, each with one COREST configured for each PDCCH
			* Symbols for PDCCH：0,1
			* Number of PRB, Half of the channel bandwidth with contiguous RB allocation and non-interleaved CCE-to-REG mapping
			* K0=0
			* AL=8
	+ Other options not precluded
* PDSCH configuration
	+ Option 1
		- PDSCH resource mapping type: Type A
		- Resource allocation type: Type 1
		- DM-RS: DM-RS configuration type 1 with single-symbol DM-RS: 1+1
		- Antenna ports index: such as {1000,1001} and {1002,1003}, i.e. different CDM groups for two TRPs
		- Starting symbol (S): 2
		- Time duration (L): 12
		- Frequency domain: half of the maximum bandwidth by indicating the start resource block , the allocated resource blocks
	+ Other options not preclude
* PDSCH configuration
	+ Option 1
		- Layer combination: 2+2
		- Number of HARQ process
			* FR1 FDD (15KHz SCS): 4
			* FR1 TDD (30KHz SCS): 7DS2U with 8, as per the current configuration, 8+8=16 HARQ process
		- Timing offset and frequency offset
			* 2 us for 15KHz SCS, 1 us for 30KHz SCS
			* 200Hz for 15KHz SCS, 400Hz for 30KHz SCS
	+ Other options not preclude

Test configuration for single DCI based * Resource allocation
	+ full-overlapping
	+ Layer combination
		- 2 Rx UE
			* 1+1
		- 4 RX UE
			* 1+1
	+ Number of TCI state
		- Two TCI states configuration

Test cases for URLLC* FFS on defined PDSCH requirement for single-DCI based URLLC (reliable) multi-TRP/Panel transmission schemes
* FFS on test metric for requirement definition
	+ Option 1: 70% @max achievable throughput
	+ Option 2: 1% BLER
* FFS on test scenario for URLLC
	+ Option 1:
		- For FR1: consider simultaneous and non-simultaneous reception from multi-TRP/Panel
		- For FR2: consider non-simultaneous reception from multi-TRP/Panel with single Rx beam at transmission occasion
	+ Other options are not precluded:
* URLLC transmission schemes
	+ Option 1: 1a; FFS scheme 2a, 2b; Deprioritize scheme 3,4
	+ Option 2: 1a, 2a, 2b, 3, 4
	+ Option 3: 2a, 3, 4
	+ Other options are not precluded
* Applicability rule
	+ FFS on applicability rule between URLLC transmission schemes
	+ FFS on applicability rule between eMBB and URLLC transmission schemes
 |

*Agreements for PMI test cases in last RAN4 meeting:*

|  |
| --- |
| * Test setup:
	+ Option 1: Use SU-MIMO test setup as baseline scenario
	+ Option 2: MU-MIMO test setup
		- Option 2a: if needed, discuss under TEI-15

Detalied test set-up for SU-MIMO* Number of CSI-RS ports
	+ Option 1: 16 ports with (N1,N2) = (4,2) and (O1,O2)=(4,4)
	+ Option 2 : 32 ports with (N1,N2) = (4,4) and (O1,O2)=(4,4)
* Number of PMI Sub-bands per CQI Sub-band
	+ Option 1: R = 1
	+ Option 2: R = 2
* Codebook parameter configuration
	+ Option 1: paramCombination-r16: 6, with L =4, *pν* =1/2, β=1/2 as baseline
	+ Other options not precluded
* Define requirements only for sub-band PMI reporting (SU-MIMO\_
* Sub-band Size
	+ Option 1:
		- 4 for FDD with 15kHz SCS, 10MHz CBW
		- 8 for TDD with 30kHz SCS, 40MHz CBW
	+ Option 2: FFS
* Take beam steering approach as specified in B.2.3B.4A of TS 36.101 and
	+ Option 1: Extend it to L > 2 beams
	+ Option 2: Use it as it is with L = 2 beams.
* Channel Model
	+ TDLA30-5 as baseline
	+ Other options not precluded
* MIMO Correlation
	+ Option 1: XP High
	+ Option 2: XP Medium
	+ Down-select to one option based on simulation results in the next meeting
* MCS and Rank
	+ MCS 20 (64QAM Table), Rank 2 as baseline
	+ Other options not precluded
* For initial simulations:
	+ Use the parameters listed in previous slides.
	+ The remaining parameters will be same as for Rel-15 Type II codebook simulation assumptions in R4-2005550

Test metric* Test Metric for SU-MIMO
	+ Relative Throughput ratio between following PMI and random PMI
* Test Metric for MU-MIMO
	+ Option 1: Relative Throughput ratio between following PMI for Rel-16 enhanced Type II and Rel-15 Type II codebook for MU-MIMO based test setup
	+ Other options not precluded
 |