**3GPP TSG-RAN WG4 Meeting # 97-e R4-200XXXX**

**Electronic Meeting, Nov. 2 – Nov .13, 2020**

**Agenda item:** 7.9.4

**Source:** Moderator (Samsung)

**Title:** Email discussion summary for [97e][324] NR\_eMIMO\_Demod

**Document for:** Information

# Introduction

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

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

* 1st round: Discuss the details test parameters to facilitate the test case setup for requirements.
* 2nd round: Further discuss the left open issue and CR, pending on the progress on 1st round.

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **R4-2014248** | Apple | Draft CR for eMIMO demod requirements - General and Applicability rule |
| **R4-2014556** | Intel | Proposal 1:Schedule PDSCH data in TDD special slots in multi-DCI based multi-TRP Tx test cases  Proposal 2:Schedule PDSCH data in DL slots which carries TRS Tx in multi-DCI based multi-TRP Tx test cases. |
| **R4-2014557** | Intel | Proposal 1: Define requirements for single-DCI multi-TRP Tx with negative TO and frequency offset (test case 1a) with following applicability rule:   * If UE only supports single-DCI based multi-TRP transmission for eMBB, it should be tested with test cases 1a and 1b * If UE can support both single-DCI and multi-DCI for eMBB, it should be tested with test case 2a and 1b   Proposal 2: Schedule PDSCH data in TDD special slots in single-DCI multi-TRP SDM test cases.  Proposal 3: Schedule PDSCH data in DL slots which carries TRS Tx in single-DCI multi-TRP SDM test cases. |
| **R4-2014558** | Intel | Proposal 1:Define performance requirements for FDM scheme A and inter-slot TDM repetition transmission schemes with the following test applicability rule: FDM scheme is skipped if UE passes the multi-DCI based multi-TRP Tx requirements and TDM scheme is skipped if UE passes URLLC slot aggregation requirements and anyone of the other multi-TRP Tx requirements.  Proposal 2: Define performance requirements for FDM scheme A with wideband precoding configuration and inter-slot TDM scheme with 2 PRB precoding granularity.  Proposal 3: Consider two PDSCH repetitions for test case with inter-slot TDM scheme.  Proposal 4: Consider -0.5us, 2us and -0.25us, 1us TO values for requirements definition for multi-TRP repetition schemes for 15 kHz SCS and 30 kHz SCS respectively  Proposal 5: Consider 200Hz and 300Hz FO values for requirements definition for multi-TRP repetition schemes for 15 kHz SCS and 30 kHz SCS respectively.  Proposal 6: Use MCS 13 from MCS Table 3 for requirements definition of multi-TRP repetition schemes.  Proposal 7: Define performance requirements for repetition Tx schemes with the following QCL assumption: 1000 DMRS antenna port with TCI state #1, 1001 DMRS antenna port with TCI state #2  Proposal 8: Use 1% BLER as a test metric for single-DCI based multi-TRP repetition Tx schemes performance requirements  Proposal 9: Define the following test cases per each duplex mode for multi-TRP repetition schemes:   * Test 1a: Single-DCI based FDM scheme A with frequency offset and positive time offset * Test 1b: Single-DCI based inter-slot TDM A with frequency offset and positive time offset   Proposal 10: Adopt proposed above procedure to organize specification structure for multi-TRP Tx schemes. |
| **R4-2014559** | Intel | CR to TS 38.101-4: Performance requirements single-DCI based multi-TRP Repetition Tx schemes |
| **R4-2014741** | Samsung | eMBB test scope  Proposal 1: eMBB test cases: Introduce following test cases for Multi-TRP/Panel transmission schemes (eMBB) to cover frequency offset, negative and positive time offset to verify proper UE processing and performance   * Test 1a Single-DCI with frequency offset and negative time offset and overlapping scheduling * Test 1b Single- DCI with positive time offset and overlapping scheduling. * Test 2a Multi- DCI with frequency offset and negative time offset and non-overlapping scheduling   Proposal 2: eMBB test cases: Test applicable can be introduced for above test cases:   * If UE only supports single-DCI based multi-TRP transmission for eMBB, it should be tested with test case 1a and test case 1b * If UE can support both single-DCI and multi-DCI for eMBB, it should be tested test 2a and test 1b   URLLC test scope  Proposal 3-URRC test cases-Test scope: Introducing PDSCH demodulation requirements for transmission schemes related to URLLC operation   * Test schemes: Only FDM scheme A and inter-slot TDM scheme * Test applicable rules can be applied (not our preference, can be accepted as comprise): FDM scheme is skipped if UE passes the multi-DCI based multi-TRP Tx requirements and TDM scheme is skipped if UE passes URLLC slot aggregation requirements and anyone of the other multi-TRP Tx requirements   Proposal 4: URLLC test cases- test parameters:   * Using option 1 to introduce test cases:   + Test 1a: Single-DCI based FDM scheme A with frequency offset and negative time offset   + Test 1b: Single-DCI based inter-slot TDM with positive time offset * MCS: MCS 19 (Option2) * Test metric: 1% BLER (Option 1) |
| **R4-2014742** | Samsung | Simulation results summary for Rel-16 eMIMO WI |
| **R4-2014743** | Samsung | Observation 2: The performance with frequency offset is degraded slightly than with no frequency offset case.  Observation 3: The impact with negative time offset is more significantly than with positive time offset case.  Observation 4: The FDD performance is similar with TDD performance. |
| **R4-2014744** | Samsung | Observation 2: The performance of FDD is similar to TDD ones.  Observation 3: The performance of ’antenna configuration 2x4’ achieves about 5dB gain than ’antenna configuration 2x2’ case. |
| **R4-2014745** | Samsung | Simulation results for Single-DCI URLLC schemes |
| **R4-2015128** | MTK | Simulation results on PDSCH performance requirements for multi-DCI based multi-TRP transmission |
| **R4-2015648** | Huawei, HiSilicon | Proposal 1: Not introduce test 1a for Multi/Single-DCI PDSCH requirement |
| **R4-2015649** | Huawei, HiSilicon | Simulation results of PDSCH requirements for Multi-DCI transmission scheme |
| **R4-2015650** | Huawei, HiSilicon | Simulation results of PDSCH requirements for Single-DCI SDM scheme |
| **R4-2015651** | Huawei, HiSilicon | Proposal 1: Option 1 for the number of test cases for FDM scheme A and inter-slot TDM  Proposal 2: Option 2 MCS 19 for MCS configuration  Proposal 3: Reuse the test metric of SNR point of 70% maximum throughput  Proposal 4: Consider the possibility of reusing the parameter configuration of URLLC slot aggregation |
| **R4-2015652** | Huawei, HiSilicon | Simulation Results |
| **R4-2015653** | Huawei,  HiSilicon | Draft CR for 38.101-4: Introduction of PDSCH requirement with Single-DCI based SDM scheme |
| **R4-2015654** | Huawei, HiSilicon | DraftCR on PDSCH requirement with Multi-DCI based multi-TRP |
| **R4-2015830** | Ericsson | Draft CR: PDSCH FRC for eMIMO sDCI/mDCI-based SDM transmission |
| **R4-2015831** | Ericsson | Simulation results of single-DCI based SDM transmission |
| **R4-2015832** | Ericsson | Proposal 1: RAN4 defines three test cases with the following applicability rule:  If UE supports single-DCI based SDM transmission scheme (i.e., singleDCI-SDM-scheme) but not support multi-DCI based SDM transmission scheme (i.e., multiDCI-MultiTRP), it should be tested with test case 1a and test case 1b.  If UE supports both single-DCI based SDM transmission scheme (i.e., singleDCI-SDM-scheme) and multi-DCI based SDM transmission scheme (i.e., multiDCI-MultiTRP), it should be tested test 1b and test 2a.  Test 1a/1b/2a is given as follows:   * If UE only supports single-DCI based multi-TRP transmission for eMBB, it should be tested with test cases 1a and 1b * If UE only supports single-DCI based multi-TRP transmission for eMBB, it should be tested with test cases 1a and 1b * If UE only supports single-DCI based multi-TRP transmission for eMBB, it should be tested with test cases 1a and 1b   Proposal 2: Introduce new FRC for multi-DCI based SDM transmission requirements with 26PRB per codeword for FDD and with 53PRB per codeword for TDD. It also configures two TRS configurations every 20ms.  Proposal 3: Introduce new FRC for single-DCI based SDM transmission requirements with two TRS configurations every 20ms.  Proposal 4: Schedule PDSCH in the TDD special slots.  Proposal 5: For multi-DCI SDM transmission, the same precoding is applied for both codewords, where PDSCH & PDSCH DMRS Precoding is configured with Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, and with PRB bundling granularity. |
| **R4-2015833** | Ericsson | Simulation results of multi-DCI based SDM transmission |
| **R4-2015834** | Ericsson | Proposal 3-URRC test cases-Test scope: Introducing PDSCH demodulation requirements for transmission schemes related to URLLC operation   * Test schemes: Only FDM scheme A and inter-slot TDM scheme   Proposal 1: RAN4 defines PDSCH demodulation requirements with sDCI-based FDM Scheme A for UE capable of supportFDM-SchemeA.  Proposal 2: FDM scheme A requirement is skipped if UE passes the multi-DCI based SDM requirements.  Proposal 3: For FDM scheme A requirements, RAN4 reuses the same test setup and metric as the mDCI-based SDM transmission requirements, that is   * Configure MCS 19 * Use the 70% of maximum throughput as the test metric * Set the same requirements (SNR) as multi-DCI based transmission scheme, and Configure frequency offset and negative time offset   Proposal 4: RAN4 defines PDSCH demodulation requirements with sDCI-based inter-slot TDM for UE capable of supportInter-slotTDM.  Proposal 5: Inter-slot TDM requirement is skipped if UE passes URLLC slot aggregation requirements, discussed in Rel-16 URLLC WI performance, and anyone of the other multi-TRP Tx requirements.  Observation 1: sDCI-based inter-slot transmission shows performance gain compared with single-TRP based transmission.  Observation 2: sDCI-based iner-slot transmission performance is affected by frequency offset between two TRPs, especially for higher MCS.  Proposal 6: Set the same MCS (13, 16, or 19) as PDSCH slot aggregation defined in Rel-16 URLLC WI performance part.  Proposal 7: Use the same test metric as PDSCH slot aggregation defined in URLLC WI, that is, 1% BLER.  Proposal 8: Configure frequency offset and positive time offset. |

## Open issues summary

Last RAN4 meeting agreements in WF R4-2012662 and R4-2012663

List of open issues:

* Sub-Topic 1-1: Generic test set-up
  + Issue 1-1-1: Scheduling PDSCH data in TDD special slots for single/multi-DCI
  + Issue 1-1-2: Scheduling PDSCH data in DL slots which carriers TRS Tx for single/multi-DCI
* Sub-Topic 1-2: Test parameters for Multi-DCI based multi-TRP/Panel transmission schemes (eMBB)
  + Issue 1-2-1: Number of test cases for single-DCI/multi-DCI
  + Issue 1-2-2: FRC for single /multi-DCI based SDM transmission
  + Issue 1-2-3: Precoding scheme for multi-DCI SDM
* Sub-Topic 1-3: Test parameters for Single-DCI based multi-TRP/Panel transmission schemes (URLLC)
  + Issue 1-3-1: Transmission schemes
  + Issue 1-3-2: Number of test cases
  + Issue 1-3-3: PRB precoding granularity
  + Issue 1-3-4: Antenna Port indices
  + Issue 1-3-5: timing offset among multi-panel/TRP
  + Issue 1-3-6: Frequency offset among multi-panel/TRP
  + Issue 1-3-7: Tx occasions for inter-slot TDM
  + Issue 1-3-8: Requirement setup for FDM scheme A
  + Issue 1-3-9: MCS for FDM scheme A and inter-slot TDM scheme
  + Issue 1-3-10: Test Metric for FDM scheme A and inter-slot TDM scheme
  + Issue 1-3-11: Simulation Assumption

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

**Issue 1-1-1: Scheduling PDSCH data in TDD special slots for single/multi-DCI**

* Proposals
  + Option 1: Yes (Intel, Ericsson)
* Recommended WF
  + Companies’ feedback needed for above proposal

**Issue 1-1-2: Scheduling PDSCH data in DL slots which carriers TRS Tx for single/multi-DCI**

* Proposals
  + Option 1: Yes (Intel)
* Recommended WF
  + Companies’ feedback needed for above proposal

### Sub-topic 1-2: Test parameters for Single-DCI/Multi-DCI based multi-TRP/Panel transmission schemes (eMBB)

**Issue 1-2-1: Number of test cases for single-DCI/multi-DCI**

* Proposals
  + Option 1: 3 test cases per duplex mode with test applicability rule (Samsung, Intel, Ericsson)
* Test 1a: Single-DCI with frequency offset and negative time offset and overlapping scheduling
* Test 1b: Single-DCI with positive time offset, and overlapping scheduling
* Test 2a: Multi- DCI with frequency offset and negative time offset and non-overlapping scheduling
* Applicability rule
* If UE only supports single-DCI based multi-TRP transmission for eMBB, it should be tested with test case 1a and test case 1b
* If UE can support both single-DCI and multi-DCI for eMBB, it should be tested test 2a and test 1b
  + Option 2: only 2 test cases per duplex mode (Huawei)
* Test 1b: Single-DCI with positive time offset, and overlapping scheduling
* Test 2a: Multi- DCI with frequency offset and negative time offset and non-overlapping scheduling
* Recommended WF
  + 3 Companies prefer option 1 and 1 company prefer option 2; can we agree with option 1 with test applicable rules following majority approach?

**Issue 1-2-2: FRC for single /multi-DCI based SDM transmission**

* Proposals
  + Option 1: Introduce new FRC for Single/multi-DCI based SDM transmission requirements with
* Multi-DCI based SDM schemes
* FDD: 26PRB per codeword
* TDD: 53PRB per codeword
* Two TRS configurations every 20ms
* Single-DCI based SDM schemes
* Two TRS configurations every 20ms
* Reference channel
* R.PDSCH.1-3.2 FDD: single-DCI based SDM schemes in FDD
* R.PDSCH.1-3.3 FDD: multi-DCI based SDM schemes in FDD
* R.PDSCH.2-3.2 TDD: single-DCI based SDM schemes in TDD
* R.PDSCH.2-3.3 TDD: multi-DCI based SDM scheme in TDD

FDD FRCs for single DCI and multi-DCI based SDM transmissions

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | |
| Reference channel |  | R.PDSCH.1-3.1 FDD | [R.PDSCH.1-3.2 FDD] | [R.PDSCH.1-3.3 FDD] |  |  |
| Channel bandwidth | MHz | 10 | 10 | 10 |  |  |
| Subcarrier spacing | kHz | 15 | 15 | 15 |  |  |
| Number of allocated resource blocks | PRBs | 52 | 52 | 26 |  |  |
| Number of consecutive PDSCH symbols |  | 12 | 12 | 12 |  |  |
| Allocated slots per 2 frames | Slots | 19 | 19 | 19 |  |  |
| MCS table |  | 64QAM | 64QAM | 64QAM |  |  |
| MCS index |  | 19 | 19 | 19 |  |  |
| Modulation |  | 64QAM | 64QAM | 64QAM |  |  |
| Target Coding Rate |  | 0.51 | 0.51 | 0.51 |  |  |
| Number of MIMO layers |  | 2 | 2 | 2 |  |  |
| Number of DMRS REs |  | 12 | 12 | 12 |  |  |
| Overhead for TBS determination |  | 0 | 0 | 0 |  |  |
| Information Bit Payload per Slot |  |  |  |  |  |  |
| For Slot i = 0 | Bits | N/A | N/A | N/A |  |  |
| For Slots i = 10, 11 |  | 39936 | 37896 | 18960 |  |  |
| For Slots i = 1,…, 9, 12, …, 19 | Bits | 42016 | 42016 | 21000 |  |  |
| Transport block CRC per Slot |  |  |  |  |  |  |
| For Slot i = 0 | Bits | N/A | N/A | N/A |  |  |
| For Slots i = 1,…, 19 | Bits | 24 | 24 | 24 |  |  |
| Number of Code Blocks per Slot |  |  |  |  |  |  |
| For Slot i = 0 | CBs | N/A | N/A | N/A |  |  |
| For Slots i = 1,…, 19 | CBs | 5 | 5 | 3 |  |  |
| Binary Channel Bits Per Slot |  |  |  |  |  |  |
| For Slot i = 0 | Bits | N/A | N/A | N/A |  |  |
| For Slots i = 10, 11 | Bits | 78624 | 74800 | 37440 |  |  |
| For Slots i = 1,…, 9, 12, …, 19 | Bits | 82368 | 82368 | 41184 |  |  |
| Max. Throughput averaged over 2 frames | Mbps | 39.707 | 39.503 | 18.216 |  |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms  Note 2: Slot i is slot index per 2 frames | | | | | | |

TDD FRCs for single DCI and multi-DCI based SDM transmissions

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | |
| Reference channel |  | R.PDSCH.2-3.1 TDD | [R.PDSCH.2-3.2 TDD] | [R.PDSCH.2-3.3 TDD] |  |  |
| Channel bandwidth | MHz | 40 | 40 | 40 |  |  |
| Subcarrier spacing | kHz | 30 | 30 | 30 |  |  |
| Allocated resource blocks | PRBs | 106 | 106 | 53 |  |  |
| Number of consecutive PDSCH symbols |  |  |  |  |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} |  | 4 | 4 | 4 |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} |  | 12 | 12 | 12 |  |  |
| Allocated slots per 2 frames |  | 31 | 31 | 31 |  |  |
| MCS table |  | 64QAM | 64QAM | 64QAM |  |  |
| MCS index |  | 19 | 19 | 19 |  |  |
| Modulation |  | 64QAM | 64QAM | 64QAM |  |  |
| Target Coding Rate |  | 0.51 | 0.51 | 0.51 |  |  |
| Number of MIMO layers |  | 2 | 2 | 2 |  |  |
| Number of DMRS REs |  |  |  |  |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} |  | 6 | 6 | 6 |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} |  | 12 | 12 | 12 |  |  |
| Overhead for TBS determination |  | 0 | 0 | 0 |  |  |
| Information Bit Payload per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A | N/A | N/A |  |  |
| For Slots i = 20, 21 | Bits | 83976 | 77896 | 38936 |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 27144 | 27144 | 13576 |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,19,22,…,39} | Bits | 83976 | 83976 | 42014 |  |  |
| Transport block CRC per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A | N/A | N/A |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 24 | 24 | 24 |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6}for i from {1,…,39} | Bits | 24 | 24 | 24 |  |  |
| Number of Code Blocks per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | CBs | N/A | N/A | N/A |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | CBs | 4 | 4 | 2 |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} | CBs | 10 | 10 | 5 |  |  |
| Binary Channel Bits Per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A | N/A | N/A |  |  |
| For Slots i = 20, 21 | Bits | 160272 | 152640 | 76320 |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 53424 | 53424 | 26712 |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,19,22,…,39} | Bits | 167904 | 167904 | 83952 |  |  |
| Max. Throughput averaged over 2 frames | Mbps | 118.796 | 118.188 | 59.126 |  |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms  Note 2: Slot i is slot index per 2 frames | | | | | | |

* Recommended WF
  + Companies’ feedback needed for above proposal

**Issue 1-2-3: Precoding scheme for multi-DCI SDM**

* Proposals
  + Option 1(Ericsson): Same precoding is applied for both codewords, where PDSCH & PDSCH DMRS Precoding is configured with Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, and with PRB bundling granularity.
* Recommended WF
  + Companies’ feedback needed for above proposal

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

**Issue 1-3-1: Transmission schemes**

* Proposals
  + Option 1(Samsung, Intel, Ericsson, Huawei): Define performance requirement for URLLC transmission schemes with test applicability rule
* Only FDM scheme A for UE capable of *supportFDM-SchemeA* and inter-slot TDM scheme for UE capable of *supportIntel-slotTDM*
* Test applicability
* FDM scheme is skipped if UE passes the multi-DCI based multi-TRP Tx requirements
* TDM scheme is skipped if UE passes URLLC slot aggregation requirements and anyone of the other multi-TRP Tx requirements
* Recommended WF
  + All companies prefer option1, agree option 1?

**Issue 1-3-2: Number of test cases**

* Proposals
  + Option 1 (Samsung, Huawei):
* Test 1a: Single-DCI based FDM scheme A with frequency offset and negative time offset
* Test 1b: Single-DCI based inter-slot TDM with positive time offset
  + Option 2 (Intel):
* Test 1a: Single-DCI based FDM scheme A with frequency offset and positive time offset
* Test 1b: Single-DCI based inter-slot TDM A with frequency offset and positive time offset
  + Option 3 (Ericsson):
* Test 1a: Single-DCI based FDM scheme A with frequency offset and negative time offset
* Test 1b: Single-DCI based inter-slot TDM A with frequency offset and positive time offset
* Recommended WF
  + Option 3 is the hybrid of option 1 and option 2, can we take option 3?

**Issue 1-3-3: PRB precoding granularity**

* Proposals
  + Option 1(Intel):
* Wideband precoding for Single-DCI based FDM scheme A
* 2 PRB precoding granularity for Single-DCI based inter-slot TDM scheme
* Recommended WF
  + Companies’ feedback needed for above proposal

**Issue 1-3-4: Antenna Port indices**

* Proposals
  + Option 1(Intel):
* 1000 DMRS antenna port with TCI state#1
* 1001 DMRS antenna port with TCI state#2
* Recommended WF
  + Agree option 1

**Issue 1-3-5: timing offset among multi-panel/TRP**

* Proposals
  + Option 1(Intel): Considering -0.5 us, 2us and -0.25, 1us values for requirement definition for multi-TRP repetition schemes for 15KH SCS and 30 KHz SCS
* FDD with 15KHz : 2 us
* TDD with 30 KHz: 2 us?
* Recommended WF
  + Companies’ feedback needed for above proposal

**Issue 1-3-6: Frequency offset among multi-panel/TRP**

* Proposals
  + Option 1(Intel):
* FDD with 15KHz: 200Hz
* TDD with 30KHz: 300Hz
* Recommended WF
  + Agree option 1

**Issue 1-3-7: Tx occasions for inter-slot TDM**

* Proposals
  + Option 1: two repetitions (Intel, Ericsson)
  + Option 2: Consider the possibility of reusing the parameter configuration of URLLC slot aggregation (Huawei)
* Recommended WF
  + Agree option 1. For URLLC WI, RAN4 defined the PDSCH requirement with 2 slot aggregation?

**Issue 1-3-8: Requirement setup for FDM scheme A**

* Proposals
  + Option 1(Ericsson): Set the same requirements (SNR) as multi-DCI transmission scheme
* Recommended WF
  + Companies’ feedback needed for above proposal

**Issue 1-3-9: MCS for FDM scheme A and inter-slot TDM scheme**

* Proposals
  + Option 1(Samsung, Huawei): MCS 19 both FDM scheme A and inter-slot TDM scheme
  + Option 2 (Ericsson):
* FDM scheme A: MCS19
* inter-slot TDM scheme : same MCS (13,16 or 19) defined in Rel-16 URLLC WI performance part for inter-slot TDM scheme
  + Option 3 : MCS13 from MCS Table 3 (Intel)
* Recommended WF
  + Issue 1: further clarification MCS table used? MCS table 1 or MCS table 3?
* FDM scheme: MCS 19?
* Inter-slot TDM scheme: FFS among 13/16/19,down selection one of them

**Issue 1-3-10: Test Metric for FDM scheme A and inter-slot TDM scheme**

* Proposals
  + Option 1: 1% BLER (BLER is calculated after all transmission) (Intel, Samsung)
  + Option 2(Ericsson):
* 70% TP for FDM scheme A
* 1% BLER (BLER is calculated after all transmission) for inter-slot TDM scheme
  + Option 3: 70% TP (Huawei)
* Recommended WF
  + Seems option2 would be possible comprise solution as the hybrid of option 1 and option 3, can we take option 2?

**Issue 1-3-11: Simulation Assumption**

* Proposals
  + Option 1 (Intel):

|  |  |  |
| --- | --- | --- |
| Parameters | Simulation cases 1-1~ 1-8 | Simulation cases 2-1~ 2-8 |
| Duplex mode | FDD | TDD |
| TDD UL/DL configuration | N/A | [FR1.30-1 (7DS2U, 6D+4G+4U)]  FFS whether PDSCH is scheduled in the special slots |
| Timing offset of the second TRP from the first TRP | 2 μs | 2 μs |
| Frequency offset between two TRPs | 200 Hz | 300 Hz |
|  | **Common serving cell parameters** | |
| Physical Cell ID | 0 | |
| SSB position in burst | First SSB in Slot #0 | |
| SSB periodicity | 20ms | |
| Transmit TRP of SSB | Only from TRP1 | |
|  | TRS#1 (configuration for TCI state #1) | |
| Transmit TRP | **TRP#1** | |
| CSI-RS periodicity | [20] slots | [40] slots |
| CSI-RS offset | [10] for CSI-RS resources 1 and 2  [11] for CSI-RS resources 3 and 4 | [20] for CSI-RS resources 1 and 2  [21] for CSI-RS resources 3 and 4 |
| Density | 3 | 3 |
| First subcarrier index in the PRB used for CSI-RS | k0=0 | k0=0 |
| QCL Info | TCI state #0 | TCI state #0 |
| First OFDM symbol in the PRB used for CSI-RS | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 |
|  | TRS#2 (configuration for TCI state #2) | |
| Transmit TRP | **TRP#2** | |
| CSI-RS periodicity | [20] slots | [40] slots |
| CSI-RS offset | [10] for CSI-RS resources 1 and 2  [11] for CSI-RS resources 3 and 4 | [20] for CSI-RS resources 1 and 2  [21] for CSI-RS resources 3 and 4 |
| Density | 3 | 3 |
| First subcarrier index in the PRB used for CSI-RS | k0=1 | k0=1 |
| First OFDM symbol in the PRB used for CSI-RS | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 |
| QCL Info | TCI state #0 | TCI state #0 |
|  | **TCI State configuration #0** | |
| Type 1 QCL information | SSB index #0, QCL type C | |
| Type 2 QCL information | N/A | |
|  | **TCI State configuration #1** | |
| Type 1 QCL information | CSI-RS resource: TRS#1, QCL type A | |
| Type 2 QCL information | N/A | |
|  | **TCI State configuration #2** | |
| Type 1 QCL information | CSI-RS resource: TRS#2, QCL type A | |
| Type 2 QCL information | N/A | |
|  | **PDCCH configuration** | |
| CORESETPoolIndex | 0 (or not configured) | |
| Symbols for PDCCH | 0, 1 | |
| K0 | 0 | |
| AL | 8 (576REs) | |
|  | **PDSCH configuration** | |
| PDSCH resource mapping type | Type A | |
| Resource allocation type | Type 1 | |
| Antenna ports index ​ | {1000} for TCI#1 and {1001} for TCI#2 | |
| Note 1: The same SSB (index #0) is transmitted from both TRP1 and TRP2. | | |

|  |  |  |
| --- | --- | --- |
|  | FDMSchemeA | Inter-slot TDM |
| DMRS configuration | Type 1, 1+1 | Type 1, 1+1 |
| Start symbol and time duration | PDSCH#1: 2, 12  PDSCH#1: 2, 12 | PDSCH#1: 2, 12  PDSCH#1: 2, 12 |
| Precoding granularity | WB | 2 |
| FDD PRB allocation | PDSCH#1: PRB#0 to PRB#25  PDSCH#2: PRB#26 to PRB#51 | PDSCH#1: PRB#0 to PRB#51  PDSCH#2: PRB#0 to PRB#51 |
| TDD PRB allocation | PDSCH#1: PRB#0 to PRB#52  PDSCH#2: PRB#53 to PRB#105 | PDSCH#1: PRB#0 to PRB#105  PDSCH#2: PRB#0 to PRB#105 |

* Recommended WF
  + Companies’ feedback needed for above proposal

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Company A | **Sub-Topic 1-1: Generic test set-up**   * Issue 1-1-1: Scheduling PDSCH data in TDD special slots for single/multi-DCI * Issue 1-1-2: Scheduling PDSCH data in DL slots which carriers TRS Tx for single/multi-DCI   **Sub-Topic 1-2: Test parameters for Multi-DCI based multi-TRP/Panel transmission schemes (eMBB)**   * Issue 1-2-1: Number of test cases for single-DCI/multi-DCI * Issue 1-2-2: FRC for single /multi-DCI based SDM transmission * Issue 1-2-3: Precoding scheme for multi-DCI SDM   **Sub-Topic 1-3: Test parameters for Single-DCI based multi-TRP/Panel transmission schemes (URLLC)**   * Issue 1-3-1: Transmission schemes * Issue 1-3-2: Number of test cases * Issue 1-3-3: PRB precoding granularity * Issue 1-3-4: Antenna Port indices * Issue 1-3-5: timing offset among multi-panel/TRP * Issue 1-3-6: Frequency offset among multi-panel/TRP * Issue 1-3-7: Tx occasions for inter-slot TDM * Issue 1-3-8: Requirement setup for FDM scheme A * Issue 1-3-9: MCS for FDM scheme A and inter-slot TDM scheme * Issue 1-3-10: Test Metric for FDM scheme A and inter-slot TDM scheme * Issue 1-3-11: Simulation Assumption |
| Apple | **Sub-Topic 1-1: Generic test set-up**   * Issue 1-1-1: Scheduling PDSCH data in TDD special slots for single/multi-DCI   We are fine to keep the same test setup as Rel-15 tests and schedule PDSCH in special slots for TDD.   * Issue 1-1-2: Scheduling PDSCH data in DL slots which carriers TRS Tx for single/multi-DCI   Scheduling PDSCH in slots with TRS transmission increases the code-rate. Compared to single TRP tests we would have twice the number of REs rate-matched due to TRS from 2 TRP. Since we cannot have different TBS without changing MCS in slots with PDSCH transmission, we prefer not to schedule PDSCH in TRS slots.  **Sub-Topic 1-2: Test parameters for Multi-DCI based multi-TRP/Panel transmission schemes (eMBB)**   * Issue 1-2-1: Number of test cases for single-DCI/multi-DCI   We support the recommended WF by moderator and define applicability rule.   * Issue 1-2-2: FRC for single /multi-DCI based SDM transmission   The FRC definition is dependent on issue 1-1-1 and 1-1-2. Also related to Rel-15 maintenance CR by Ericsson, we cannot have different TBS in slots with TRS transmission without changing MCS.   * Issue 1-2-3: Precoding scheme for multi-DCI SDM   Firstly, would like to understand if this is for single DCI SDM or multi-DCI transmission scheme. In our opinion the random precoder for each TRP should be independently generated.  **Sub-Topic 1-3: Test parameters for Single-DCI based multi-TRP/Panel transmission schemes (URLLC)**  Has it already been agreed to define requirements with multi-TRP single DCI URLLC schemes? We prefer not to define requirements for this case. |
| Ericsson | **Sub-Topic 1-1: Generic test set-up**   * Issue 1-1-1: Scheduling PDSCH data in TDD special slots for single/multi-DCI   Support Option 1   * Issue 1-1-2: Scheduling PDSCH data in DL slots which carriers TRS Tx for single/multi-DCI   Support Option 1  **Sub-Topic 1-2: Test parameters for Multi-DCI based multi-TRP/Panel transmission schemes (eMBB)**   * Issue 1-2-1: Number of test cases for single-DCI/multi-DCI   Support Option 1. It is a good compromise to considering the test coverage (positive/negative time offset between two antenna ports) and number of test cases. However we are also ok to reduce the test case further, like option 2.   * Issue 1-2-2: FRC for single /multi-DCI based SDM transmission   Support Option 1. For FRC, since we don’t consider TRS to derive TBS, we need to set the same TBS value for both slots where TRS is transmitted and TRS is not transmitted.   * Issue 1-2-3: Precoding scheme for multi-DCI SDM   Support Option 1. We suggest to capture this text in the draft CR for sDCI-based SDM transmission, if it is agreed.  **Sub-Topic 1-3: Test parameters for Single-DCI based multi-TRP/Panel transmission schemes (URLLC)**   * Issue 1-3-1: Transmission schemes   Support Option 1.   * Issue 1-3-2: Number of test cases   Support Option 3. For sDCI-based FDM, we prefer to use the same configuration as mDCI-based SDM. Therefore we propose to consider the frequency offset and negative time offset. For inter-slot TDM, our simulation result shows the performance is sensitive to frequency offset. We therefore want to verify the performance of inter-slot TDM with frequency offset.   * Issue 1-3-3: PRB precoding granularity   Support Option 1.   * Issue 1-3-4: Antenna Port indices   Support Option 1   * Issue 1-3-5: timing offset among multi-panel/TRP   We prefer the same time offset setting as sDCI/mDCI-based SDM transmission, that is, 2us for FDD SCS=15kHz and 1us for TDD SCS=30kHz.   * Issue 1-3-6: Frequency offset among multi-panel/TRP   Support the moderator’s recommendation.   * Issue 1-3-7: Tx occasions for inter-slot TDM   I think options 1 and 2 are identical because PDSCH demod with URLLC WI uses repetition=2.   * Issue 1-3-8: Requirement setup for FDM scheme A   Support Option 1   * Issue 1-3-9: MCS for FDM scheme A and inter-slot TDM scheme   Option 2. Considering the applicability rule that FDM scheme A is tested if UE is not capable of multi-DCI monitoring and inter-slot TDD is tested if UE does not pass URLLC slot aggregation requirements, we would like to set the same MCS as the corresponding test cases.   * Issue 1-3-10: Test Metric for FDM scheme A and inter-slot TDM scheme   Option 2. Considering the applicability rule that FDM scheme A is tested if UE is not capable of multi-DCI monitoring and inter-slot TDD is tested if UE does not pass URLLC slot aggregation requirements, we would like to set the same metric as the corresponding test cases.   * Issue 1-3-11: Simulation Assumption   Timing offset of TDD should be 1us.  Schedule PDSCH in the special slots. |
| Huawei | **Sub-Topic 1-1: Generic test set-up**   * Issue 1-1-1: Scheduling PDSCH data in TDD special slots for single/multi-DCI   Given that no degradation on performance has been observed, it is ok to schedule PDSCH data in the special slot.   * Issue 1-1-2: Scheduling PDSCH data in DL slots which carriers TRS Tx for single/multi-DCI   OK with us.  **Sub-Topic 1-2: Test parameters for Multi-DCI based multi-TRP/Panel transmission schemes (eMBB)**   * Issue 1-2-1: Number of test cases for single-DCI/multi-DCI   Support option 2. Two test cases are enough for verifying the right compensation for time offset and frequency offset. For time offset, one compensation algorithm will be used. So, either positive or negative time offset is the same thing to the testing. For frequency offset, it can be added into test 1b for coverage. In this case, we propose the following compromising option 2a: Only 2 test cases per duplex mode   * Test 1b: Single-DCI with frequency offset and positive time offset and overlapping scheduling. * Test 2a: Multi-DCI with frequency offset and negative time offsets and non-overlapping scheduling. * Issue 1-2-2: FRC for single /multi-DCI based SDM transmission   Decide after issue 1-1-1 and 1-1-2 are settled.   * Issue 1-2-3: Precoding scheme for multi-DCI SDM   We don’t have strong view. Seems like it does not affect the performance requirement.  **Sub-Topic 1-3: Test parameters for Single-DCI based multi-TRP/Panel transmission schemes (URLLC)**   * Issue 1-3-1: Transmission schemes   Agree with recommended WF.   * Issue 1-3-2: Number of test cases   No strong view. Recommended WF is also fine for us.   * Issue 1-3-3: PRB precoding granularity   Option 1 is fine for us.   * Issue 1-3-4: Antenna Port indices   Agree with recommended WF.   * Issue 1-3-5: timing offset among multi-panel/TRP   Agree with option 1. 15kHz SCS: 2us, -0.5us. 30kHz SCS: 1us, -0.25us.   * Issue 1-3-6: Frequency offset among multi-panel/TRP   Agree with recommended WF.   * Issue 1-3-7: Tx occasions for inter-slot TDM   Agree with recommended WF.   * Issue 1-3-8: Requirement setup for FDM scheme A   Further check the results and then decide.   * Issue 1-3-9: MCS for FDM scheme A and inter-slot TDM scheme   We prefer to reuse the MCS as multi/single-DCI transmission schemes for eMBB.   * Issue 1-3-10: Test Metric for FDM scheme A and inter-slot TDM scheme   Support option 2. Back to the RAN4 #94-e meeting, while companies were discussing the test scope of Multi-TRP/Panel transmission, there was an agreement related to the test metric of URLLC multi-TRP transmission schemes saying that:   |  | | --- | | * No PDSCH requirements for URLLC multi-TRP transmission schemes with reliability transmission with lower BLER test metric (e.g., lower than 1% BLER) in Rel-16 NR eMIMO WI |   which indicated that lower BLER test metric will not be considered for the requirement definition of URLLC multi-TRP transmission scheme. Then companies began to discuss whether to define PDSCH requirements for URLLC multi-TRP transmission schemes with test metric @70% maximum TP,   |  | | --- | | * Whether to define PDSCH requirements for URLLC multi-TRP transmission schemes with test metric @70% maximum TP   - Option 1: Yes  - Option 2: Deprioritize  - Option 3: No |   which means that only 70% max TP is within the discussion scope.  Besides, eMIMO is not within the scope of URLLC WI, so it is reasonable to differentiate from it.  Issue 1-3-11: Simulation Assumption  Further decide after above parameter are settled. |
| Intel | **Sub-Topic 1-1: Generic test set-up**   * Issue 1-1-1: Scheduling PDSCH data in TDD special slots for single/multi-DCI   Support Option 1 since there is no performance impact.   * Issue 1-1-2: Scheduling PDSCH data in DL slots which carriers TRS Tx for single/multi-DCI   Even that effective code rate in PDSCH slots which carry TRS Tx is higher than in other slots, based on our link-level results there is no performance difference if we consider PDSCH scheduling or not. Therefore, we support Option 1.  **Sub-Topic 1-2: Test parameters for Multi-DCI based multi-TRP/Panel transmission schemes (eMBB)**   * Issue 1-2-1: Number of test cases for single-DCI/multi-DCI   From test coverage perspective we should ensure that robustness to both time and frequency offsets will be tested for both Single-DCI and Multi-DCI schemes. In this case we support option 1 or proposed option 2a by Huawei.   * Issue 1-2-2: FRC for single /multi-DCI based SDM transmission   Agree with proposed FRCs.   * Issue 1-2-3: Precoding scheme for multi-DCI SDM   We agree that it is beneficial to capture precoding generation procedure in specification. However, we do not think that same PMI among two PDSCHs is a typical configuration for multi-TRP Tx. In real field UE will report PMI for each PDSCH and due to different propagation conditions more likely it will be different PMIs. In this case we suggest considering independent random PMI generation for each TRP.  Similar approach should be adopted for other multi-TRP TX schemes and addressed in corresponding CRs.  **Sub-Topic 1-3: Test parameters for Single-DCI based multi-TRP/Panel transmission schemes (URLLC)**   * Issue 1-3-1: Transmission schemes   Support Option 1 and recommended WF.   * Issue 1-3-2: Number of test cases   As compromise we agree with recommended WF (Option 3).   * Issue 1-3-3: PRB precoding granularity   Support Option 1.   * Issue 1-3-4: Antenna Port indices   Support Option 1.   * Issue 1-3-5: timing offset among multi-panel/TRP   In proposed Table with recommended simulation assumptions there is a typo regarding TO for TDD.  Our intention is to use same values as were agreed for eMBB schemes. In this case we support option with 2us;-0;5us for FDD and 1us;-0.25us for TDD.   * Issue 1-3-6: Frequency offset among multi-panel/TRP   Support Option 1.   * Issue 1-3-7: Tx occasions for inter-slot TDM   Agree with recommended WF.   * Issue 1-3-8: Requirement setup for FDM scheme A   In multi-DCI Tx schemes each codeword is coded independently, when is FDM scheme A it is a single codeword. Different TBS sizes will lead to different coding gains and different demodulation performances. The main intention of Option 1 is to reduce the simulation efforts. However, simulation result collection campaign is required to identify the exact difference. Therefore, we cannot accept Option 1.   * Issue 1-3-9: MCS for FDM scheme A and inter-slot TDM scheme   As compromise we agree with recommended WF. Regarding MCS table we suggest considering Low SE table (Table 3) which is more typical configuration for URLLC scenario.   * Issue 1-3-10: Test Metric for FDM scheme A and inter-slot TDM scheme   Options with 1% BLER is fully align with previous agreement which preclude discussions regarding options with (lower) less than 1% BLER.  To decide appropriate test metric, we should not rely on applicability rule and make prioritizations for some schemes under another. FDMA scheme A is not a subset of multi-DCI scheme - it is another UE feature. Also, it will be strange to have different test metrics for URLLC repetition schemes which were designed by RAN1 under single motivation to ensure reliable packet transmission.  Considering that simulation results collection is needed for repetition schemes (there are concerns regarding reusing SNR point) we do not see reasons to consider 70% Throughput as an appropriate test metric. Support Option 1 with 1% BLER for each scheme.  Issue 1-3-11: Simulation Assumption  Agree with comment from Ericsson that:  Timing offset of TDD should be 1us.  Schedule PDSCH in the special slots. |
| MediaTek | **Sub-Topic 1-2: Test parameters for Multi-DCI based multi-TRP/Panel transmission schemes (eMBB)**   * Issue 1-2-1: Number of test cases for single-DCI/multi-DCI   Support the recommended WF.  **Sub-Topic 1-3: Test parameters for Single-DCI based multi-TRP/Panel transmission schemes (URLLC)**   * Issue 1-3-1: Transmission schemes   Support option 1.   * Issue 1-3-2: Number of test cases   Support option 1 and option 3.   * Issue 1-3-10: Test Metric for FDM scheme A and inter-slot TDM scheme   Support option 1. |

### 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** |
| **R4-2014559**  (Intel)  CR to TS 38.101-4: Performance requirements single-DCI based multi-TRP Repetition Tx schemes | Apple: Have we already agreed to introduce requirements with single DCI URLLC transmission schemes?  Intel: There was agreement to introduce such requirements, but exact schemes are still open. |
| Huawei: Proposed change affects should not be void. |
| Company C |
| **R4-2015653**  (Huawei)  draftCR on PDSCH requirement with Single-DCI based SDM scheme | **Apple:** Coversheet - ***Proposed change affects***: Should be ME  The section number needs to be updated based on agreement of Issue 3-1-1.  In Test parameter tables:  Timing offset of the second TRP from the first TRP (Note 2): If only one value is used for tests, it should be specified instead of positive and negative TO. If 2 values are used, we prefer to specify in testcase. Avoid specifying parameters in both Test parameters and Minimum requirements table.  Frequency offset between two TRPs (Note 2). Incorrect reference to Note 2. Need to specify in Test parameters table as its fixed for all tests and need not be duplicated in Minimum requirements table.  The number of tests needs to updated based on agreement on Issue 1-2-1 |
| Ericsson: Format of test parameter table should be aligned with other requirements. |
| Intel: We should align TRS configuration between CR for repetition schemes and CRs for eMBB schemes. In our understanding QCL assumptions for CSI-RS is defined per each CSI-RS resource not per resource set. In this case we can configure 8 CSI-RS resources from which 1-4 are transmitted from TRP#1 with TCI#1 and 5-8 are transmitted from TRP#2 with TCI#2. |
| **R4-2015654**  (Huawei)  draftCR on PDSCH requirement with Multi-DCI based SDM scheme | **Apple:** Coversheet - ***Proposed change affects***: Should be ME  The section number needs to be updated based on agreement of Issue 3-1-1.  Same comments as R4-2015653 on TO/FO parameter.  The number of tests needs to updated based on agreement on Issue 1-2-1 |
| Ericsson: Same comment as R4-2015653. Format of test parameter table should be aligned with other requirements. |
| Intel: Same comment as on R4-2015653. |
| **R4-2015830**  (Ericsson)  Draft CR: PDSCH FRC for eMIMO sDCI/mDCI-based SDM transmission | Apple  Pending discussion and agreement on Issue 1-1-2. For slots with TRS transmission, FFS if we should schedule PDSCH or reduced TBS can be used without changing MCS. |
| Company B |
| Company C |
| **R4-2014248**  (Apple)  Draft CR for eMIMO demod requirements - General and Applicability rule | Huawei: The category should be ‘B’. |
| Company B |
| Company C |

## 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:* |

*Recommendations 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)

## 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** |
| **R4-2014249** | Apple | Observation 1: With SU-MIMO setup performance with correctly reported Type II PMI is significantly better than incorrect Type II PMI reporting.  Observation 2: With SU-MIMO setup performance of Type II PMI is better than Type I PMI.  Proposal 1: Define PMI reporting requirements in Rel-16 with SU-MIMO test setup for Type II and enhanced Type II codebook. |
| **R4-2014740** | Samsung | Observation 1: With SU-MIMO set-up, the Rel-16 Enhanced Type II could achieve significant gain over Rel-15 Type II and Rel-15 Type I codebook with following PMI.  Observation 2: With MU-MIMO Set-up, the performance of Type II codebook even worse than Type I codebook based on the agreed test parameters.  Observation 3: With SU-MIMO set-up, the throughput ratio among following PMI and random under Rel-16 Type II codebook is quite huge at 90% relative throughput.  Proposal1: Overall Test set-up:   * Introduce Rel-15 Type II PMI test cases under SU-MIMO test set-up in Rel-16 timeframe. * Further study and define proper performance requirements if needed under MU-MIMO scenarios in Rel-17 performance enhancement WI.   Proposal 2: In order to achieve test point and test requirements under SU-MIMO test set-up:   * Using 95% relative throughput with following PMI as test point * Restrict random PMI to random selected within Rel-15 Type I codebook set |
| **R4-2014747** | Samsung | Draft CR for introduction of Rel-16 Type II PMI test cases |
| **R4-2014949** | Nokia | Observation 1. eType II PMI is primarily intended to enhance MU-MIMO throughput by providing a much more accurate representation of the strongest channel eigenvectors than Type I SP PMI. This allows the gNB to steer the beams of co-schedule UEs in each other’s null space with less residual interference.  Observation 2. SU-MIMO throughput is less sensitive than MU-MIMO to PMI inaccuracies because MU-MIMO throughput is limited by interference between co-scheduled UEs.  Observation 3. A DUT could in practice be able to report a eType II PMI that does not represent well the channel main eigenvectors and still pass an SU-MIMO test for eType II, because the throughput difference between Type I SP and eType II is not large enough for SU-MIMO transmission.  Observation 4. On a MU-MIMO test setup, the TE does not necessarily need to encode any data or control signal for the co-scheduled UE. The data sequence for the co-scheduled UE may be generated as a random sequence of QAM symbols and processed by the MU-MIMO precoder calculated for the co-scheduled UE.  Observation 5. The precoder calculation, x\_b, for the co-scheduled UE described in the WF document results in reduced computational complexity at the TE: about 3N\_t complex multiplications and additions in total, where N\_t is the number of transmit antennas, and no advanced processing techniques are needed.  Observation 6. The comparison of the Type I with the eType II throughput provides an efficient mean of asserting the improved accuracy of the PMI reported with eType II codebook.  Proposal 1. RAN4 to adopt the MU-MIMO test setup described in the WF and clarify the simplification options for the co-scheduled UE generation. Further clarify that the TE does not need to encode any data or control signal for the co-scheduled UE. As an example, the data sequence for the co-scheduled UE may be generated as a random sequence of QAM symbols and processed by the simplified MU-MIMO precoder calculated for the co-scheduled UE.  Proposal 2. Further clarify that the precoder calculation for the co-scheduled UE boils down to the following simple procedure in case of rank 1 test  Proposal 3. RAN4 to adopt random PMI generation for the co-scheduled UE. Further clarify that, for rank 1 test, the PMI for the co-scheduled UE, w\_b, is a vector of size N\_t×1, with elements drawn from a complex Gaussian distribution of mean 0 and variance 1.  Proposal 4. RAN4 to adopt Option 1 for the test metric, i.e., the throughput ratio between following PMI for Type I SP and eType II |
| **R4-2015646** | Huawei, HiSilicon | Observation 1: For SU-MIMO test setup, the performance of Follow PMI for Type II has an obvious gain over Follow PMI for Type I single panel  Proposal 1: Option 3 for the test setup of (e) Type II codebook based PMI reporting test  Proposal 2: Consider proposed simulation assumption for the PDSCH requirement under the test setup of MU-MIMO |
| **R4-2015647** | Huawei, HiSilicon | Simulation results for SU-MIMO eType II codebook based PMI reporting test |
| **R4-2016033** | R&S | Proposal 1: RAN4 agrees to use an SU-MIMO based test setup for type II PMI reporting for Rel-15 and Rel-16 requirements.  Proposal 2: RAN4 further investigates how to enhance the PMI type II test using the SU-MIMO test setup. |
| **R4-2016101** | Ericsson | Simulation results for Rel-16 Type II codebook |
| **R4-2016102** | Ericsson | Observation 1: The proposed SU-MIMO test cannot be used for Type II CSI reporting since the performance benefit of Type II feedback is not visible. This is due to that SU-MIMO doesn’t take advantage of the rich channel feedback of Type II reporting  Observation 2: Type I codebook is a subset of the Type II codebook, the “Type I subset”  Observation 3: It is difficult to guarantee a minimum performance and benchmark when employing a random type II PMI value to the gNB precoder  Observation 4: There is practically no performance difference when ‘High’ correlation matrix is employed in the SU-MIMO test  Observation 5: 70% throughput mark shows more gain with Type II codebook over the 90% throughput mark for custom correlation and medium correlation.  Observation 6: The subband size does not distinguish performance to any significant degree  Observation 7: The gain when calculated by comparing follow Type II PMI with random Type II PMI has high variance arising from the stochastical behaviour and uncertainty of random PMI precoder selection  Proposal 1: Use 70% throughput mark as reference throughput for gain requirement  Proposal 2: Configure subband size 4 for FDD and 8 for TDD.  Proposal 3: Use Type II follow PMI divided by Type I follow PMI to guarantee performance benefit of Type II codebooks  Proposal 4: Configure medium or custom correlation  Proposal 5: use MCS11 Rank1 for MU-MIMO testing  Proposal 6: use custom correlation for MU-MIMO PMI testing |
| **R4-2016429** | Qualcomm | Observation 1: UE reports the same precoder for both SU-MIMO and MU-MIMO test setups  Observation 2: There is a significant difference in PMI ratio and SNR needed to reach 90% of peak throughput between eType 2 and Type 1 PMI reporting.  Proposal 1: Use SU-MIMO test setup for defining Enhanced Type II PMI reporting tests. |

## Open issues summary

Last RAN4 meeting agreements captured in WF R4-2012761

List of open issues:

* Sub-Topic 2-1: Test set-up SU-MIMO VS. MU-MIMO
  + Issue 2-1-1: SU-MIMO VS MU-MIMO Setup
* Sub-Topic 2-2: Test parameters for SU-MIMO option
  + Issue 2-2-1: MIMO Correlation
  + Issue 2-2-2: Test point for gain requirements
  + Issue 2-2-3: Test metric
* Sub-Topic 2-3: Test parameters for MU-MIMO option
  + Issue 2-3-1: Simplification of MU-MIMO scheduling
  + Issue 2-3-2: Precoder generation in TE for DUT and co-scheduled UEs
  + Issue 2-3-3: Sub-band Size
  + Issue 2-3-4: Channel Model
  + Issue 2-3-5: MIMO Correlation
  + Issue 2-3-6: MCS and Rank
  + Issue 2-3-7: Test metric

### Sub-topic 2-1: Test setup (SU-MIMO vs MU-MIMO)

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

* Proposals
  + Option 1: SU-MIMO Set-up (Apple, R&S, Huawei, Qualcomm, Samsung)
* Option 1a: Using SU-MIMO set-up to introduce PMI test cases meanwhile a MU-MIMO setup based demodulation test with test metric of either follow PMI based or random PMI based throughput can be introduced (Huawei)
* Option 1b: Introduce Type II PMI test cases under SU-MIMO test set-up in Rel-16 timeframe. Further study and define proper performance requirements if needed under MU-MIMO scenarios in Rel-17 performance enhancement WI (Samsung)
  + Option 2: MU-MIMO Set-up (Ericsson, Nokia)
* Recommended WF

5 companies preferred SU-MIMO set-up, and 2 companies prefer option2. And one TE vendor provides feedback the current proposal MU-MIMO setup is not feasible

The performance under SU-MIMO and MU-MIMO performance with Rel-16 Type II and Type I codebook summarized in following tables (5 companies provided results for SU-MIMO set-up, only 2 company provide results for MU-MIMO scenario)

**FDD 16x2 Medium -64 QAM Rank2-with SU-MIMO set-up**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Company | Rel16 Enhanced Type II PMI | | Rel15 Enhanced Type II PMI | | Type I PMI | | TP ratio eType II/Type I |
| SNR in dB at 90% of peak throughput | TP ratio | SNR in dB at 90% of peak throughput | TP ratio | SNR in dB at 90% of peak throughput | TP ratio |
| Samsung | 6.3 | 10.33 | 12.6 | 2.9 | 15.0 | 2.75 | 2.1 |
| Qualcomm | 8.45 | 5.76 | 10.44 | 4.10 | 13.84 | 2.10 | 2.75 |
| Ericsson | 11.3 | 3.81 | 12.1 | 2.82 |  |  | 1.12/1.32 (70% point) |
| Huawei |  |  | 9.82 |  |  |  |  |
| Apple | 11.28 | 4.69 | 12.16 | 3.57 | 14.5 | 2.4 |  |

**FDD 16x2 Medium –MCS 7 Rank1-with SU-MIMO set-up**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Company | Rel16 Enhanced Type II PMI | | Rel15 Enhanced Type II PMI | |
| SNR in dB at 90% of peak throughput | Gain Type II/Type I | SNR in dB at 90% of peak throughput | Gain Type II/Type I |
| Samsung  (Option 1: Xb using random PMI) | -2.5 | 0.99 | -4.3 | 0.99 |
| Ericsson (not mentioned) | -2.81 | 1.17 | -2.67 | 2.82 |

Major concern from the proponent of option 2 is that option 1 with SU-MIMO set-up, test cases cannot discriminate UE behaviour to follow eType II codebook as Type I codebook is the sub-set of eType II codebook.

From the simulation results from all the companies’ results, we can see that Type II show enough performance gap over than Type I, which is enough to discriminate UE behaviour to ensure proper UE processing.

This issue has been discussed over 3 meeting cycles without agreements, and this is the basic set-up we started to define eType II requirement in Rel-16. As rapporteur, we do encourage companies comprised to a concrete proposal and make decision in this meeting.

As recommended WF:

* + Introduce Rel-16 Type II codebook requirements with SU-MIMO set-up under the condition that with proper test parameters to ensure enough performance difference over than Type I
  + Further study and define proper performance requirements if needed under MU-MIMO scenario in Rel-17 performance enhancement WI.

### Sub-topic 2-2: Test parameters for SU-MIMO option

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

* Proposals
  + Option 1: XP (custom)low ( Ericsson)
  + Option 2: XP Medium (Previous agreement)
* Recommended WF
  + Agreed option 2. Option 2 is the agreement in the last meeting for SU-MIMO test setup

**Issue 2-2-2: Test point for gain requirements**

* Proposals
  + Option 1: 70% of TP (Ericsson)
  + Option 2: 95% of TP (Samsung)
  + Option 3: 90% of TP
* Recommended WF
  + Companies’ feedback needed for above proposal

**Issue 2-2-3: Test Metric**

* Proposals
  + Option 1: The ratio of following PMI with enhanced type II codebook and type I single panel codebook (Ericsson)
  + Option 2: The ratio of following PMI with enhanced type II codebook and random PMI (Previous agreements)
* Recommended WF
  + Following the agreement in RAN4#94b-e meeting in WF-2005530. The test metric is the ratio of following PMI and random PMI. Based on the simulation results. The gain is feasible with this test metric.

### Sub-topic 2-3: Test parameters for MU-MIMO option

**Issue 2-3-1: Simplification of MU-MIMO scheduling**

* Proposals
  + Option 1 (Nokia): Simplified MU-MIMO test setup with 1 real UE (DUT) where a dummy co-scheduled UE is modelled a through random PMI, TE does not need to encode any data ort control signal for the co-schedule UE. Data sequence for the co-scheduled UE may be generated as random sequence of QAM symbols and processed by the simplified MU-MIMO precoder calculated for the co-scheduled UE



* Recommended WF
  + N.A

**Issue 2-3-2: Precoder generation in TE for DUT and co-scheduled UEs**

* Proposals
  + Option 1: Using ZF to generate co-schedule UE precoder with rank 1 test clarification (Nokia)

|  |
| --- |
| **where is the orthogonalized and normalised and is the normalized projection of the co-scheduled PMI on the null space of** |

|  |
| --- |
| * Initialisation: is an unit-norm vector (=1) reconstructed from the PMI reported by the DUT. * Step 1) Generate a random vector of size , with elements drawn from a complex Gaussian distribution of mean 0 and variance 1. * Step 2) Calculate the quantities: , and * Step 3) |

* Recommended WF
  + N.A

**Issue 2-3-3: Sub-band Size**

* Proposals
  + Option 1: (Ericsson)
* 4 for FDD with 15kHz SCS, 10MHz CBW
* 8 for TDD with 30kHz SCS, 40MHz CBW
* Recommended WF
  + Companies’ feedback needed for above proposal

**Issue 2-3-4: Channel Model**

* Proposals
  + Option 1: TDLC300-5 (Ericsson)
* Recommended WF:
  + Companies’ feedback needed for above proposal

**Issue 2-3-5: MIMO Correlation**

* Proposals
  + Option 1: XP (custom)low (Ericsson)
* Recommended WF:
  + Companies’ feedback needed for above proposal

**Issue 2-3-6: MCS and Rank**

* Proposals
  + Option 1: MCS 11 (64QAM Table), Rank 1 (Ericsson)
* Recommended WF:
  + Companies’ feedback needed for above proposal

**Issue 2-3-7: Test metric**

* Proposals
  + Option 1 : The ratio of following PMI with following PMI with enhanced type II codebook and type I single panel codebook (Ericsson, Nokia)
* Recommended WF:
  + Companies’ feedback needed for above proposals

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Company | **Sub-Topic 2-1: Test set-up SU-MIMO VS. MU-MIMO**   * Issue 2-1-1: SU-MIMO VS MU-MIMO Setup   **Sub-Topic 2-2: Test parameters for SU-MIMO option**   * Issue 2-2-1: MIMO Correlation * Issue 2-2-2: Test point for gain requirements * Issue 2-2-3: Test metric   **Sub-Topic 2-3: Test parameters for MU-MIMO option**   * Issue 2-3-1: Simplification of MU-MIMO scheduling * Issue 2-3-2: Precoder generation in TE for DUT and co-scheduled UEs * Issue 2-3-3: Sub-band Size * Issue 2-3-4: Channel Model * Issue 2-3-5: MIMO Correlation * Issue 2-3-6: MCS and Rank * Issue 2-3-7: Test metric |
| Apple | **Sub-Topic 2-1: Test set-up SU-MIMO VS. MU-MIMO**   * Issue 2-1-1: SU-MIMO VS MU-MIMO Setup   We agree with the recommended way forward from moderator.  **Sub-Topic 2-2: Test parameters for SU-MIMO option**   * Issue 2-2-1: MIMO Correlation   XP\_medium is already agreed in last meeting and also have good performance and prefer not to change it.   * Issue 2-2-2: Test point for gain requirements   We prefer to use same test point as Type I codebook – 90% max TP   * Issue 2-2-3: Test metric   We prefer to use same test metric as previously agreed for SU-MIMO setup. TP ratio of follow PMI vs random PMi |
| Ericsson | **Sub-Topic 2-1: Test set-up SU-MIMO VS. MU-MIMO**   * Issue 2-1-1, 2-2-1, 2-2-2, 2-2-3   We can agree to use the SU-MIMO based setup **if and only if** we distinguish the performance over Type I PMI reporting. When we create these requirements, companies’ have simulated and shown performance gains over Type I codebook with different simulations. Yet if we measure the throughput over random PMI we do not capture those performance gains into the specification. Furthermore, with simulations coming from different companies the requirements will create a **minimum** requirement based on all simulations from all companies. E.g., if one company shows ~6dB gain over Type I with Type II codebook it will not be reflected in the specification when another company may only show ~2dB gain. The point of simulations is to align a minimum gain requirement. Considering the 6dB gain may not be used as the sole value when creating requirements.  Thus, the only way we see that the performance may be distinguished for the Type II family of codebooks is to measure the gain over the Type I codebook. Thereby ensuring that the UE has a different implementation of the two codebooks and ensuring a performance gain as such.  In our simulations we see that there is slightly more performance gain when tweaking the correlation matrix according to our alpha, beta, and gamma values. However, there may also be sufficient performance gains when medium correlation is configured.  It is also questionable whether these performance gains observed with Type II codebook will be negligible if we do not ensure that there is a different implementation for the Type II codebook compared to the Type I codebook.  Furthermore, as we highlight in our paper, the performance under ‘random’ PMI is very diverging amongst companies’ and it poorly reflects a test metric to highlight Type II implementation. ‘Random’ PMI feedback showcases solely that performance will be very poor if the gNB randomly selects a precoder to employ when precoding the transmission. Indeed this should be the case for large antenna arrays that the codebook will have a large amount of poor PMIs to select from.  If we measure against the Type I codebook. We have a very good baseline to create requirements which will suitably reflect a performance gain when employing more advanced codebooks. Also, the expected performance for the Type I codebook is much more stable and will create a requirement where the benchmark reference guarantees that the Type II codebook performs as expected.  **Sub-Topic 2-3: Test parameters for MU-MIMO option**  For the MU-MIMO approach we see that the conditions and limitations of the previous WF causes the performance of Type II codebook to degrade. As a result, the performance gain previously employed when the MU-MIMO environment considered zero-forcing accurate PMI reports both from the DUT, and the co-scheduled UE are not attainable. As such, for MU-MIMO performance, we may need to look into Rel-17 and study how to setup a test which is suitable from both a performance perspective. But also, from a feasibility perspective. |
| Huawei | **Sub-Topic 2-1: Test set-up SU-MIMO VS. MU-MIMO**   * Issue 2-1-1: SU-MIMO VS MU-MIMO Setup   In our paper, we have listed four reasons to support SU-MIMO for Type II and eType II PMI reporting test in Rel-16.  Four reasons for us to support using SU-MIMO for (e) Type II codebook PMI reporting test:   * Significant gain of Type II over Type I under SU-MIMO test setup has been observed * SU-MIMO is simple and wildly used for years * After several meetings discussion, parameter configurations for SU-MIMO test setup are all settled * The goal of testing Type II codebook based PMI reporting can be reached   So, our preference is to use SU-MIMO test setup for Type II and eType II codebook based PMI testing.  For MU-MIMO test setup, it has its own advantages in testing and we also see a wild demand on it, which makes it hard to be ruled out. So if we are going to have MU-MIMO as test setup, our preference is to have it in a demodulation test case.  The thing is that there will be a new topic called Advance Receiver in Rel-17 which will mainly focus on the interference elimination on UE receiver. And it is agreed that MU-MIMO will be introduced as a special scenario and discuss the evaluation of performance requirements. In this case, we think MU-MIMO also can be further introduced at that time.  To summarize, we prefer to define Type II and eType II codebook using SU-MIMO test setup, and define a new demodulation test case using MU-MIMO test setup only if MU-MIMO test setup is agreed to be introduced in Rel-16.  **Sub-Topic 2-2: Test parameters for SU-MIMO option**   * Issue 2-2-1: MIMO Correlation   Support option 2 and keep previous agreement.   * Issue 2-2-2: Test point for gain requirements   Depends on the issue 2-2-3.   * Issue 2-2-3: Test metric   Since now companies have different views on how to implement ‘Random PMI’ for (e) Type II codebook based PMI reporting tests, the throughput ratio by using the agreed test metric ‘Follow PMI versus Random PMI’ is not stable.  Based on the simulation results submitted by different companies, the performance requirement will suffer from the difficulty of alignment for TP ratio of ‘Follow PMI versus Random PMI’ due to big gaps observed.  In this case, we think that option 1, which refers to the ratio of following PMI with enhanced type II codebook and type I single panel codebook, can be considered since it can reflect the enhancement and also ensure the right reporting of Rel-16 Type II codebook if a reasonable gain (TP ratio of following PMI with enhanced type II codebook and type I single panel codebook) can be reached.  **Sub-Topic 2-3: Test parameters for MU-MIMO option**  Pending for the issue 2-1-1. |

### 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** |
| **R4-2014747**  (Samsung)  Draft CR for introduction of Rel-16 Type II PMI test cases | Company A |
| Ericsson: May need to be revised based on the ongoing discussion. |
| Huawei: Proposed change affects should be ‘ME’. |

## 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”* |

# Topic #3: Structure for specfications

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **R4-2014558** | Intel | Proposal 10: Adopt proposed procedure to organize specification structure for multi-TRP Tx schemes   * *5.2.2.1.5 Minimum requirements for PDSCH 0.001% BLER* * *5.2.2.1.6 Minimum requirements for PDSCH repetitions over multiple slots* * *5.2.2.1.7 Minimum requirements for PDSCH Mapping Type B and UE processing capability 2* * *5.2.2.1.8 Minimum requirements for PDSCH pre-emption* * *5.2.2.1.9 Minimum requirements for PDSCH HST-SFN* * *5.2.2.1.10 Minimum requirements for PDSCH HST-DPS* * 5.2.2.1.11 Minimum requirements for PDSCH with multi-DCI based Tx scheme * 5.2.2.1.12 Minimum requirements for PDSCH with single-DCI based SDM scheme * 5.2.2.1.13 Minimum requirements for PDSCH with single-DCI based FDM Scheme A * 5.2.2.1.14 Minimum requirements for PDSCH with single-DCI based Inter-slot TDM scheme |

## Open issues summary

### Sub-topic 3-1: Structure for specification for demodulation and CSI

**Issue 3-1-1: specification for demodulation and CSI**

Considering only one official meeting for NR eMIMO WI, the CR work split is proceed to finalization of performance requirement on schedule as follows

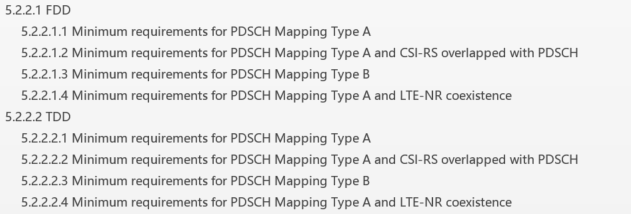
|  |  |
| --- | --- |
|  | **Responsibility** |
| CR on general and applicability rule | Apple |
| CR on PDSCH requirement with Single-DCI based SDM scheme | Huawei |
| CR on PDSCH requirement with Multi-DCI based multi-TRP | Huawei |
| CR on PDSCH requirement with Single-DCI based FDMScheme A (if agreed) | Intel |
| CR on PDSCH requirement with Single-DCI based inter-slot TDM scheme (if agreed) | Intel |
| CR on PMI reporting requirement based on Regular eType-II | [Samsung] |
| CR on Annex (FRC if any) | Ericsson |

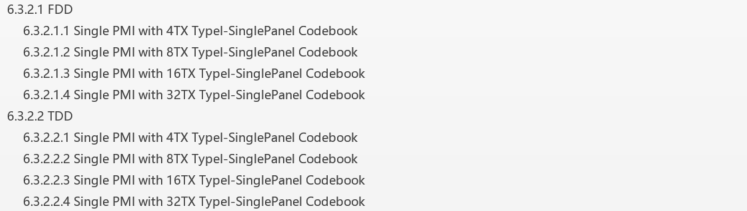
The volunteer companies have submitted the corresponding CR in this meeting. Regarding how to capture eMIMO feature into specification, both adding a separate section or continuous section are feasible.

Considering the current progress of HST and URLLC WI, it was agreed to use the same section for specifying PDSCH demodulation requirement for different WI. Based on discussions on previous meetings it was agreed to introduce 4 new clauses for URLLC performance requirements. Two new clauses are needed to define HST-SFN and HST-DPS requirement.

For example, the following is the existing specification for 2Rx with FDD for PDSCH demodulation requirements and CSI requirement

In this sub-topic, the section numbers will be discussed and allocated. According to the agreements, the new features should be added following the existing requirements. Companies provide views for 2Rx FDD, then 2Rx TDD and 4Rx FDD/TDD will the agreement

**

**

* Proposals
  + Option 1(Intel):
* PDSCH demodulation requirements
* *5.2.2.1.5 Minimum requirements for PDSCH 0.001% BLER*
* *5.2.2.1.6 Minimum requirements for PDSCH repetitions over multiple slots*
* *5.2.2.1.7 Minimum requirements for PDSCH Mapping Type B and UE processing capability 2*
* *5.2.2.1.8 Minimum requirements for PDSCH pre-emption*
* *5.2.2.1.9 Minimum requirements for PDSCH HST-SFN*
* *5.2.2.1.10 Minimum requirements for PDSCH HST-DPS*
* 5.2.2.1.11 Minimum requirements for PDSCH with multi-DCI based Tx scheme
* 5.2.2.1.12 Minimum requirements for PDSCH with single-DCI based SDM scheme
* 5.2.2.1.13 Minimum requirements for PDSCH with single-DCI based FDM Scheme A
* 5.2.2.1.14 Minimum requirements for PDSCH with single-DCI based Inter-slot TDM scheme
* Reporting of Precoding Matrix Indicator (PMI)
* *6.3.2.1.5 Multiple PMI with 16TX TypeII Codebook*
* 6.3.2.1.6 Multiple PMI with 16TX Enhanced Type II Codebook
* Recommended WF
  + Agree option 1?

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Company A | **Sub-Topic 3-1: Structure for specification of demodulation and CSI**   * Issue 3-1-1: Specification of demodulation and CSI |
| Apple | **Sub-Topic 3-1: Structure for specification of demodulation and CSI**   * Issue 3-1-1: Specification of demodulation and CSI   We are fine with the proposed structure from Intel |
| Huawei | **Sub-Topic 3-1: Structure for specification of demodulation and CSI**   * Issue 3-1-1: Specification of demodulation and CSI   OK with option 1. |

### 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** |
|  | 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)

## 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”* |