**3GPP TSG-RAN WG4 Meeting # 101-bis-e R4-2202976**

**Electronic Meeting, 1st – 12th Nov, 2021**

**Agenda item:** 6.19.4

**Source:** Moderator (Samsung)

**Title:** Email discussion summary for [101-bis-e][320] NR\_FeMIMO\_Demod\_NWM

**Document for:** Information

# Introduction

Rel-17 NR FeMIMO WI is a RAN1 leading WI with below major enhancement in RAN1 area

* Enhancement on multi-beam operation
* Enhancement on multi-TRP
* Enhancement on SRS
* Enhancement on CSI reporting

This meeting is the 1st meeting to discuss the performance requirement of NR FeMIMO.

Based on the RAN1 feature and work plan of NR FeMIMO, the scope of this email discussion mainly focuses to identify the test scope of performance requirements of NR FeMIMO, identify the potential impact of the UE demodulation requirements and CSI requirements. Meanwhile, the initial simulation assumption also should be discussed to facilitate the test case setup for requirements

In practical, the scope of this email discussion is indicated as follows agenda:

* UE Demodulation and CSI requirements(6.19.4)

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

* 1st round: Discussion and identify the potential impact on the UE performance requirements based on the RAN1 feature
* 2nd round: Discussion the test setup and agree the initial simulation assumption for UE demodulation and CSI parts test cases

# Topic #1: General

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2200767 | Samsung | Work plan for Rel-17 FeMIMO Performance partAn initial work plan for Rel-17 FeMIMO performance part was provided in table of section 3. |

## Open issues summary

List of open issues

* Sub-topic 1-1 Work Plan for Rel-17 FeMIMO Performance part

### Sub-topic 1-1: Work Plan

* Proposals
	+ Option 1(Samsung):

**Table 1: Work plan for performance part of Rel-17 FeMIMO WI**

|  |
| --- |
| RAN4 #101bis:* Identify performance impact and endorse initial work scope for performance requirements
* Agree initial simulation assumption

RAN4#102* Update work scope of performance requirements
* Update simulation assumption
 |
| March 2022 RAN#95 |
| RAN4#103* Further discuss and resolve remaining open issues for test set-up
* Provide alignment simulation results
 |
| June 2022 RAN#96 |
| RAN4#104* Provide impairment results
* Agree CRs to introduce performance requirements for Rel-17 FeMIMO WI
 |
| Sep 2022 RAN#97 |

* Recommended WF
	+ Encourage comments if any.

## Companies views’ collection for 1st round

### Open issues

*One of the two formats, i.e. either example 1 or 2 can be used by moderators.*

Sub topic 1-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| Intel | In general, we support proposed work plan. One suggestion is to change “update” to “further discuss and clarify” work scope and simulation assumptions to avoid misinterpretation. |
| Ericsson | We think for the first meeting, it is rather difficult to dive deep into the simulation assumption. We should focus on the scope first. So, we propose to remove the second bullet:~~Agree initial simulation assumption~~ |
| Nokia | Propose to move the “Agree initial simulation assumptions” to RAN4#102e |
| Apple | In general the work plan is fine. But it might be pretty difficult to discuss any initial simulation assumptions in this meeting. We propose to move ·        ~~Agree initial simulation assumption to RAN4#102.~~ |
| QUALCOMM | Considering this is the first meeting, we propose to move the “Agree initial simulation assumptions” to RAN4#102e |
| Huawei | We are OK with Option 1 if “Agree initial simulation assumption” is moved to RAN4#102. |
| Samsung | We are fine to focus on the test scope discussion firstly with remove “agree initial simulation assumption to RAN4#102”, and we can update the work planIf some of scope for some items are stable, we can further discuss the detail setup for these stable scope to achieve common setup agreement during 2nd round discussion  |

### CRs/TPs comments collection

*For close-to-finalize WIs and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing 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:* |
| **Sub-topic 1-1** | *Tentative agreements:*

|  |
| --- |
| RAN4 #101bis:* Identify performance impact and endorse initial work scope for performance requirements

RAN4#102* Update work scope of performance requirements
* Agree initial simulation assumption
 |
| March 2022 RAN#95 |
| RAN4#103* Further discuss and resolve remaining open issues for test set-up
* Provide alignment simulation results
 |
| June 2022 RAN#96 |
| RAN4#104* Provide impairment results
* Agree CRs to introduce performance requirements for Rel-17 FeMIMO WI
 |
| Sep 2022 RAN#97 |

 |

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **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)

# Topic #2: Enhancement on multi-beam operation

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2200767 | Samsung | Overview on performance requirements

|  |  |  |  |
| --- | --- | --- | --- |
| **Items** | **BS demodulation** | **UE demodulation**  | **CSI**  |
| Enhancement on multi-beam operation  | NO | NO | NO |
| Enhancements on multi-TRP | Enhancements on Multi-TRP for PDCCH, PUCCH and PUSCH  | FFS (PUSCH, PUCCH M-TRP) | M-TRP PDCCH repetition  | NO |
| Enhancements on Multi-TRP inter-cell operation | NO | Yes, M-TRP Inter-cell PDSCH  | NO |
| Enhancements on beam management for multi-TRP | NO | NO | NO |
| Enhancements on HST-SFN deployment | NO | Yes, PDSCH for SFN scheme A and scheme B | NO |
| Enhancement on SRS | NO | NO | NO |
| Enhancement on CSI reporting  | M-TRP | NO | NO | Yes, CSI for M-TRP |
| FDD reciprocity  | NO | NO | Yes, PMI for enhanced Type II port selection codebook |

Proposal 1: No performance requirements (demodulation and CSI) impact for Rel-17 FeMIMO objective “Enhancement on multi-beam operation”. |
| R4-2200280 | Apple | Proposal 1: No impact to UE demodulation with the following enhancements* Enhancements to multi-beam operation
* Multi-TRP PUCCH/PUSCH
* SRS Enhancements
* Further enhanced Type II port selection codebook
 |
| R4-2201014 | Huawei, HiSilicon | Proposal 1: Do not define any performance requirements for enhancement on multi-beam. |

## Open issues summary

List of open issues

* Sub-topic 2-1 Test Scope
	+ Issue 2-1-1: Whether to define performance requirement (demodulation and CSI) on Multi-beam operation

### Sub-topic 2-1: Test Scope

**Issue 2-1-1: Whether to define performance requirement (demodulation and CSI) on Multi-beam operation**

* Proposals
	+ Option 1(Samsung, Apple, Huawei): No performance requirements (demodulation and CSI) impact for Rel-17 FeMIMO objective “Enhancement on multi-beam operation”.
* Recommended WF
	+ Option 1

## Companies views’ collection for 1st round

### Open issues

*One of the two formats, i.e. either example 1 or 2 can be used by moderators.*

Sub topic 2-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 2-1-1 |
| Intel | Support Option 1. |
| Ericsson | Support Option 1 |
| Nokia | Agree with WF (Option 1). The work in RRM should make this topic transparent to Demod. |
| Apple | Agree with option 1 as the WF. |
| Qualcomm | Agree with the recommended WF (option 1). |
| Huawei | We are OK with Option 1. |
| Samsung | Agreed with option 1 an recommended WF |

### CRs/TPs comments collection

*For close-to-finalize WIs and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing 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:* |
| **Sub-topic** | **Issue 2-1-1: Whether to define performance requirement (demodulation and CSI) on Multi-beam operation***Tentative agreements:** No performance requirements (demodulation and CSI) impact for Rel-17 FeMIMO objective “Enhancement on multi-beam operation”.
 |

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **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)

# Topic #3: Enhancement on multi-TRP

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2200767 | Samsung | Overview on performance requirements

|  |  |  |  |
| --- | --- | --- | --- |
| **Items** | **BS demodulation** | **UE demodulation**  | **CSI**  |
| Enhancement on multi-beam operation  | NO | NO | NO |
| Enhancements on multi-TRP | Enhancements on Multi-TRP for PDCCH, PUCCH and PUSCH  | FFS (PUSCH, PUCCH M-TRP) | M-TRP PDCCH repetition  | NO |
| Enhancements on Multi-TRP inter-cell operation | NO | Yes, M-TRP Inter-cell PDSCH  | NO |
| Enhancements on beam management for multi-TRP | NO | NO | NO |
| Enhancements on HST-SFN deployment | NO | Yes, PDSCH for SFN scheme A and scheme B | NO |
| Enhancement on SRS | NO | NO | NO |
| Enhancement on CSI reporting  | M-TRP | NO | NO | Yes, CSI for M-TRP |
| FDD reciprocity  | NO | NO | Yes, PMI for enhanced Type II port selection codebook |

Proposal 2: Introduce PDCCH requirements for multi-TRP repetition transmission schemes. Proposal 3: FFS whether BS demodulation requirements impact for enhancements on Multi-TRP under Rel-17 FeMIMO WI.Proposal 4: Introduce PDSCH requirements for multi-TRP inter-cell operation.Proposal 5: No performance requirements impact for Rel-17 FeMIMO WI objective “Enhancements on beam management for multi-TRP”.Proposal 6: Introduce PDSCH requirements for HST SFN scenario with SFN scheme A and scheme B.Proposal 10: Postpone the discussion on m-TRP transmission UE demodulation/CSI requirements in FR2 till RAN4 RF and RRM core have conclusion on supporting FR2 UE with the capability of simultaneous reception with different QCL Type-D RSs.Test case design for PDSCH requirementsProposal 11: Reusing test parameters of existing Rel-16 multi-DCI based on TRP transmission test case (Table 5.2.2.1.12-2) with different PCI for TP1 and TP2 i.e.* Time offset/frequency offset: -0.5us /200Hz for FR1 FDD 15kHz SCS; -0.25us/300Hz for FR1 TDD 30kHz SCS
* RB allocation: frequency non-overlapping
* MCS: 64QAM 1/2
* PCI ID: [0] for TP1, [3] for TP2
* SSB transmission: SSB 1 for TP1, SSB 2 for TP2

Proposal 12: Reusing existing Rel-16 HST-SFN test set-up as baseline to introduce enhanced SFN scheme A and SFN scheme B PDSCH test cases with below update:* SFN scheme A (UE based solution): two TCI states with QCL A type information included
	+ PDCCH/PDSCH/PBCH SFN transmitted from two RRHs
	+ TCI state 1 and TCI state 2 applied for for TRP/RRH #2n, #2n+1 separately; TRS 1 and TRS 2 transmitted from TRP#2n, and #2n+1 separately
	+ HST SFN channel model specified in B.3.2 of TS 38.101-4 reused
* SFN scheme B (TRP based pre-compensation solution): two TCI states with one configured QCL type A information, and another one configured QCL Type B information’
	+ PDCCH/PDSCH/PBCH SFN transmitted from two RRHs
	+ TCI state 1 and TCI state 2 applied for for TRP/RRH #2n, #2n+1 separately; TRS 1 and TRS 2 transmitted from TRP#2n, and #2n+1 separately
	+ HST SFN channel model specified in B.3.2 of TS 38.101-4 reused without modelling Doppler shift
 |
| R4-2200280 | Apple | Proposal 1: No impact to UE demodulation with the following enhancements* Enhancements to multi-beam operation
* Multi-TRP PUCCH/PUSCH
* SRS Enhancements
* Further enhanced Type II port selection codebook

Proposal 2: Do not define UE demod requirements for the following FeMIMO enhancements:* Multi-TRP PDCCH enhancements
* Inter-cell multi-TRP operation

Proposal 3: Further discuss if requirements are introduced for the following enhancements for FeMIMO* HST-SFN enhancements
* CSI enhancements for single DCI SDM transmission scheme
 |
| R4-2200365 | NTT DOCOMO | Proposal 1: Define the UE demodulation requirement of Rel-17 HST-SFN scheme 1Proposal 2: For FR1 FDD 15kHz, define the maximum Doppler with 972HzProposal 3: For FR1 TDD 30kHz, define the maximum Doppler with 1667Hz |
| R4-2200522 | Intel | Proposal 1: Do not define demodulation performance requirements for scenario with simultaneous signals reception with different QCL type-D in Rel-17.Proposal 2: Deprioritize performance requirements definition for FR2.Proposal 3: Do not define demodulation performance requirements for inter-cell beam management and joint and separate DL/UL TCI state update.Proposal 4: Do not define performance requirements for SSBRI and CRI reporting.Proposal 5: Do not define a dedicated test case for inter-cell multi-DCI multi-TRP Tx scheme performance verification.Proposal 6: Discuss the following alternatives how to guarantee demodulation performance for inter-cell multi-DCI multi-TRP Tx scheme* Alt1: Define applicability rule for UE that supports “IntCell-Mtrp” feature that if such UE satisfied Rel-16 minimum requirements for PDSCH multi-DCI based transmission scheme, inter-cell operation can be also guaranteed.
* Alt2: Add a note to specification that if UE supports “IntCell-Mtrp” feature, minimum requirements for PDSCH multi-DCI based transmission scheme is applicable for this UE, but test configuration (i.e., RRC, SSB) should reflects inter-cell operation mode. Applicability rule between requirements for intra-cell and inter-cell scenarios can be further discussed.

Proposal 7: Define demodulation performance requirement for PDCCH FDM repetition scheme.Proposal 8: Consider simulation assumptions from Table 1 for PDCCH repetition scheme performance requirement definition.

|  |  |
| --- | --- |
| Parameter | Value |
| FDD 15 kHz SCS | TDD 30 kHz SCS |
| CBW | 10 MHz | 40 MHz |
| Antenna configuration | 2x2; 2x4 (2Tx for each TRP) |
| CORESET RB | 24 | 48 |
| CORESET Duration | 2 |
| Aggregation level | 4, 8 |
| CCE-REG mapping | Non-interleaved |
| REG bundle size | 6 |
| Propagation conditions | TDLA30-10 |
| Test metric | SNR @1% Probability of missed downlink scheduling grant |

Proposal 9: Define demodulation performance requirements for SFN Scheme A. Define requirements only for FR1 in Rel-17.Proposal 10: Define demodulation performance requirements for SFN Scheme A for CA.Proposal 11: Consider simulation assumptions from Table 2 for PDSCH HST-SFN Scheme A performance requirement definition.

|  |  |
| --- | --- |
| Parameter | Value |
| FDD 15 kHz SCS | TDD 30 kHz SCS |
| CBW | 10 MHz (5, 10, 15, 20, 25, 30, 40, 50 for CA) | 40 MHz (5, 10, 15, 20, 25, 30, 40, 50, 60, 80, 90, 100 for CA) |
| Antenna configuration | 2x2; 2x4 |
| DMRS type | Type 1 |
| Number of DMRS symbols | 1+1+1 |
| TDD pattern |  | 7D1S2U, S: 6D 4G 4U |
| TRS periodicity | 10ms, 2 slot pattern |
| PDSCH mapping | Type A, Start symbol 2, Duration 12 |
| MCS | MCS 13, 17 from MCS Table 1 |
| Rank | 2 |
| Propagation conditions | HST-SFN for PDSCH, PDCCH, DMRSHST-SFN single tap for TRS |
| Ds and Dmin | Ds =700m; Dmin=150m |
| Maximum Doppler shift | 870Hz | 1667Hz |
| Test metric | SNR @70% of maximum throughput |

 |
| R4-2200644 | CMCC | Proposal 1: for the enhancement on QCL assumption for DMRS, it is proposed to define PDSCH and PDCCH requirements.Proposal 2: for TRP-based pre-compensation, there are two options:* Option 1: define new demodulation performance requirements for TRP-based pre-compensation
* Option 2: not define new demodulation performance requirements for TRP-based pre-compensation with the condition to introduce applicability rule: if UE passes the existing test cases, the performance of TRP-based pre-compensation are guaranteed
 |
| R4-2201014 | Huawei, HiSilicon | Observation 1: There is a great gain by performing soft-combining for non-SFN PDCCH enhancement.Observation 2: Better performance can be achieved for Scheme A comparing to the normal SFN, with the performance degradation when UE is at the middle place between two TRP due to ICI.Observation 3: Better performance can be achieved for Scheme B comparing to the normal SFN.Observation 4: There is large UE performance difference for Scheme B between different BS implementation of frequency offset between two TRP.Proposal 1: Do not define any performance requirements for enhancement on multi-beam.Proposal 2: Consider FR1 case and FR2 single-panel reception case with high priority.Proposal 3: Whether to consider FR2 multi-panel reception simultaneously case should be based on the conclusion from RRM part and RF part discussion.Proposal 4: Define PDCCH performance requirements for the following case:* FR1 FDM with intra-slot repetition
* FR1 TDM with intra-slot repetition
* FR2 TDM with intra-slot repetition

Proposal 5: Define PDSCH performance requirements to verify whether UE is with proper oppler of rate matching around the two linked PDCCH.Proposal 6: Define performance requirement for enhancements on multi-TRP inter-cell operation with full-overlapping resource allocation.Proposal 7: Do not define any performance requirement for enhancements on beam management for multi-TRP.Proposal 8: Define PDSCH performance requirements for Scheme A for HST scenario.Proposal 9: For test setup of Scheme A PDSCH case for HST scenario, reusing the existing Rel-16 HST-SFN channel model (Ds=700m, Dmin=150m) with removing the two furthest paths corresponding to the two furthest TRP.Proposal 10: For test setup of Scheme A PDSCH case for HST scenario, MCS 17 with rank 2 can be used as a starting point.Proposal 11: Define PDSCH performance requirements for Scheme B for HST scenario.Proposal 12: For test setup of Scheme B PDSCH case for HST scenario, reusing the existing Rel-16 HST-SFN channel model (Ds=700m, Dmin=150m) with removing the two furthest paths corresponding to the two furthest TRP.Proposal 13: For test setup of Scheme B PDSCH case for HST scenario, select typical network implementation and consider the network implementation as a part of channel model (i.e. specify the function between the time and the pre-compensation value) to make sure TE implementation of pre-compensation has no impact on the UE performance during the test.Proposal 14: For test setup of Scheme B PDSCH case for HST scenario, MCS 17 with rank 2 can be used as a start point.Proposal 15: Do not define any PDCCH requirements for HST scenario but define PDCCH requirements for Scheme A for non-HST scenario. |
| R4-2201421 | Ericsson | Proposal 1: Define either TDM or FDM based intra-slot PDCCH repetition demodulation performance requirement for Multi-TRP in Rel-17Proposal 2: Not to define PDSCH/PDCCH demodulation requirement for inter-cell Multi-TRP transmission if intra-slot PDCCH repetition demodulation requirement is agreed to be introducedProposal 3: Define PDSCH demodulation requirement for Multi-TRP HST-SFN deployment scheme A Proposal 4: RAN4 discusses and decides whether to still have PDCCH demodulation requirement if intra-slot PDCCH repetition demodulation requirement is agreed to be introducedProposal 5: Not to define demodulation performance requirement for scheme B |
| R4-2201841 | Qualcomm | Proposal 8: The difference between the estimated Dopplers for TRP#1 (i.e., estimated from TRS1) and TRP#2 (i.e., estimated from TRS2) should be within the TRS-based tracking pull-in range with some margin.Proposal 9: The resultant maximum delay spread estimated at the UE side from two TRSs should be within the length of the cyclic prefix. |

## Open issues summary

List of open issues

* General scope for Multi-TRP
	+ Issue 3-1-1: Whether to define m-TRP transmission UE demodulation/CSI requirement in FR2
* Sub-topic 3-2 Test Scope on Multi-TRP enhancement for PDCCH, PUSCH and PUCCH
	+ Issue 3-2-1: Whether to define PDCCH requirement for multi-TRP repetition transmission schemes
	+ Issue 3-2-2: Whether to define PDSCH requirement to verify whether UE is with proper behaviour of rate matching around the two linked PDCCH.
	+ Issue 3-2-3: Whether to define PUCCH/PUSCH requirement for multi-TRP repetition transmission schemes
* Sub-topic 3-3 Test Scope on Multi-TRP inter-cell operation
	+ Issue 3-3-1: Whether to define PDSCH requirement for Multi-TRP inter-cell operation
* Sub-topic 3-4 Test Scope on beam management for Multi-TRP
	+ Issue 3-4-1: Whether to define performance requirement (demodulation and CSI) on beam management for multi-TRP
* Sub-topic 3-5: Test Scope on Enhancement on HST-SFN deployment
	+ Issue 3-5-1: Whether to define PDSCH requirement for HST SFN scenario
	+ Issue 3-5-2: Whether to define PDCCH requirement for HST SFN scenario
	+ Issue 3-5-3: Whether to define PDSCH requirement for HST SFN scenario for CA
* Sub-topic 3-6: Test setup for PDCCH requirement for Multi-TRP
	+ Issue 3-6-1: Multi-TRP repetition transmission schemes for PDCCH requirements
	+ Issue 3-6-2: Simulation Assumption for PDCCH with repetition scheme
* Sub-topic 3-7: Test setup for PDSCH requirement for inter-cell operation
	+ Issue 3-7-1: Simulation assumption for PDSCH requirement
* Sub-topic 3-8: Test setup for demodulation requirement for HST-SFN enhancement
	+ Issue 3-8-1: Test Case design for PDSCH requirement for SFN scheme A
	+ Issue 3-8-2: Test Case design for PDSCH requirement for SFN scheme B

### Sub-topic 3-1: General scope for Multi-TRP

**Issue 3-1-1: Whether to define m-TRP transmission UE demodulation/CSI requirement in FR2**

* Proposals
	+ Option 1 (Samsung, Nokia, Apple,Huawei):
		- Postpone the discussion on m-TRP transmission UE demodulation/CSI requirements in FR2 till RAN4 RF and RRM core have conclusion on supporting FR2 UE with the capability of simultaneous reception with different QCL Type-D RSs.
	+ Option 2 (Intel):
		- Do not define demodulation performance requirements for scenario with simultaneous signals reception with different QCL type-D in Rel-17.
		- Deprioritize performance requirement definition in FR2
	+ Option 3 (Huawei):
		- Consider FR1 case and FR2 single-panel reception case with high priority.
		- Whether to consider FR2 multi-panel reception simultaneously case should be based on the conclusion from RRM part and RF part discussion.
	+ Option 4 (Qualcomm):
		- The m-TRP CSI requirements be limited to FR1 and do not define requirements for FR2.
* Recommended WF
	+ Postpone the discussion on m-TRP transmission UE demodulation/CSI requirements in FR2 till RAN4 RF and RRM core have conclusion on supporting FR2 UE with the capability of simultaneous reception with different QCL Type-D RSs.

### Sub-topic 3-2: Test Scope on Multi-TRP enhancement for PDCCH, PUSCH and PUCCH

**Issue 3-2-1: Whether to define PDCCH requirement for multi-TRP repetition transmission schemes**

* Observations
	+ Observation 1 (Huawei):
		- There is a great gain by performing soft-combining for non-SFN PDCCH enhancement.
* Proposals
	+ Option 1 (Intel, Huawei, Ericsson): Yes
	+ Option 2 (Apple): No
* Recommended WF
	+ Encourage comments if any.

**Issue 3-2-2: Whether to define PDSCH requirement to verify whether UE is with proper behaviour of rate matching around the two linked PDCCH.**

* Proposals
	+ Option 1 (Huawei): Yes
* Recommended WF
	+ Encourage comments if any.

**Issue 3-2-3: Whether to define PUCCH/PUSCH requirement for multi-TRP repetition transmission schemes**

* Proposals
	+ Option 1 (Samsung): FFS whether BS demodulation requirements impact for enhancements on Multi-TRP under Rel-17 FeMIMO WI.
* Recommended WF
	+ Encourage comments if any.

### Sub-topic 3-3: Test Scope on Multi-TRP inter-cell operation

**Issue 3-3-1: Whether to define PDSCH requirement for Multi-TRP inter-cell operation**

* Proposals
	+ Option 1 (Samsung, Huawei): Yes
	+ Option 2 (Apple, Intel, Ericsson): No
		- Option 2a (Intel) : Discuss the following alternatives how to guarantee demodulation performance for inter-cell multi-DCI multi-TRP Tx scheme
* Alt1: Define applicability rule for UE that supports “IntCell-Mtrp” feature that if such UE satisfied Rel-16 minimum requirements for PDSCH multi-DCI based transmission scheme, inter-cell operation can be also guaranteed.
* Alt2: Add a note to specification that if UE supports “IntCell-Mtrp” feature, minimum requirements for PDSCH multi-DCI based transmission scheme is applicable for this UE, but test configuration (i.e., RRC, SSB) should reflects inter-cell operation mode. Applicability rule between requirements for intra-cell and inter-cell scenarios can be further discussed.
	+ - Option 2b (Ericsson) : Not to define PDSCH/PDCCH demodulation requirement for inter-cell Multi-TRP transmission if intra-slot PDCCH repetition demodulation requirement is agreed to be introduce
* Recommended WF
	+ Encourage comments if any.

### Sub-topic 3-4: Test Scope on beam management for multi-TRP

**Issue 3-4-1: Whether to define performance requirement (demodulation and CSI) on beam management for multi-TRP**

* Proposals
	+ Option 1 (Samsung, Intel, Huawei): No
		- Do not define demodulation performance requirements for inter-cell beam management and joint and separate DL/UL TCI state update.
		- Do not define performance requirements for SSBRI and CRI reporting.
* Recommended WF
	+ Option 1

### Sub-topic 3-5: Test Scope on Enhancement on HST-SFN deployment

**Issue 3-5-1: Whether to define PDSCH requirement for HST SFN scenario**

* Proposals
	+ Option 1 (Samsung, Apple, NTT DoCoMo, Intel, CMCC, Huawei, Ericsson, Qualcomm): Yes
		- Option 1a (Samsung, Huawei, CMCC): Both SFN scheme A and SFN scheme B
		- Option 1b (Ericsson, Intel, NTT DoCoMo): Only SFN scheme A
		- Option 1c (CMCC): SFN scheme A with introduction test applicability rule:
* If UE pass passes the existing test cases (demodulation requirement for HST-SFN with high Doppler shift), the performance of SFN scheme B (TRP-based pre-compensation) are guaranteed
* Recommended WF
	+ Introduce PDSCH requirements for HST SFN scheme A, further discuss whether PDSCH requirements for HST SFN scheme B needed or not

**Issue 3-5-2: Whether to define PDCCH requirement for HST SFN scenario**

* Proposals
	+ Option 1 (CMCC,): Yes
	+ Option 2 (Ericsson): RAN4 discusses and decides whether to still have PDCCH demodulation requirement if intra-slot PDCCH repetition demodulation requirement is agreed to be introduced
	+ Option 3 (Huawei): Do not define any PDCCH requirements for HST scenario but define PDCCH requirements for Scheme A for non-HST scenario.
* Recommended WF
	+ Encourage comments if any.

**Issue 3-5-3: Whether to define PDSCH requirement for HST SFN scenario for CA**

* Proposals
	+ Option 1 (Intel): Yes
* Recommended WF
	+ Encourage comments if any.

### Sub-topic 3-6: Test setup for PDCCH requirment for Multi-TRP

**Issue 3-6-1: Multi-TRP repetition transmission schemes for PDCCH requirements**

* Proposals
	+ Option 1 (Huawei): Define PDCCH performance requirement with following cases
		- FR1 FDM with intra-slot repetition
		- FR1 TDM with intra-slot repetition
		- FR2 TDM with intra-slot repetition
	+ Option 2 (Ericsson): Define either TDM or FDM based intra-slot PDCCH repetition demodulation performance requirement
	+ Option 3(Intel): FDM repetition scheme
* Recommended WF
	+ Encourage comments if any.

**Issue 3-6-2: Simulation Assumption for PDCCH with FDM repetition scheme**

* Proposals
	+ Option 1(Intel):

|  |  |
| --- | --- |
| Parameter | Value |
| FDD 15 kHz SCS | TDD 30 kHz SCS |
| CBW | 10 MHz | 40 MHz |
| Antenna configuration | 2x2; 2x4 (2Tx for each TRP) |
| CORESET RB | 24 | 48 |
| CORESET Duration | 2 |
| Aggregation level | 4, 8 |
| CCE-REG mapping | Non-interleaved |
| REG bundle size | 6 |
| Propagation conditions | TDLA30-10 |
| Test metric | SNR @1% Probability of missed downlink scheduling grant |

### Sub-topic 3-7: Test setup for PDSCH requirement for inter-cell operation

**Issue 3-7-1: Simulation assumption for PDSCH requirement**

* Proposals
	+ Option 1 (Samsung): Reusing test parameters of existing Rel-16 multi-DCI based on TRP transmission test case (Table 5.2.2.1.12-2) with different PCI for TP1 and TP2 i.e.
		- Time offset/frequency offset: -0.5us /200Hz for FR1 FDD 15kHz SCS; -0.25us/300Hz for FR1 TDD 30kHz SCS
		- RB allocation: frequency non-overlapping
		- MCS: 64QAM 1/2
		- PCI ID: [0] for TP1, [3] for TP2
		- SSB transmission: SSB 1 for TP1, SSB 2 for TP2
	+ Option 2 (Huawei):
		- RB allocation: frequency overlapping
* Recommended WF
	+ Encourage comments if any.

### Sub-topic 3-8: Test setup for demoduation requirement for HST-SFN enhancement

**Issue 3-8-1: Test Case design for PDSCH requirement for SFN scheme A**

* Proposals
	+ Option 1 (Samsung): Reusing existing Rel-16 HST-SFN test set-up as baseline
		- Two TCI states with QCL A type information
* PDCCH/PDSCH/PBCH SFN transmitted from two RRHs
* TCI state 1 and TCI state 2 applied for for TRP/RRH #2n, #2n+1 separately; TRS 1 and TRS 2 transmitted from TRP#2n, and #2n+1 separately
* HST SFN channel model specified in B.3.2 of TS 38.101-4 reused
	+ Option 2 (Intel): Reusing existing Rel-16 and Rel-17 HST-SFN for non CA and CA requirement

|  |  |
| --- | --- |
| Parameter | Value |
| FDD 15 kHz SCS | TDD 30 kHz SCS |
| CBW | 10 MHz (5, 10, 15, 20, 25, 30, 40, 50 for CA) | 40 MHz (5, 10, 15, 20, 25, 30, 40, 50, 60, 80, 90, 100 for CA) |
| Antenna configuration | 2x2; 2x4 |
| DMRS type | Type 1 |
| Number of DMRS symbols | 1+1+1 |
| TDD pattern |  | 7D1S2U, S: 6D 4G 4U |
| TRS periodicity | 10ms, 2 slot pattern |
| PDSCH mapping | Type A, Start symbol 2, Duration 12 |
| MCS | MCS 13, 17 from MCS Table 1 |
| Rank | 2 |
| Propagation conditions | HST-SFN for PDSCH, PDCCH, DMRSHST-SFN single tap for TRS |
| Ds and Dmin | Ds =700m; Dmin=150m |
| Maximum Doppler shift | 870Hz | 1667Hz |
| Test metric | SNR @70% of maximum throughput |

* + Option 3 (NTT DoCoMo): Maximum Doppler Shift
		- 15KHz SCS: 972Hz
		- 30KHz SCS: 1667Hz
	+ Option 4 (Huawei): Reusing the existing Rel-16 HST-SFN channel model (Ds=700m, Dmin=150m) with removing the two furthest paths corresponding to the two furthest TRP.
		- MCS 17 with rank 2 can be used as a starting point
* Recommended WF
	+ Encourage comments if any.

**Issue 3-8-2: Test Case design for PDSCH requirement for SFN scheme B**

* Proposals
	+ Option 1 (Samsung): Reusing existing Rel-16 HST-SFN test set-up as baseline
		- Two TCI states with QCL A type information, and another one configured QCL type B information
* PDCCH/PDSCH/PBCH SFN transmitted from two RRHs
* TCI state 1 and TCI state 2 applied for for TRP/RRH #2n, #2n+1 separately; TRS 1 and TRS 2 transmitted from TRP#2n, and #2n+1 separately
* HST SFN channel model specified in B.3.2 of TS 38.101-4 reused without modelling Doppler shift
	+ Option 2 (Huawei): Reusing existing Rel-16 HST-SFN test set-up as baseline Reusing the existing Rel-16 HST-SFN channel model (Ds=700m, Dmin=150m) with removing the two furthest paths corresponding to the two furthest TRP
		- MCS 17 with rank 2 can be used as a starting point
		- Select typical network implementation and consider the network implementation as a part of channel model (i.e. specify the function between the time and the pre-compensation value) to make sure TE implementation of pre-compensation has no impact on the UE performance during the test.
* Recommended WF
	+ Encourage comments if any.

## Companies views’ collection for 1st round

### Open issues

*One of the two formats, i.e. either example 1 or 2 can be used by moderators.*

Sub topic 3-1

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| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 3-1-1 |
| Intel | We cannot define demodulation performance requirements for scenario with simultaneous reception with different QCL Type-D sources due to current limitation of radiated two stage OTA testing methodology. This methodology assumes that Rx beam is locked during the test hence only single AoA can be considered. Besides that, there is no sense to consider single panel UE with TDM switching of Rx beam (like PDCCH TDM repetition scheme). With current testing methodology we can only emulate situation that repetitions come from the same direction that is not aligned with assumptions of real scenario and main purpose of this scheme. We can address this scheme later on also once test methodology is enhanced. Therefore, we propose to limit requirements introduction to FR1 only. |
| Ericsson | Support the recommended WF. |
| Nokia | We agree that the current OTA testing setup does not support simultaneous reception with two different spatial filters. As such we can either come back to the “FR2 UE with the capability of simultaneous reception with different QCL Type-D RSs” question after core discussion has finished (i.e., the propose WF), or we directly exclude this case (i.e., option 2 and option 4). |
| Apple | We support the recommended WF. But for demod requirements we have limitation from OTA feasibility to support simultaneous 2 AoA. We suggest to capture that as well in the WF. |
| Qualcomm | We support option 4. The m-TRP transmission for FR2 would involve multi-panel reception at the UE side, which may not be feasible. |
| Huawei | We are OK with the recommended WF |
| Samsung | We support the recommended WFFrom RAN1 feature design perspective, several features on M-TRP transmission are applicable for both FR1 and FR2 i.e. multi-cell m-TRP transmission, PDCCH m-TRP transmission schemes, HST-SFN scheme A, and CSI enhancement for m-TRP transmission.The same question/situation as Rel-16, whether these will be specified for FR2 with simultaneous active TCI states (QCL type D) which also need to be aligned with RAN4 core (RF and RRM) assumption |

Sub topic 3-2

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| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 3-2-1Issue 3-2-2Issue 3-2-3 |
| Intel | Issue 3-2-1PDCCH repetition scheme provides performance benefits and requires another Rx processing compared to the conventional scenario with single-TRP operation. Therefore, we suggest defining corresponding performance requirements. Support Option 1.Issue 3-2-2We do no think that new UE rate-matching behavior need to be verified. Important to note that RAN4 did not define dedicated requirement for new CRS rate-matching pattern in Rel-16 Emimo WI. In Rel-17 we suggest also focusing on other features considering quite limited WI time budget.Issue 3-2-3In our understanding, Rel-17 PUSCH/PUCCH enhancements were mainly defined to enable Tx of different PUSCH/PUCCH repetitions with different UL Tx beams that is relevant to FR2 operation. Requirements for PUSCH repetition and multi-slot PUCCH Tx for FR1 are already defined. Considering issue 3-1-1 we suggest focusing only on DL requirements now and come-back to necessity of UL requirements introduction later when FR2 operation will be considered. |
| Ericsson | Issue 3-2-1Share similar view with Intel. Support Option 1.Issue 3-2-2We think there is no need to define PDSCH rate-matching around two PDCCH. It is hard to differentiate the impact brought by either PDSCH or PDCCH to the final performance.Issue 3-2-3We prefer not to consider PUCCH/PUSCH requirement for multi-TRP repetition transmission schemes. |
| Apple | Issue 3-2-1The PDCCH repetition is designed to improve reliability and would have benefits. We don’t see a need to define requirements for PDCCH repetition in Rel-17. In most practical use cases PDCCH reliability can be improved with higher AL. PDCCH operating SNR is already low and with reliability enhancement it would be further lowered. We don’t see a big benefit from defining requirements for this and prefer to focus on other features. Given the limited time for the WI we need to be selective on what we define requirements for. Issue 3-2-2We share same views as Intel and Ericsson that there is no need to define requirements with PDSCH rate matching. |
| Qualcomm | Issue 3-2-1We share similar views with Apple and support Option 2. We don’t foresee a huge benefit from defining requirements for PDCCH. Also, PDSCH requirements would implicitly ensure the PDCCH performance.Issue 3-2-2We don’t see a need to define PDSCH requirement to verify the rate-matching behavior around PDCCH. |
| Huawei | Issue 3-2-1We prefer Option 1 considering that there is baseband impact.Issue 3-2-2We prefer Option 1 considering that there is baseband impact.Issue 3-2-3We prefer to not consider PUCCH/PUSCH requirements since only UE demodulation requirements should be considered as per WID. |
| Samsung | Issue 3-2-1We are ok with option 1For PDCCH, Rel-17 PDCCH repetition multi-TRP transmission support TDM and FDM scheme. Similar as Rel-16 m-TRP PDSCH repetition transmission schemes, PDCCH requirements need to be introduced to verify UE supporting m-TRP repetition transmission schemes.Issue 3-2-2Considering the limit time line, in our view, we should focus on the essential requirement based on RAN1 feature. From RAN4 demod, in general, we define PDSCH requirement and PDCCH requirement separately to verify the UE baseband processing. Even in Rel-15, there is no rate matching considering for single PDCCH, since resource of linked PDCCH candidates is non-overlapped with the corresponding of scheduled PDSCH. Whether the resource is overlapped or not, it can be scheduled based on network sideIssue 3-2-3For m-TRP PUSCH transmission, both Multi-TRP PUSCH repetition Type A and Type B are supported. And for m-TRP PUCCH transmission, PUCCH repetition scheme 1(inter-slot) and scheme 3 (intra-slot) are supported. In Rel-16, only PUSCH with inter-slot repetition is considered for requirement, and only format1 with multi-slot transmission in Rel-15. There is no intra-slot repetition requirement for PUCCH. Even the deployment and transmission scheme are different between single-TRP and multi-TRP uplink PUSCH/PUCCH repetition transmission, it’s still FFS whether any baseband receiver implementation and/or receiver performance difference between them in BS sideConsidering, there is no objective for BS requirement, we are open to discuss whether it is need to define BS demodulation requirement |

Sub topic 3-3

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| **Company** | **Comments** |
| XXX | Issue 3-3-1 |
| Intel | From receive processing perspective, we do not see a difference between scenarios when inter-cell or intra-cell multi-TRP configuration is considered. The same propagation conditions and time/frequency offset values can be assumed for this scenarios. The formal difference is in only of SSB PCIs received from two TRPs. In this case we do not see a value to define dedicated performance test case at least for non-overlapped multi-DCI inter-cell multi-TRP Tx scheme. To guarantee performance with this scheme we suggested two alternatives and encouraged other companies to provide their feedback.  |
| Ericsson | Support Option 2b. There is no need to define duplicate requirements for verifying the same UE demodulation process. |
| Apple  | From UE processing Rel-16 multi-TRP and inter-cell mutli-TRP have no difference. There is no benefit of introducing the same requirements for inter-cell Mtrp. We are fine to further discuss Alt 1 in Proposal from Intel. |
| Qualcomm | We support option 2 as we don’t see a necessity to define requirements for inter-cell m-TRP considering the UE demod processing is same as the Rel-16 m-TRP transmission. |
| Huawei | We prefer Option 1, performance under inter-cell multi-TRP scenario should be ensured. We propose to define requirements with the full-overlapping resource allocation. |
| Samsung | In Rel-17, multi-TRP PDSCH transmission are further extended to multi-TRP inter cell operation with multi-PCIs. Similar as Rel-16, PDSCH requirements require to be introduced for such scenario with associated additional PCI in additional to serving cell PCI.  |

Sub topic 3-4

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| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 3-4-1 |
| Intel | Support Option 1. |
| Ericsson | Support Option 1. |
| Apple | We support Option 1. |
| Qualcomm | We support the recommended WF. |
| Huawei | We are OK with Option 1. |
| Samsung | Agree with option 1 and recommended WF |

Sub topic 3-5

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| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 3-5-1Issue 3-5-2Issue 3-5-3 |
| Intel | Issue 3-5-1We support at least requirements introduction for SFN Scheme A since it brings performance benefits and requires new UE receive processing. For SFN scheme B we suggest to further evaluate impact on UE receive processing to identify whether new requirement is needed or normal requirement can cover this scenario as well. At current stage a channel model that can be considered for testing and BS processing assumptions are not clear for us. Same time they have direct impact on UE receive processing. Issue 3-5-2RAN4 has never defined HST requirements for PDCCH since PDCCH is quite reliable. In this case we do not think that we need to define PDCCH requirement with enhanced HST-SFN Tx scheme without requirement for baseline scheme. However, HST-SFN scheme A feature assumes that UE can be able to receive both PDCCH and PDSCH with new Tx scheme. In this case we can define test case when both channels are transmitted using SFN scheme A and verify performance of PDSCH only. |
| Ericsson  | Issue 3-5-1Support Option 1b. Testing on scheme B would be difficult since the pre-compensation will impact the result. Besides, with network pre-compensation, the processing from UE will be the same as that of HST single tap. Since we have defined requirement for HST single tap, there is no need to define another requirement for Scheme B. |
| Apple | Issue 3-5-1We support option 1b to only consider SFN Scheme A. We need to further discuss the channel model for this scheme.We also would like to use existing HST SFN requirements as a baseline in evaluating performance with HST SFN scheme A.Issue 3-5-2In RAN4 we haven’t defined any PDCCH demod requirements in HST scenarios – single tap or SFN-JT. Since PDCCH is expected to be reliable. So we don’t see why we need to introduce requirements for SFN Scheme A now.Issue 3-5-3We think this is very early to discuss this. Its not only about defining requirements with additional CBW for each SCS but also discussions on new UE capability, network opplerg etc. Also, this requires enhanced processing with multiple TCI states for PDCCH/PDSCH, we would need to evaluate how this affects CA case. Depending on progress of requirements for single carrier case we can discuss |
| NTT DoCoMo | Issue 3-5-1For SFN scheme A, we are fine to define requirements.As for SFN scheme B, we think this scheme is also useful. However, it is not clear how to design UE demodulation requirements considering the BS pre-compensation. |
| Huawei | Issue 3-5-1We prefer Option 1a with applicability rule proposed by CMCC considering that both two SFN schemes are important application scenario.Issue 3-5-2We prefer Option 3 considering that PDSCH requirements is to be defined for both Scheme A and Scheme B so corresponding PDCCH performance can also be ensured. If SFN Scheme B PDSCH requirements are not defined, then SFN Scheme B PDCCH requirements should be defined. In addition, the SFN Scheme A PDCCH performance under URLLC use case should be ensured.Issue 3-5-3We prefer to not consider CA requirements for HST SFN scenario and assume that the enhanced SFN CA performance can be ensured if UE has passed both the normal SFN CA requirements and the enhanced SFN single carrier requirements. |
| Qualcomm | Issue 3-5-1We support Option 1b and share similar views with Ericsson. Assuming PDSCH is Doppler pre-compensated (via Scheme B), we see it not impacting the UE side processing in a meaningful way which justifies defining requirements for this scheme.Issue 3-5-2We share similar views with Apple and don’t think it is required to define PDCCH performance requirement for non-SFN TRS/HST-SFN schemes. Also, assuming that UE passes PDSCH requirement, corresponding PDCCH performance can be implicitly ensured. Furthermore, existing HST-SFN scenarios did not define PDCCH requirements and we think we should follow the sameIssue 3-5-3We think that we should focus on the single carrier case for HST-SFN and performance requirement for CA should not be defined. |
| CMCC | Issue 3-5-1Option 1a is preferred, and fine with the recommended WF.For option 1c, firstly, there is a typo, it is about SFN scheme B (TRP-based pre-compensation), not for scheme A. Secondly, for TRP-based pre-compensation, our consideration is that UE may still need to handle the oppler shift but the oppler shift is not so large as the case without pre-compensation. Since UE still need to handle multi-path with oppler shift, it is better to guarantee UE demodulation performance. One way is to define new demodulation performance requirements. The other way is to introduce applicability rule: if UE passes the existing test cases, the performance of TRP-based pre-compensation are also guaranteed. We are open to discussion, and would like to hear companies’ views.Issue 3-5-2Option 1. According to RAN1 agreements, both PDCCH and PDSCH are considered for HST-SFN. It is necessary to specify PDCCH requirements to guarantee the performance. And we agree with HW’ comments that it also depends on how we consider the PDSCH requirements for HST-SFN scenarios. If SFN Scheme B PDSCH requirements are defined, we can consider not to define PDCCH requirements. However, if SFN Scheme B PDSCH requirements are not defined, SFN Scheme B PDCCH requirements should be definedIssue 3-5-3Prefer to focus on single carrier firstly. And we are open for the CA case, can be further discussed. |
| Samsung | Issue 3-5-1Two SFN transmission schemes (SFN scheme A- UE based on solution, and SFN scheme B-TRP based pre-compensation) are introduced to improved performance under HST SFN scenarios with multi-TRP transmissionIn general, we agree scheme B may be not impact on UE processing. With TRP pre-compensation, it depend on the BS processing. Under this scheme, it’s assume Doppler shift already compensated in Gnb side per TRP basis, the residual Doppler shift/spread should be same for two TRPs. UE will use TRP based TRSs to track delay parameters in per RRH/TCI state manner. It is necessary to define requirement with related two TCI states with variant A assumption to verify the proper TRP based TRS processing to track delay with multi-RRH, different with HST single tapWe are open to further discuss the applicability rule proposed by CMCC how to cover these two SFN schemes in RAN4 Issue 3-5-2In additional to enhanced transmission schemes on PDSCH, the combination of schemes on PDCCH and PDSCH, both legacy SFN based on scheme and equivalent enhanced TRP based scheme (SFN scheme A and B) can be applied for PDCCH. It is necessary to verify the PDCCH requirement with enhanced TRP based scheme. While considering there is no PDCCH requirement for Rel-16 SFN PDCCH requirement, we are open to further discuss whether PDCCH is needed. Issue 3-5-3We are open to further discuss whether CA requirement is needed, since it also related with additional UE capability, we suggest to focus on single carrier requirement firstly, considering limited timeline for Rel-17 performance time line. If time allowed, we can have discuss the CA requirement for enhancement SFN scenario.  |

Sub topic 3-6

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| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 3-6-1Issue 3-6-2 |
| Intel | Issue 3-6-1TDM scheme was defined for single panel UE operation in FR2. For FR1 it is better to consider FDM scheme that provides less latency. Support Option 3. |
| Ericsson | Issue 3-6-1We are fine with Option 2 and Option 3.Issue 3-6-2We prefer to first focus on the scope. Need to further check on that. |
| Apple | Issue 3-6-1We don’t support defining requirements for this case.Issue 3-6-2We don’t support defining requirements for this case. |
| Huawei | Issue 3-6-1We are OK to only consider both FDM and TDM intra-slot repetition for FR1. Permutation and combination can be used to reduce the test efforts, such as FDM for AL4 and TDM for AL8.Issue 3-6-2We prefer to reuse the configuration of the existing cases, such as Test 1 in Table 5.3.2.1.1-1/Table 5.3.3.1.1-1 for 1T2R and 1T4R respectively; Test 2 in Table 5.3.2.1.2-1/Table 5.3.3.1.2-1 for 2T2R and 2T4R respectively. |
| Qualcomm | Issue 3-6-1We don’t support defining PDCCH requirement for m-TRP transmission and we suggest that test setup be discussed only after the outcome of corresponding scoping discussion (Issue 3-2-1). Issue 3-6-2We don’t support defining PDCCH requirement for m-TRP transmission and we suggest any simulation assumptions be discussed only after the outcome of related scoping discussions (Issue 3-2-1). |

Sub topic 3-7

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| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 3-7-1 |
| Ericsson | We prefer to discuss it after having decision on issue 3-3-1 |
| Apple | We don’t support defining requirements for this case.We should first discuss and agree on the scope of demod before discussing detailed sim assumptions. |
| Huawei | We propose to define requirements with the full-overlapping resource allocation. For other parameters, we are OK to reuse from the existing Rel-16 multi-DCI multi-TRP cases. |
| Qualcomm | We suggest to discuss this only after the outcome of scoping discussion (Issue 3-3-1). |

Sub topic 3-8

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| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 3-8-1Issue 3-8-2 |
| Ericsson | Issue 3-8-1We prefer to discuss it after having decision on the issue 3-5-1. One thing we would like to point it out is that the number of visible RRH should be 2 for HST-SFN Scheme A.Issue 3-8-2We prefer to discuss it after having decision on the issue 3-5-1. |
| Apple | Issue 3-8-1We should first discuss and agree on the scope of demod before discussing detailed sim assumptions/ test case design.Issue 3-8-2We should first discuss and agree on the scope of demod before discussing detailed sim assumptions/ test case design. |
| Huawei | Issue 3-8-1We prefer Option 4. For the maximum Doppler, we prefer 870Hz and 1667Hz for 15kHz SCS and 30kHz SCS respectively that is same as the normal SFN.Issue 3-8-2Further discuss is needed. |
| NTT DoCoMo | Issue 3-8-1We basically support treating the existing HST-SFN test set-up as baseline except for Maximum Doppler shift for FDD 15kHz. Our preference is 972Hz that is the same value as Rel-16 Single-tap. Also, we are fine to discuss on the test scope first. |
| Qualcomm | Issue 3-8-1We prefer to discuss detailed test cases/simulation assumptions only after agreeing on the scope of demod requirements.Issue 3-8-2We prefer to discuss only after the outcome of Issue 3-5-1. |

### CRs/TPs comments collection

*For close-to-finalize Wis and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing 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:* |
| **Sub-topic#3-1** | **Issue 3-1-1: Whether to define m-TRP transmission UE demodulation/CSI requirement in FR2***Tentative agreements:** Postpone the discussion on m-TRP transmission UE demodulation/CSI requirements in FR2 till RAN4 RF and RRM core have conclusion on supporting FR2 UE with the capability of simultaneous reception with different QCL Type-D RSs.
* With current testing methodology has limitation from OTA feasibility to support simultaneous 2 AOA for demodulation requirement test
 |
| **Sub-topic 3-2** | **Issue 3-2-1: Whether to define PDCCH requirement for multi-TRP repetition transmission schemes***Candidate options:** Proposals
	+ Option 1 (Intel, Huawei, Ericsson, Samsung): Yes
	+ Option 2 (Apple, Qualcomm): No

*Recommendations for 2nd round:** Encourage comments if any.

**Issue 3-2-2: Whether to define PDSCH requirement to verify whether UE is with proper behaviour of rate matching around the two linked PDCCH.***Candidate options:** Proposals
	+ Option 1 (Huawei): Yes
	+ Option 2 (Intel, Ericsson, Apple, Qualcomm, Samsung ): No

*Recommendations for 2nd round:** Encourage comments if any.

**Issue 3-2-3: Whether to define PUCCH/PUSCH requirement for multi-TRP repetition transmission schemes***Candidate options:** Proposals
	+ Option 1 (Samsung): FFS whether BS demodulation requirements impact for enhancements on Multi-TRP under Rel-17 FeMIMO WI.
	+ Option 2 (Ericsson, Intel, Huawei): No

*Recommendations for 2nd round:** Encourage comments if any.
 |
| **Sub-topic 3-3** | **Issue 3-3-1: Whether to define PDSCH requirement for Multi-TRP inter-cell operation** *Candidate options:** Proposals
	+ Option 1 (Samsung, Huawei): Yes
	+ Option 2 (Apple, Intel, Ericsson, Qualcomm): No
		- Option 2a (Intel) : Discuss the following alternatives how to guarantee demodulation performance for inter-cell multi-DCI multi-TRP Tx scheme
* Alt1 (Apple): Define applicability rule for UE that supports “IntCell-Mtrp” feature that if such UE satisfied Rel-16 minimum requirements for PDSCH multi-DCI based transmission scheme, inter-cell operation can be also guaranteed.
* Alt2: Add a note to specification that if UE supports “IntCell-Mtrp” feature, minimum requirements for PDSCH multi-DCI based transmission scheme is applicable for this UE, but test configuration (i.e., RRC, SSB) should reflects inter-cell operation mode. Applicability rule between requirements for intra-cell and inter-cell scenarios can be further discussed.
	+ - Option 2b (Ericsson) : Not to define PDSCH/PDCCH demodulation requirement for inter-cell Multi-TRP transmission if intra-slot PDCCH repetition demodulation requirement is agreed to be introduce

*Recommendations for 2nd round:** Encourage comments if any.
 |
| **Sub-topic 3-4** | **Issue 3-4-1: Whether to define performance requirement (demodulation and CSI) on beam management for multi-TRP***Tentative agreements:** No performance requirements (demodulation and CSI) on beam management for multi-TRP
 |
| **Sub-topic 3-5** | **Issue 3-5-1: Whether to define PDSCH requirement for HST SFN scenario***Tentative agreements:** + Introduce PDSCH requirements for HST SFN scheme A,
	+ FFS on HST SFN scheme B

*Candidate options:** Proposals
	+ Option 1 (Samsung, Huawei, CMCC): Both SFN scheme A and SFN scheme B
	+ Option 2 (Ericsson, Intel, NTT DoCoMo, Qualcomm, Apple): Only SFN scheme A
	+ Option 3 (CMCC): SFN scheme B with introduction test applicability rule:
		- If UE pass passes the existing test cases (demodulation requirement for HST-SFN with high Doppler shift), the performance of SFN scheme B (TRP-based pre-compensation) are guaranteed
	+ Option 4(Intel): Further evaluate impact on UE receive processing
	+ Option 5 (Huawei) Both SFN scheme A and SFN scheme B with introduction test applicability rule
	+  If UE pass passes the existing test cases (demodulation requirement for HST-SFN with high Doppler shift), the performance of SFN scheme B (TRP-based pre-compensation) are guaranteed

*Recommendations for 2nd round:** Encourage comments if any.

**Issue 3-5-2: Whether to define PDCCH requirement for HST SFN scenario***Candidate options:** Proposals
	+ Option 1 (CMCC): Yes
	+ Option 2 (Ericsson): RAN4 discusses and decides whether to still have PDCCH demodulation requirement if intra-slot PDCCH repetition demodulation requirement is agreed to be introduced
	+ Option 3 (Huawei): Do not define any PDCCH requirements for HST scenario but define PDCCH requirements for Scheme A for non-HST scenario.
	+ Option 4(Intel): Define test case when both channels (PDSCH/PDCCH) are transmitted using SFN scheme A and verify performance of PDSCH only
	+ Option 5(Apple, Qualcomm): No

*Recommendations for 2nd round:** Encourage comments if any.

**Issue 3-5-3: Whether to define PDSCH requirement for HST SFN scenario for CA***Candidate options:** Proposals
	+ Option 1 (Intel): Yes
	+ Option 2 (Huawei, Qualcomm): No
	+ Option 3 (Apple, CMCC, Samsung): Define single carrier requirement firstly

*Recommendations for 2nd round:** Encourage comments if any.
 |
| **Sub-topic 3-6** | **Issue 3-6-1: Multi-TRP repetition transmission schemes for PDCCH requirements***Candidate options:** Proposals
	+ Option 1 (Huawei): Define PDCCH performance requirement with following cases
		- FR1 FDM with intra-slot repetition
		- FR1 TDM with intra-slot repetition
	+ Option 2 (Ericsson): Define either TDM or FDM based intra-slot PDCCH repetition demodulation performance requirement
	+ Option 3(Intel, Ericsson): FDM repetition scheme

*Recommendations for 2nd round:** Focus on the test scope discussion firstly

**Issue 3-6-2: Simulation Assumption for PDCCH with FDM repetition scheme** *Candidate options:** Proposals
	+ Option 1(Intel):

|  |  |
| --- | --- |
| Parameter | Value |
| FDD 15 kHz SCS | TDD 30 kHz SCS |
| CBW | 10 MHz | 40 MHz |
| Antenna configuration | 2x2; 2x4 (2Tx for each TRP) |
| CORESET RB | 24 | 48 |
| CORESET Duration | 2 |
| Aggregation level | 4, 8 |
| CCE-REG mapping | Non-interleaved |
| REG bundle size | 6 |
| Propagation conditions | TDLA30-10 |
| Test metric | SNR @1% Probability of missed downlink scheduling grant |

* + Option 2(Huawei)
		- Reuse the configuration of the existing cases, such as Test 1 in Table 5.3.2.1.1-1/Table 5.3.3.1.1-1 for 1T2R and 1T4R
		- Test 2 in Table 5.3.2.1.2-1/Table 5.3.3.1.2-1 for 2T2R and 2T4R.

*Recommendations for 2nd round:** Focus on the test scope discussion firstly
 |
| **Sub-topic 3-7** | **Issue 3-7-1: Simulation assumption for PDSCH requirement** *Candidate options:** Proposals
	+ Option 1 (Samsung): Reusing test parameters of existing Rel-16 multi-DCI based on TRP transmission test case (Table 5.2.2.1.12-2) with different PCI for TP1 and TP2 i.e.
		- Time offset/frequency offset: -0.5us /200Hz for FR1 FDD 15kHz SCS; -0.25us/300Hz for FR1 TDD 30kHz SCS
		- RB allocation: frequency non-overlapping
		- MCS: 64QAM 1/2
		- PCI ID: [0] for TP1, [3] for TP2
		- SSB transmission: SSB 1 for TP1, SSB 2 for TP2
	+ Option 2 (Huawei):
		- RB allocation: frequency overlapping

*Recommendations for 2nd round:** Focus on the test scope discussion firstly
 |
| **Sub-topic 3-8** | **Issue 3-8-1: Test Case design for PDSCH requirement for SFN scheme A with Single Carrier** *Tentative agreements::** Reusing existing Rel-16 HST-SFN test set-up as baseline
	+ PDCCH/PDSCH/PBCH SFN transmitted from two RRHs
	+ TCI state 1 and TCI state 2 applied for TRP/RRH #2n, #2n+1 separately; TRS 1 and TRS 2 transmitted from TRP#2n, and #2n+1 separately

|  |  |
| --- | --- |
| Parameter | Value |
| FDD 15 kHz SCS | TDD 30 kHz SCS |
| CBW | 10 MHz  | 40 MHz  |
| Antenna configuration | 2x2; 2x4 |
| DMRS type | Type 1 |
| Number of DMRS symbols | 1+1+1 |
| TDD pattern |  | 7D1S2U, S: 6D 4G 4U |
| TRS periodicity | 10ms, 2 slot pattern |
| PDSCH mapping | Type A, Start symbol 2, Duration 12 |
| Propagation conditions | HST-SFN for PDSCH, PDCCH, DMRSHST-SFN single tap for TRS |
| Ds and Dmin | Ds =700m; Dmin=150m |
| Test metric | SNR @70% of maximum throughput |

*Candidate options:***Maximum Doppler shift*** Proposals
	+ Option 1 (NTT DoCoMo):
		- 15KHz SCS: 972Hz
		- 30KHz SCS: 1667Hz
	+ Option 2 (Samsung, Intel, Huawei):
		- 15KHz SCS: 870Hz
		- 30KHz SCS: 1667Hz

**MCS and Rank*** Proposals
	+ Option 1 (Intel):
		- MCS 13, MCS17 with Rank 2 from MCS Table 1
	+ Option 2 (Huawei, Samsung):
		- MCS 17 with Rank 2 from MCS Table 1

**Channel Model*** Proposals
	+ Option 1 (Samsung):
		- HST SFN channel model specified in B.3.2 of TS 38.101-4 reused as baseline
		- MCS 13, MCS17 with Rank 2 from MCS Table 1
	+ Option 2 (Huawei, Ericsson):
		- Reusing the existing Rel-16 HST-SFN channel model (Ds=700m, Dmin=150m) with removing the two furthest paths corresponding to the two furthest TRP
	+ Option 3 (Apple):
		- Other options are not precluded

*Recommendations for 2nd round:** Encourage comments if any.

**Issue 3-8-2: Test Case design for PDSCH requirement for SFN scheme B** *Candidate options** Proposals
	+ Option 1 (Samsung): Reusing existing Rel-16 HST-SFN test set-up as baseline
		- Two TCI states with QCL A type information, and another one configured QCL type B information
* PDCCH/PDSCH/PBCH SFN transmitted from two RRHs
* TCI state 1 and TCI state 2 applied for for TRP/RRH #2n, #2n+1 separately; TRS 1 and TRS 2 transmitted from TRP#2n, and #2n+1 separately
* HST SFN channel model specified in B.3.2 of TS 38.101-4 reused without modelling Doppler shift
	+ Option 2 (Huawei): Reusing existing Rel-16 HST-SFN test set-up as baseline Reusing the existing Rel-16 HST-SFN channel model (Ds=700m, Dmin=150m) with removing the two furthest paths corresponding to the two furthest TRP
		- MCS 17 with rank 2 can be used as a starting point
		- Select typical network implementation and consider the network implementation as a part of channel model (i.e. specify the function between the time and the pre-compensation value) to make sure TE implementation of pre-compensation has no impact on the UE performance during the test.

*Recommendations for 2nd round:** Focus on the test scope discussion firstly
 |

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **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)

# Topic #4: Enhancement on SRS

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2200767 | Samsung | Overview on performance requirements

|  |  |  |  |
| --- | --- | --- | --- |
| **Items** | **BS demodulation** | **UE demodulation**  | **CSI**  |
| Enhancement on multi-beam operation  | NO | NO | NO |
| Enhancements on multi-TRP | Enhancements on Multi-TRP for PDCCH, PUCCH and PUSCH  | FFS (PUSCH, PUCCH M-TRP) | M-TRP PDCCH repetition  | NO |
| Enhancements on Multi-TRP inter-cell operation | NO | Yes, M-TRP Inter-cell PDSCH  | NO |
| Enhancements on beam management for multi-TRP | NO | NO | NO |
| Enhancements on HST-SFN deployment | NO | Yes, PDSCH for SFN scheme A and scheme B | NO |
| Enhancement on SRS | NO | NO | NO |
| Enhancement on CSI reporting  | M-TRP | NO | NO | Yes, CSI for M-TRP |
| FDD reciprocity  | NO | NO | Yes, PMI for enhanced Type II port selection codebook |

Proposal 7: No performance requirements (demodulation and CSI) impact for Rel-17 FeMIMO objective “Enhancement on SRS”. |
| R4-2200280 | Apple | Proposal 1: No impact to UE demodulation with the following enhancements* Enhancements to multi-beam operation
* Multi-TRP PUCCH/PUSCH
* SRS Enhancements
* Further enhanced Type II port selection codebook
 |

## Open issues summary

List of open issues

* Sub-topic 4-1 Test Scope
	+ Issue 4-1-1: whether to define performance requirement (demodulation and CSI) for SRS enhancement

### Sub-topic 4-1: Test Scope

**Issue 4-1-1: whether to define performance requirement (demodulation and CSI) for SRS enhancement**

* Proposals
	+ Option 1(Samsung, Apple, Intel, Ericsson, Qualcomm, Huawei): No performance requirements (demodulation and CSI) impact for Rel-17 FeMIMO objective “Enhancement on SRS”
* Recommended WF
	+ Option 1

## Companies views’ collection for 1st round

### Open issues

*One of the two formats, i.e. either example 1 or 2 can be used by moderators.*

Sub topic 4-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 4-1-1 |
| Intel  | Support Option 1. |
| Ericsson | Support Option 1. |
| Apple | Support Option 1. |
| Huawei | We are OK with Option 1. |
| Qualcomm | We support the recommended WF |
| Samsung | Agree with option1 and recommend WF |

### CRs/TPs comments collection

*For close-to-finalize WIs and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing 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:* |
| **Sub-topic 4-1** | **Issue 4-1-1: whether to define performance requirement (demodulation and CSI) for SRS enhancement***Tentative agreements:*No performance requirements (demodulation and CSI) impact for Rel-17 FeMIMO objective “Enhancement on SRS” |

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **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)

# Topic #5: Enhancement on CSI reporting

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2200767 | Samsung | Overview on performance requirements

|  |  |  |  |
| --- | --- | --- | --- |
| **Items** | **BS demodulation** | **UE demodulation**  | **CSI**  |
| Enhancement on multi-beam operation  | NO | NO | NO |
| Enhancements on multi-TRP | Enhancements on Multi-TRP for PDCCH, PUCCH and PUSCH  | FFS (PUSCH, PUCCH M-TRP) | M-TRP PDCCH repetition  | NO |
| Enhancements on Multi-TRP inter-cell operation | NO | Yes, M-TRP Inter-cell PDSCH  | NO |
| Enhancements on beam management for multi-TRP | NO | NO | NO |
| Enhancements on HST-SFN deployment | NO | Yes, PDSCH for SFN scheme A and scheme B | NO |
| Enhancement on SRS | NO | NO | NO |
| Enhancement on CSI reporting  | M-TRP | NO | NO | Yes, CSI for M-TRP |
| FDD reciprocity  | NO | NO | Yes, PMI for enhanced Type II port selection codebook |

.Proposal 8: Introduce CSI requirements for CSI reporting enhancement for m-TRP NCJT transmission.Proposal 9: Introduce PMI requirements for enhanced PS (port selection) Type II codebook (FR1 only).Test case design for CSI requirements Proposal 13: Introduce CQI test case for single-DCI based M-TRP transmission * 2 TPs configured with fully overlapping Resource allocation
* One CSI-RS resource set with Ks = 2
	+ TP1 associated with NZP-CSI-RS resource 1
	+ TP2 associated with NZP CSI-RS resource 2
* CSI reporting: One CSI associated with multi-TRP measurement hypothesis and X=0 CSI associated with single-TRP measurement hypothesis
	+ CMR group 1 {CMR a} corresponding to NZP CSI-RS resource 1, K1=1
	+ CMR group 2 {CMR b} corresponding to NZP CSI-RS resource 2, K2=1
	+ CMR pair (N=1) : CMR {a,b} for M-TRP measurement hypothesis
* Fix layer combination and precoding during test cases i.e. 1+1 for 2Rx, 2+2 for 4Rx
* No time/frequency offset between two TPs

Other test parameters reusing existing Rel-16 PDSCH requirements with single-DCI M-TRP SDM schemeProposal 14: Introduce PMI test with enhanced PS Type II codebook, by modelling BF CSI-RS ports with below two alternatives:* Alternative 1: Apply specific beamforming vector on each CSI-RS pair (polarization)
* Alternative 2: Apply power scaling factor on each CSI-RS pair (polarization)
 |
| R4-2200280 | Apple | Proposal 3: Further discuss if requirements are introduced for the following enhancements for FeMIMO* HST-SFN enhancements
* CSI enhancements for single DCI SDM transmission scheme
 |
| R4-2200522 | Intel | Proposal 12: Do not consider Rel-16 repetition schemes for CSI reporting requirements definition.Proposal 13: Define CQI reporting requirements for multi-DCI Tx scheme and single-DCI SDM scheme.Proposal 14: Define PMI and RI reporting requirements for single-DCI SDM scheme only.Proposal 15: Define PMI reporting requirements with Rel-17 FeType-II Codebooks for FDD. |
| R4-2201014 | Huawei, HiSilicon | Proposal 16: Do not define performance requirements for Rel-17 port-selection codebook.Proposal 17: For Rel-17 CSI measurement enhancement, define CQI, PMI, RI reporting cases for single-DCI based multi-TRP scheme.Proposal 18: Only consider the first reporting method with X=0 for CSI reporting requirement.Proposal 19: Number of antenna port, reporting granularity, CSI-RS resource type (P/AP), CSI-RS reporting type (P/AP), test metric, etc. can be reused from the existing CSI reporting cases, i.e. configuration of 4+4/8+8/16+16 port case is corresponding to that of the existing 8/16/32 port case. |
| R4-2201421 | Ericsson | Proposal 6: Not to define per-TRP CSI reporting requirementProposal 7: Not to define PMI reporting test and requirement for Rel-17 enhanced Type II port selection codebookProposal 8: Companies evaluate the impact of false PMI reporting on throughputProposal 9: Consider the simulation assumption of RAN1 evaluation and CQI reporting test for inter-cell interference as a starting pointProposal 10: RAN4 defines a validation method considering such evaluation metric (option 1) as a starting point with multi-TRP operation: Throughput ratio between follow PMI with inter-cell interference and follow PMI without interferenceProposal 11: RAN4 defines PMI reporting requirement for inter-cell interference scenario |
| R4-2201841 | Qualcomm | Proposal 1: The propagation channels apply to each of TRP #1 and TRP #2 is TDLA30-5 and are statistically independent.Proposal 2: Correlation matrix and antenna configuration parameters apply to each of TRP #1 and TRP #2 is high corr and cross-polarized, respectively.Proposal 3: The same Pc ratios to be considered for TRP #1 and TRP #2 in defining requirements.Proposal 4: The SNRs for TRP #1 and TRP #2 are assumed to be balanced with a scaling factor of 1/sqrt(2) for the transmitted signal from each TRP.Proposal 5: Only PMI reporting is considered for defining the requirements for the m-TRP CSI.Proposal 6: The number of CSI-RS ports is assumed to be 8 for each TRP for the PMI tests.Proposal 7: The m-TRP CSI requirements be limited to FR1 and do not define requirements for FR2. |
| R4-2201922 | Nokia | Observation 1: The Rel-17 feTypeIIPS codebook is (for the UE) a lower complexity version of Rel-16 eTypeIIPS style of codebooks, which can be equally well applied to both MU and SU MIMO scenarios.Observation 2: The Rel-17 further enhanced type II port selection codebook is structurally, computationally, and implementation wise, very distinct from the Rel-16 PS codebook and requirements do not exist for any codebooks with comparable structure.Observation 3: Standardization of a test procedure for feType II PS performance requirements is a complex problem, in particular if the SS/BS algorithm for UL/DL reciprocity based beam selection is to be modelled.Proposal 1: Include feType II PS performance requirements utilizing CSI-RS transmission with a predetermined beam selection used in the transmission.Observation 4: An important use case for the feType II PMI is to enhance MU-MIMO throughput by providing a much more accurate representation of the strongest channel eigenvectors than Type I single panel PMI. This allows the gNB to steer the beams of co-scheduled UEs in each other’s null space with less residual interference.Observation 5: 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 6: A DUT could in practice be able to report a feType II PMI that does not represent well the main eigenvectors of the channel and still pass an SU-MIMO test for feType II, because the throughput difference between Type I SP and feType II is not large enough for SU-MIMO transmission.Proposal 2: RAN4 to evaluate both SU-MIMO and MU-MIMO options for the propagation environment and/or interference setting, when determining the Rel-17 feType II PS performance requirements. |

## Open issues summary

List of open issues

* Sub-Topic 5-1: Test Scope
	+ Issue 5-1-1: whether to define CSI reporting requirement for Multi-TRP transmission
	+ Issue 5-1-2: whether to define PMI reporting requirement for Rel-17 eType II port selection codebook for FDD
	+ Issue 5-1-3: whether to define PMI reporting requirement for inter-cell interference scenario
* Sub-Topic 5-2: Test setup for CSI reporting requirement for multi-TRP
	+ Issue 5-2-1: CQI test setup for single-DCI based on multi-TRP transmission SDM
	+ Issue 5-2-2: Common setup for CSI reporting requirement for multi-TRP
	+ Issue 5-2-3: Number of CSI-RS Ports for PMI reporting test
* Sub-Topic 5-3: Test setup for PMI reporting requirement based on eType II port selection
	+ Issue 5-3-1: whether to define Rel-17 eType II port selection codebook PMI reporting requirement for MU-MIMO
	+ Issue 5-3-2: Modelling BF CSI-RS Port
* Sub-Topic 5-4: Test setup for PMI reporting requirement with inter-cell interference
	+ Issue 5-4-1: Simulation Assumption for evaluation
	+ Issue 5-4-2: Test Metric

### Sub-topic 5-1 Test Scope

**Issue 5-1-1: whether to define CSI reporting requirement for Multi-TRP transmission**

* Proposals
	+ Option 1(Samsung, Huawei, Qualcomm, Intel, Apple, Ericsson(Compromised )): Introduce CSI requirements for CSI reporting enhancement for m-TRP NCJT transmission,
		- Option 1a(Huawei): Define CQI, PMI, RI reporting cases for single-DCI based multi-TRP scheme
		- Option 1b(Intel): Do not consider Rel-16 repetition schemes for CSI requirement definition
* Define CQI reporting requirements for multi-DCI Tx scheme and single-DCI SDM scheme.
* Define PMI and RI reporting requirements for single-DCI SDM scheme only.
	+ - Option 1c(Qualcomm): Only PMI reporting is considered for defining the requirements for the m-TRP CSI
		- Option 1d(Apple): Further discussion CSI enhancements for single DCI SDM transmission scheme
	+ Option 2 (Ericsson): Not to define per-TRP CSI reporting requirement
* Recommended WF
	+ Introduce CSI requirements for CSI reporting enhancement for m-TRP NCJT transmission; further discussion below candidate options
		- Option 1: CQI, PMI, RI
		- Option 2: CQI only
		- Option 3: PMI only

**Issue 5-1-2: whether to define PMI reporting requirement for Rel-17 eType II port selection codebook for FDD**

* Observation
	+ Observation 1 (Nokia):
		- Further discuss and define applicability rules between defined test cases for different scenarios
		- The Rel-17 feTypeIIPS codebook is (for the UE) a lower complexity version of Rel-16 eTypeIIPS style of codebooks, which can be equally well applied to both MU and SU MIMO scenarios.
		- The Rel-17 further enhanced type II port selection codebook is structurally, computationally, and implementation wise, very distinct from the Rel-16 PS codebook and requirements do not exist for any codebooks with comparable structure.
		- Standardization of a test procedure for feType II PS performance requirements is a complex problem, in particular if the SS/BS algorithm for UL/DL reciprocity based beam selection is to be modelled
* Proposals
	+ Option 1(Samsung, Intel, Nokia): Yes
	+ Option 2 (Ericsson, Apple, Huawei): No
* Recommended WF
	+ Encourage comments if any.

**Issue 5-1-3: whether to define PMI reporting requirement for inter-cell interference scenario**

* Proposals
	+ Option 1 (Ericsson): Yes
		- Companies evaluate the impact of false PMI reporting on throughput
		- RAN4 defines PMI reporting requirement for inter-cell interference scenario
* Recommended WF
	+ Encourage comments if any.

### Sub-topic 5-2: Test setup for CSI reporting requirement for multi-TRP

**Issue 5-2-1: CQI test setup for single-DCI based on multi-TRP transmission SDM**

* Proposals
	+ Option 1 (Samsung):
		- 2 TPs configured with fully overlapping Resource allocation
		- One CSI-RS resource set with Ks = 2
* TP1 associated with NZP-CSI-RS resource 1
* TP2 associated with NZP CSI-RS resource 2
	+ - CSI reporting: One CSI associated with multi-TRP measurement hypothesis and X=0 CSI associated with single-TRP measurement hypothesis
* CMR group 1 {CMR a} corresponding to NZP CSI-RS resource 1, K1=1
* CMR group 2 {CMR b} corresponding to NZP CSI-RS resource 2, K2=1
* CMR pair (N=1) : CMR {a,b} for M-TRP measurement hypothesis
	+ - Fix layer combination and precoding during test cases i.e. 1+1 for 2Rx, 2+2 for 4Rx
		- No time/frequency offset between two TPs
		- Other test parameters reusing existing Rel-16 PDSCH requirements with single-DCI M-TRP SDM scheme
	+ Option 2 (Huawei):
		- Only consider the first reporting method with X=0 for CSI reporting requirement
		- Number of antenna port, reporting granularity, CSI-RS resource type (P/AP), CSI-RS reporting type (P/AP), test metric, etc. can be reused from the existing CSI reporting cases, i.e. configuration of 4+4/8+8/16+16 port case is corresponding to that of the existing 8/16/32 port case.
* Recommended WF
	+ Encourage comments if any.

**Issue 5-2-2: Common setup for CSI reporting requirement for multi-TRP**

* Proposals
	+ Option 1 (Qualcomm):
		- TDLA30-5 with statistically independent for each TRP
		- XP High for each TRP for correlation matrix and antenna configuration
		- Same Pc ratios for each TRP in defining requirement
		- The SNRs for TRP #1 and TRP #2 are assumed to be balanced with a scaling factor of 1/sqrt(2) for the transmitted signal from each TRP
* Recommended WF
	+ Encourage comments if any.

**Issue 5-2-3: Number of CSI-RS Ports for PMI reporting test**

* Proposals
	+ Option 1 (Qualcomm):
		- 8 for each TRP
* Recommended WF
	+ Encourage comments if any.

### Sub-topic 5-3: Test setup for PMI reporting requirement based on eType II port selection

**Issue 5-3-1: whether to define Rel-17 eType II port selection codebook PMI reporting requirement for MU-MIMO**

* Observation
	+ Observation 1 (Nokia):
		- An important use case for the feType II PMI is to enhance MU-MIMO throughput by providing a much more accurate representation of the strongest channel eigenvectors than Type I single panel PMI. This allows the gNB to steer the beams of co-scheduled UEs in each other’s null space with less residual interference.
		- SU-MIMO throughput is less sensitive than MU-MIMO to PMI inaccuracies because MU-MIMO throughput is limited by interference between co-scheduled UEs.
		- A DUT could in practice be able to report a feType II PMI that does not represent well the main eigenvectors of the channel and still pass an SU-MIMO test for feType II, because the throughput difference between Type I SP and feType II is not large enough for SU-MIMO transmission.
* Proposals
	+ Option 1 (Nokia):
		- RAN4 to evaluate both SU-MIMO and MU-MIMO options for the propagation environment and/or interference setting, when determining the Rel-17 feType II PS performance requirements.
* Recommended WF
	+ Encourage comments if any.

**Issue 5-3-2: Modelling BF CSI-RS Port**

* Proposals
	+ Option 1 (Samsung):
		- Option 1a: Apply specific beamforming vector on each CSI-RS pair (polarization)
		- Option 1b: Apply power scaling factor on each CSI-RS pair (polarization)
* Recommended WF
	+ Encourage comments if any.

### Sub-topic 5-4: Test setup for PMI reporting requirement with inter-cell interference

**Issue 5-4-1: Simulation Assumption for evaluation**

* Proposals
	+ Option 1 (Ericsson):
		- Consider the simulation assumption of RAN1 evaluation and CQI reporting test for inter-cell interference as a starting point
* Recommended WF
	+ Encourage comments if any.

**Issue 5-4-2: Test Metric**

* Proposals
	+ Option 1 (Ericsson): RAN4 defines a validation method considering such evaluation metric(option 1) as a starting point with multi-TRP operation:
		- Throughput ratio between follow PMI with inter-cell interference and follow PMI without interference
* Recommended WF
	+ Encourage comments if any.

## Companies views’ collection for 1st round

### Open issues

*One of the two formats, i.e. either example 1 or 2 can be used by moderators.*

Sub topic 5-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 5-1-1Issue 5-1-2Issue 5-1-3 |
| Ericsson  | Issue 5-1-1Since the majority view is to have requirement for per-TRP CSI reporting, we can try to compromise on considering PMI reporting requirement, since the channel condition from two TRPs should be different.Issue 5-1-2We prefer option 2. In the real network, half of the performance of eType II port selection codebook should be counted on network related behavior. Same thing, in testing, the UL/DL reciprocity including Beam selecting, delay pre-compensation, etc. will be based on the implementation of TE vendor, which could be quite different among different vendors. Moreover, test setup with UL/DL reciprocity would be quite complicated. What should be the test metric? How to ensure the UE behavior of using eType II port selection codebook indeed? Besides, we should note that there is no requirement for typeII-PortSelection-r16 or even typeII-PortSelection (Rel-15). Thus, it is a little bit strange to directly consider to have requirement for eType II port selection codebook in Rel-17.Issue 5-1-3This is an issue found in the field test and caused great performance degradation. Because of the strong interference from the neighboring cell, the UE in its serving cell is reporting the wrong PMI, which harms the performance. RAN1 has been discussing this in Rel-17 FeMIMO WI as TEI but no conclusion have been made on whether to correct the CSI-RS design as below to remove the false PMI reporting problem based on the conclusion of the discussion summary. During the discussion in RAN1, many companies support to solve this problem directly in RAN(please refer to our contribution: R4-2201421). Thus, it is necessary to consider defining a PMI reporting requirement in RAN4 to ensure that the UE can report the correct PMI in the inter-cell interference environment. We encourage companies to check with their RAN1 colleagues on this. |
| Apple | Issue 5-1-1We support option 3. PMI reporting for mTRP would be most beneficial with the CSI enh for mTRP. We can focus on that first rather than having many requirements to discuss and define.Issue 5-1-2We dont see this as a UE feature alone to be tested. The benefits of enhanced Type II PS would be realized with both gNB and UE implementation/ enhancements. How do we ensure both gNB and UE behavior for this feature. We dont think this is straightforward to test and dont support introducing requirements for itIssue 5-1-3We would like to understand which feature in FeMIMO this is related to. In our understanding there was no enhancement in RAN1 to address this issue. Under FeMIMO demod scope we should limit the scope to features defined in RAN1. We dont support studying this under FeMIMO demod scope at this time. We will also further check with our RAN1 colleagues. |
| Huawei | Issue 5-1-1We prefer Option 1a to define CQI, PMI and RI reporting cases for single-DCI based multi-TRP scheme. We are OK with the recommended WF.Issue 5-1-2We prefer Option 2. Firstly, port selection codebook is introduced in Rel-15 and Rel-16 but we have never defined any requirements for it. Secondly, gNB should estimation channel information based on UE transmitted SRS and perform beam-forming to the specific CSI-RS ports. It is related to gNB implementation and greatly affect the accuracy of the precoding matrix, it is not reasonable to define such requirements. Also considering rather complex test setup, we propose to not consider Rel-17 eType II port selection codebook for FDD.Issue 5-1-3We think is related to the specific network deployment. This issue can be avoided by configure non-collision CSI resource for the different cells. In addititon, it is not feasible to handle this issue for the legacy Rel-15/16 UE that is already in the market, and new CSI-RS sequence generation method can be proposed to handle this issue from Rel-18. We are not sure if there is big necessity to define such cases. |
| Intel  | Issue 5-1-1For multi-TRP Tx scheme RAN1 has designed enhanced CSI feedback that assumes reporting of single CQI, and two PMI and RI values. For single-DCI based Tx scheme, considering reception of overlapped repetitions, calculation of CQI, PMI and RI values are different compared to a single-TRP Tx scenario. Therefore, we see a necessity to define CQI, PMI and RI reporting requirements for single-DCI based Tx scheme. Some de-prioritization can be made for RI.In addition, in our understanding the same enhanced CSI feedback can be used for multi-DCI based Tx scheme. For non-overlapped configuration only CQI calculation is different compared to the single-TRP scenario since UE should report single CQI value. In this case we suggest also defining requirements for CQI reporting for multi-DCI non-overlapped Tx scheme. To decouple Tx schemes we suggest capturing separately proposals for "single-DCI" and "multi-DCI" Tx schemes to avoid misinterpretation of NCJT scheme.Issue 5-1-2We see the lack of requirements for port selection codebooks in RAN4 hence definition of PMI reporting requirements with Rel-17 eType-II codebooks is beneficial to guarantee proper UE receive processing and ensure performance benefits for FDD systems. Therefore, we support to further discuss feasibility of test case definition for Rel-17 eType-II codebooks from test complexity perspective. (especially reference gNB design to perform reasonable CSI-RS beamforming)Issue 5-1-3We are not against to evaluate impact of interference to PMI reporting quality, but in our understating this issue is mostly related to network planning rather than UE processing. |
| Nokia | Issue 5-1-2Rel-16 port selection was not tested, since it was a rather straight forward add-on to Rel-16 non-PS.In Rel-17 the PS was substantially improved and it also covers both SU and MU scenarios.Furthermore the complexity shift from UE to BS makes it rather likely that Rel-17 feTypeIIPS is deployed in the field.The TE vendor implementation must be set in RAN4 (or "hard-coded") for the testing to be comparable between TE vendors. However, producing comparable numbers between TEs is a fundamental task of TE vendors, so we are confident a solution between the vendors can be found. We have proposed a simplified testing procedure that removes the TE implementation variability that can be further developed.Performance metrics can be as discussed in Rel-16, e.g., feTypeIIPS selection over TypeII/TypeI, or over random selection.Issue 5-1-3We agree that this is a practically relevant issue that needs solving. Though, solving this issue on the network planning level seems to be possible and preferable (non-overlapping CSI-RS configurations). In this case, technical solution and corresponding requirements would also not be needed.The Rel-18 demodulation enhancement discussions at the plenary also seem to be discussing this objective for Rel-18. At least we should make sure that the discussions are not duplicated in Rel-17 RAN4 and Rel-18 RAN.Further comments on this topics are highly welcome here. Especially, what are the technical solutions that can be introduced in RAN4? For example, what references is the UE expected to use to spatially separate the CSI-RS coming from two different TRPs/Cells? |
| Verizon | Issue 5-1-3The issue of PMI failure has happened in the field test and caused great performance degradation. As a practically relevant issue, we need RAN4 to define PMI reporting requirements in the features of Multi-TRP and CSI. UE needs to function extremely well in such colliding configuration.We support defining a method using measurements to validate that the PMI reporting fails at low SINR in the condition of the PMI reporting when nearing the cell edge behavior. |
| Qualcomm | Issue 5-1-1We think m-TRP transmission would mostly benefit from PMI reporting, captured via the precoding gain for each TRP. Since only one CQI will need to be reported and rank reporting may not be different, e.g., considering single TRP (rank4) and m-TRP with 2+2 case. Therefore, we suggest to define performance requirement only for PMI reporting.Issue 5-1-2We support Option 2 and share similar views with Huawei and Apple. Considering that the performance evaluation could be involved between UE/gNB and there were no requirements defined in Rel-15 and Rel-16 for port selection codebook, we are of the opinion that we should not define any requirements in Rel-17.Issue 5-1-3We think that we need more field data and evaluation to be able to justify PMI reporting requirement for the inter-cell scenario. Therefore, we suggest deprioritizing this item. |
| MTK | Issue 5-1-3RAN4 agreed for overlapping CSI-RS collision in inter-cell CQI test case. We think companies could evaluate first whether there are throughput loss cause by false PMI under the inter-cell interference cell scenario. |

Sub topic 5-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 5-2-1Issue 5-2-2Issue 5-2-3 |
| Ericsson  | Issue 5-2-1Prefer to discuss it after there is a conclusion on the issue 5-1-1.Issue 5-2-2Prefer to discuss it after there is a conclusion on the issue 5-1-1.Issue 5-2-3Prefer to discuss it after there is a conclusion on the issue 5-1-1 |
| Apple | Issue 5-2-1We should first discuss and agree on the scope of demod before discussing detailed sim assumptions/ test case design.Issue 5-2-2We should first discuss and agree on the scope of demod before discussing detailed sim assumptions/ test case design.Issue 5-2-3We should first discuss and agree on the scope of demod before discussing detailed sim assumptions/ test case design. |
| Huawei | Issue 5-2-1We prefer 4 port per TRP as starting point and reuse the test parameter from the existing CSI reporting cases, i.e. configuration of 4+4/8+8/16+16 port case is corresponding to that of the existing 8/16/32 port case.Issue 5-2-2We prefer 4 port per TRP as starting point and reuse the test parameter from the existing CSI reporting cases, i.e. configuration of 4+4/8+8/16+16 port case is corresponding to that of the existing 8/16/32 port case.Issue 5-2-3We prefer 4 port per TRP as starting point and reuse the test parameter from the existing CSI reporting cases, i.e. configuration of 4+4/8+8/16+16 port case is corresponding to that of the existing 8/16/32 port case. |
| Qualcomm | Issue 5-2-1Prefer to discuss after the conclusion of scoping discussion (Issue 5-1-1).Issue 5-2-2We prefer to reuse existing test parameters, can discuss further after the scoping discussions.Issue 5-2-3We prefer 8-port CSI-RS per TRP, but can discuss further after the scoping discussions. |

Sub topic 5-3

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 5-3-1Issue 5-3-2 |
| Ericsson  | Issue 5-3-1Prefer to discuss it after there is a conclusion on the issue 5-1-2.Issue 5-3-2Prefer to discuss it after there is a conclusion on the issue 5-1-2. |
| Nokia | Issue 5-3-1The issue of introducing MU test setups (with virtual/simulated secondary UEs) was discussed first in Rel-16 eMIMO. There it was agreed to come back in Rel-17 feMIMO. The MU test setup is not only related to issue 5-1-2 and can be applied to tests of all MU CBs.We should, at least, collect views and start the discussion independently of 5-1-2. |
| Apple | Issue 5-3-1We should first discuss and agree on the scope of demod before discussing detailed sim assumptions/ test case design.Issue 5-3-2We should first discuss and agree on the scope of demod before discussing detailed sim assumptions/ test case design. |
| Qualcomm | Issue 5-3-1Prefer to discuss only after the outcome of Issue 5-1-2.Issue 5-3-2Prefer to discuss test case design and simulation assumptions after the scoping discussion. |

Sub topic 5-4

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 5-4-1Issue 5-4-2 |
| Apple  | Issue 5-4-1We should first discuss and agree on the scope of demod before discussing detailed sim assumptions/ test case design. |
| Verizon | Issue 5-4-2The issue of PMI reporting on cell edges has been identified. For the feature of Multi-TRP and CSI, UEs need to function extremely well in such colliding configuration, and we would like to define a method using measurements to validate the PMI reporting fails at low SINR in the condition of the PMI reporting when nearing the cell edge behave. |
| Qualcomm | Issue 5-4-1Prefer to discuss test case design and simulation assumptions after the scoping discussion.Issue 5-4-2Prefer to discuss based on the outcome of Issue 5-1-3. |

### CRs/TPs comments collection

*For close-to-finalize WIs and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing 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:* |
| **Sub-topic 5-1** | **Issue 5-1-1: whether to define CSI reporting requirement for Multi-TRP transmission** *Tentative agreements:** Introduce CSI requirements for CSI reporting enhancement for m-TRP NCJT transmission
* FFS on CQI, PMI, and RI

*Candidate options:** Single-DCI based Multi-TRP scheme
	+ Option 1 (Huawei, Intel): CQI, PMI, RI
	+ Option 2 (Samsung): CQI
	+ Option 3 (Qualcomm, Ericsson, Apple): PMI only
* Multi-DCI based Multi-TRP scheme
	+ Option 1 ( Intel): CQI

*Recommendations for 2nd round:** Encourage comments if any.

**Issue 5-1-2: whether to define PMI reporting requirement for Rel-17 eType II port selection codebook for FDD***Candidate options:** Proposals
	+ Option 1(Samsung, Intel, Nokia): Yes
	+ Option 2 (Ericsson, Apple, Huawei, Qualcomm): No

*Recommendations for 2nd round:** Encourage comments if any.

**Issue 5-1-3: whether to define PMI reporting requirement for inter-cell interference scenario***Candidate options:** Proposals
	+ Option 1 (Ericsson, Verizon): Yes
		- Companies evaluate the impact of false PMI reporting on throughput
		- RAN4 defines PMI reporting requirement for inter-cell interference scenario
	+ Option 2 (Nokia, Apple, Huawei): No
	+ Option 3 (Qualcomm, MTK): Further evaluation is needed

*Recommendations for 2nd round:** Encourage comments if any.
 |
| **Sub-topic 5-2** | **Issue 5-2-1: CQI test setup for single-DCI based on multi-TRP transmission SDM***Candidate options:** Proposals
	+ Option 1 (Samsung):
		- 2 TPs configured with fully overlapping Resource allocation
		- One CSI-RS resource set with Ks = 2
* TP1 associated with NZP-CSI-RS resource 1
* TP2 associated with NZP CSI-RS resource 2
	+ - CSI reporting: One CSI associated with multi-TRP measurement hypothesis and X=0 CSI associated with single-TRP measurement hypothesis
* CMR group 1 {CMR a} corresponding to NZP CSI-RS resource 1, K1=1
* CMR group 2 {CMR b} corresponding to NZP CSI-RS resource 2, K2=1
* CMR pair (N=1) : CMR {a,b} for M-TRP measurement hypothesis
	+ - Fix layer combination and precoding during test cases i.e. 1+1 for 2Rx, 2+2 for 4Rx
		- No time/frequency offset between two TPs
		- Other test parameters reusing existing Rel-16 PDSCH requirements with single-DCI M-TRP SDM scheme
	+ Option 2 (Huawei):
		- Only consider the first reporting method with X=0 for CSI reporting requirement
		- Number of antenna port, reporting granularity, CSI-RS resource type (P/AP), CSI-RS reporting type (P/AP), test metric, etc. can be reused from the existing CSI reporting cases, i.e. configuration of 4+4/8+8/16+16 port case is corresponding to that of the existing 8/16/32 port case.

*Recommendations for 2nd round:** Focus on the test scope discussion firstly

**Issue 5-2-2: Common setup for CSI reporting requirement for multi-TRP***Candidate options:** Proposals
	+ Option 1 (Qualcomm):
		- TDLA30-5 with statistically independent for each TRP
		- XP High for each TRP for correlation matrix and antenna configuration
		- Same Pc ratios for each TRP in defining requirement
		- The SNRs for TRP #1 and TRP #2 are assumed to be balanced with a scaling factor of 1/sqrt(2) for the transmitted signal from each TRP

*Recommendations for 2nd round:** Focus on the test scope discussion firstly

**Issue 5-2-3: Number of CSI-RS Ports for PMI reporting test** *Candidate options:** Proposals
	+ Option 1 (Qualcomm):
		- 8 for each TRP
	+ Option 2 (Qualcomm):
		- 4 for each TRP

*Recommendations for 2nd round:** Focus on the test scope discussion firstly
 |
| **Sub-topic 5-3** | **Issue 5-3-1: whether to define Rel-17 eType II port selection codebook PMI reporting requirement for MU-MIMO***Candidate options:** Proposals
	+ Option 1 (Nokia):
		- RAN4 to evaluate both SU-MIMO and MU-MIMO options for the propagation environment and/or interference setting, when determining the Rel-17 feType II PS performance requirements.

*Recommendations for 2nd round:** Focus on the test scope discussion firstly

**Issue 5-3-2: Modelling BF CSI-RS Port***Candidate options:** Proposals
	+ Option 1 (Samsung):
		- Option 1a: Apply specific beamforming vector on each CSI-RS pair (polarization)
		- Option 1b: Apply power scaling factor on each CSI-RS pair (polarization)

*Recommendations for 2nd round:** Focus on the test scope discussion firstly
 |
| **Sub-Topic 5-4** | **Issue 5-4-1: Simulation Assumption for evaluation** *Candidate options:** Proposals
	+ Option 1 (Ericsson):
		- Consider the simulation assumption of RAN1 evaluation and CQI reporting test for inter-cell interference as a starting point

*Recommendations for 2nd round:** Focus on the test scope discussion firstly

**Issue 5-4-2: Test Metric***Candidate options:** Proposals
	+ Option 1 (Ericsson, Verizon): RAN4 defines a validation method considering such evaluation metric(option 1) as a starting point with multi-TRP operation:
		- Throughput ratio between follow PMI with inter-cell interference and follow PMI without interference

*Recommendations for 2nd round:** Focus on the test scope discussion firstly
 |

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **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)

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on general and CSI requirement for Rel-17 FeMIMO | Samsung | Capture all agreements for Topic 1, 2,sub-topic 3-1,3-4,sub-topic 4-1, topic 5 |
| WF on demodulation requirement for Enhancement on HST-SFN deployment | Intel | Capture all agreements for topic 3-5, 3-8 |
| WF on demodulation requirement for Enhancement on Multi-TRP | Huawei | Capture all agreements for topic 3-2, 3-3, 3-6 and 3-7 |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
	1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
	2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
	1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
	2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents

# Annex

Contact information

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email address** |
| Moderator (Samsung) | Yunchuan Yang | yc0301.yang@samsung.com |

Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)