**3GPP TSG-RAN WG4 Meeting # 99- e R4-210XXXX**

**Electronic Meeting, 17th – 27th May, 2021**

**Agenda item:** 9.18.1

**Source:** Moderator (Samsung)

**Title:** Email discussion summary for [99][148] NR\_feMIMO

**Document for:** Information

# Introduction

In the latest approved WID for Rel-17 FeMIMO, the below objectives have been included, i.e.,

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| The work item aims to specify the further enhancements identified for NR MIMO. The detailed objectives are as follows:   * Extend specification support in the following areas [RAN1]  1. Enhancement on multi-beam operation, mainly targeting FR2 while also applicable to FR1:    1. Identify and specify features to facilitate more efficient (lower latency and overhead) DL/UL beam management to support higher intra- and L1/L2-centric inter-cell mobility and/or a larger number of configured TCI states:       1. Common beam for data and control transmission/reception for DL and UL, especially for intra-band CA       2. Unified TCI framework for DL and UL beam indication       3. Enhancement on signaling mechanisms for the above features to improve latency and efficiency with more usage of dynamic control signaling (as opposed to RRC)    2. Identify and specify features to facilitate UL beam selection for UEs equipped with multiple panels, considering UL coverage loss mitigation due to MPE, based on UL beam indication with the unified TCI framework for UL fast panel selection 2. Enhancement on the support for multi-TRP deployment, targeting both FR1 and FR2:    1. Identify and specify features to improve reliability and robustness for channels other than PDSCH (that is, PDCCH, PUSCH, and PUCCH) using multi-TRP and/or multi-panel, with Rel.16 reliability features as the baseline    2. Identify and specify QCL/TCI-related enhancements to enable inter-cell multi-TRP operations, assuming multi-DCI based multi-PDSCH reception    3. Evaluate and, if needed, specify beam-management-related enhancements for simultaneous multi-TRP transmission with multi-panel reception    4. Enhancement to support HST-SFN deployment scenario:       1. Identify and specify solution(s) on QCL assumption for DMRS, e.g. multiple QCL assumptions for the same DMRS port(s), targeting DL-only transmission       2. Evaluate and, if the benefit over Rel.16 HST enhancement baseline is demonstrated, specify QCL/QCL-like relation (including applicable type(s) and the associated requirement) between DL and UL signal by reusing the unified TCI framework 3. Enhancement on SRS, targeting both FR1 and FR2:    1. Identify and specify enhancements on aperiodic SRS triggering to facilitate more flexible triggering and/or DCI overhead/usage reduction    2. Specify SRS switching for up to 8 antennas (e.g., xTyR, x = {1, 2, 4} and y = {6, 8})    3. Evaluate and, if needed, specify the following mechanism(s) to enhance SRS capacity and/or coverage: SRS time bundling, increased SRS repetition, partial sounding across frequency 4. Enhancement on CSI measurement and reporting:    1. Evaluate and, if needed, specify CSI reporting for DL multi-TRP and/or multi-panel transmission to enable more dynamic channel/interference hypotheses for NCJT, targeting both FR1 and FR2    2. Evaluate and, if needed, specify Type II port selection codebook enhancement (based on Rel.15/16 Type II port selection) where information related to angle(s) and delay(s) are estimated at the gNB based on SRS by utilizing DL/UL reciprocity of angle and delay, and the remaining DL CSI is reported by the UE, mainly targeting FDD FR1 to achieve better trade-off among UE complexity, performance and reporting overhead  * Investigate if the requirements on link recovery procedure is suitable for FR2 serving cells [RAN4] * Specify higher layer support of enhancements listed above [RAN2] * Specify core requirements associated with the items specified by RAN1 [RAN4] |

Based on the approved WID and latest discussion in RAN1 and RAN2, contributions have been submitted to RAN4 91 agenda 9.18.1 [2][3] to discuss the RF impact due to introducatio of FeMIMO. Also, rapporteur provide the initial workplan for RAN4 core requirements. In this e-mail thread, discussion on the RF impact is summarized with potential conclusions. View for rapporteur workplan is also collected for further information.

# Topic #1: Impac to RF requirements for FeMIMO

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2109836 | Samsung | **Observation 1:** No multi-panel simultaneous transmission is considered in RAN1  **Observation 2:** It is RAN4 understanding that existing beam switching requirements are applicable for both the same panel and cross panel beam switch cases.  **Observation 3:** RAN4 is only supposed to discuss the impact to RF requirements due to MPE mitigation after RAN1 design is clear  **Proposal 1:** RF core requirements assuming simultaneous reception channel/RS with different QCL type D can be postponed to further release  **Proposal 2:** No RF impact is identified for Multi-panel UE in Rel-17  **Proposal 3:** FFS for UE configured transmitted power requirements due to introduction of SRS switching for up to 8 antennas.  **Proposal 4:** NO RAN4 RF impact foreseen for Rel-17 FeMIMO work objectives on Multi-TRP enhancement and CSI enhancement. |
| R4-2109681 | vivo | **Observation 1:** Single panel UL transmission assumption would mean the basic FR2 UL requirements would not be impacted. Further discussion of switching time between panels is also possible.  **Observation 2:** Depending on RAN1’s discussion progress on MPE and per-panel capability, RAN4 may need related discussion.  **Observation 3:** Multi-panel reception is introduced in R17 FeMIMO, and receiver requirements may be considered.  **Observation 4:** Multi-TRP deployment do not have RF requirements impact.  **Observation 5:** For FR1, SRS switching for up to 8 antennas may have RF impact insertion loss.  **Observation 6:** No RF impact by CSI measurement and reporting.  **Proposal 1:** It is proposed to further consider RF impact for the introduction of multi panel reception for FR2, multi-panel switching requirements for FR2, and SRS extension to 8 antennas in FR1.  **Proposal 2:** Consider MPE related or panel specific capability depending on RAN1’s progress and request. |

## Open issues summary

Based on the latest approved WID, submitted contributions have summarized the objectives as below

* Multi-Beam operation Enhancement (RAN1 led)
* Multi-TRP operation enhancement (RAN1 led)
* SRS enhancement (RAN1 led)
* CSI enhancement (RAN1 led)
* Investigate on Link recovery requirements for FR2 serving cells (RAN4 led)

To facilitate the e-mail discussion, sub-topics can be organized in per objective manner. In Multi-beam operation objectives, submitted contributions are focusing on the discussion to identify the RF requirements for multi-panel UE transmission requirements and MPE mitigation scheme. RAN1 is also discussing the multi-panel receptions in Multi-TRP operation. Therefore, it is suggested to further discuss the potential RF impact for multi-panel UE including both transmission and receptions requirements, MPE and SRS enhancement.

* **Sub topic 1-1**: Potential RAN4 RF impact for Multi-panel UE
* **Sub topic 1-2**: Potential RAN4 RF impact for MPE mitigation
* **Sub topic 1**-**3**: Potential RAN4 RF impact for SRS enhancement

Based on the observation of latest agreements in other WG, RAN1 and RAN2 are still finalizing the final design for these above objectives. Therefore, moderator suggest to focus on finding some common understanding on these above sub-topics

Also, in submitted contributions, no RF impact is identified for some objectives. If possible, this e-mail discussion is also try to confirm no RF impact for the objectives, i.e.,

* Multi-TRP operation enhancement
* CSI enhancement
* Investigate on Link recovery requirements for FR2 serving cells

To simplify the discussions for confirming no RF impact, these above objectives are organized as

**Sub-topic 1-4:** Confirm if any RF impact for the below objectives

* Multi-TRP operation enhancement except for multi-panel receptions
* CSI enhancement
* Investigate on Link recovery requirements for FR2 serving cells

### Sub-topic 1-1 Potential RAN4 RF impact for Multi-panel UE

*Sub-topic description:*

Discuss the interpretation of latest RAN1 agreements for multi panel UE including both transmission and receptions requirements. Try to reach some common understanding on the potential RF impact due to multi-panel UE

**Issue 1-1-1: Transmission requirements for multi-panel UE**

* Proposals
  + Option 1: No transmission requirements impact for multi-panel UE (Samsung, vivo)
  + Option 2: FFS for reception requirements for multi-panel UE (vivo)
* Recommended WF
  + Option 1

**Issue 1-1-2: Reception requirements for multi-panel UE**

* Proposals
  + Option 1: Reception requirements for multi-panel UE can be postponed to further release (Samsung)
  + Option 2: FFS for any impact to reception requirements for multi-panel UE (vivo)
* Recommended WF
  + View collected in the 1st round

### Sub-topic 1-2 Potential RAN4 RF impact for MPE mitigation

*Sub-topic description*

Detailed MPE mitigation is still discussing in RAN, i.e., option 1A, option 1D and option 2A. In submitted contributions, there is common understanding that RAN4 shall further study the impact to RAN4 RF impact for MPE mitigation. In this sub-topic, moderator suggest companies can provide some analysis on potential impact to RF requirements. After collecting view in the 1st round, 2nd discussion can be arranged for detailed analysis if any.

**Issue 1-2-1: MPE mitigation on RAN4 RF impact**

* Proposals
  + Option 1: RAN4 shall further study the impact to RAN4 RF impact for MPE mitigation (Samsung, vivo)
* Recommended WF
  + Companies are encouraged to provide some observation/analysis if any on the potential impact to RF requirements due to MPE mitigation. After collecting view from companies, 2nd round discussion can be arranged for these options if any

### Sub-topic 1-3 Potential RAN4 RF impact for SRS enhancement

*Sub-topic description*

In submitted contributions, it is identified that UE configured transmission power may be impacted due to SRS switching for up to 8 antennas. In this topics, companies are encouraged to provide the comments on impact to UE configured transmission power (issue 1-3-1) and other requirements is any (issue 1-3-2)

**Issue 1-3-1: Whether RAN4 shall further study the UE configured transmission power due to SRS switching for up to 8 antennas shall be further studied**

* Proposals
  + Option 1: Yes for FR1 (Samsung, vivo)
  + Option 2: No
* Recommended WF
  + RAN4 shall further study the UE configured transmission power due to SRS switching for up to 8 antennas

**Issue 1-3-2: Any other impact to UE RF requirements for SRS enhancement**

* Proposals
  + Option 1: No (Samsung, vivo)
  + Option 2: Yes
* Recommended WF
  + Companies are encouraged to provide some observation/analysis if any on the potential impact to RF requirements due to SRS enhancement. After collecting view from companies, 2nd round discussion can be arranged for these options if any

### Sub-topic 1-4 Confirm if any RF impact for the below objectives

*Sub-topic description*

In submitted contributions, it is identified that no RF impact for some objectives.

**Issues 1-4:-1 Confirm no RF impact for some objectives**

* Proposals: Confirm no RF impact for below objectives
  + Option 1: Multi-TRP operation enhancement except for multi-panel receptions
  + Option 2: CSI enhancement
  + Option 3: Investigate on Link recovery requirements for FR2 serving cells
* Recommended WF
  + Collect companies’ view (More than 1 options can be selected)

## Companies views’ collection for 1st round

### Open issues

**Sub-topic 1-1: Potential RAN4 RF impact for Multi-panel UE**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | **Issue 1-1-1: Transmission requirements for multi-panel UE**  Xxx  **Issue 1-1-2: Reception requirements for multi-panel UE**  Xxx |

**Sub-topic 1-2 Potential RAN4 RF impact for MPE mitigation**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | **Issue 1-2-1: MPE mitigation on RAN4 RF impact**  xxx |

**Sub-topic 1-3 Potential RAN4 RF impact for SRS enhancement**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | **Issue 1-3-1: Whether RAN4 shall further study the UE configured transmission power due to SRS switching for up to 8 antennas shall be further studied**  **Xxx**  **Issue 1-3-2: Any other impact to UE RF requirements for SRS enhancement** |

**Sub-topic 1-4 Confirm if any RF impact for the below objectives**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | **Issues 1-4-1: Confirm no RF impact for some objectives** |

## 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:* |

## Discussion on 2nd round (if applicable)

# Topic #2: Work plan

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2109836 | Samsung | RAN4 99e (May 2021)   * Agree overall work plan for RF core requirements * Initial analysis to potential RF impact due to FeMIMO features   RAN4 100e (Aug 2021)   * Initial discussions on UE RF requirements impact due to FeMIMO features   RAN4 101e (Nov 2021)   * Further discussions on UE RF requirements impact due to FeMIMO features   RAN4 101-bis e (Jan 2022, meeting to be confirmed)   * Further discussions on UE RF requirements impact due to FeMIMO features * Review draft CRs for endorsement if any   RAN4 102e (Feb 2022)   * Agree RAN4 CR to finalize the RF core requirements   Note 1: This work plan only focused on RF core part.  Note 2: Detailed work split on CR drafting if any will be provided during WI phase in appropriate time. |

## Open issues summary

### Sub-topic 2-1 View collection for rapporteur input on work plan

*Sub-topic description:*

*Companies are encouraged to provide the comments/view on work plan*

**Issue 2-1: Work plan**

* Proposals
  + Option 1: Work plan in R4-2109836
* Recommended WF
  + Approved Workplan based on companies’ comments.

## Companies views’ collection for 1st round

### Open issues

Sub topic 2-1 View collection for rapporteur input on work plan

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

## 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:* |

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |

**Existing tdocs**

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

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