**3GPP TSG-RAN WG4 Meeting # 100-e R4-210XXXX**

**Electronic Meeting, 16th – 27th August, 2021**

**Agenda item:** 9.19.1, 9.19.2

**Source:** Moderator (Samsung)

**Title:** Email discussion summary for [100-e][141] NR\_feMIMO

**Document for:** Information

# Introduction

In RAN#92-e, the updated WID on further enhancements on MIMO for NR was approved.

In RAN4#99-e, the first discussion on the Rel-17 FeMIMO was initiated to see if any impact to RAN4 has to be considered based on the discussion progress of RAN1 on the work item. For the impact on the RF specification, a WF was approved with following agreements made during the last meeting of RAN4.

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| * No transmission requirements will be specified for multi-panel UE in Rel-17 FeMIMO WI * RAN4 will further study if any impact to the reception requirements for multi-panel UE in Rel-17 FeMIMO WI considering RAN1 status * RAN4 will further study the UE RF requirements impact for MPE mitigation. Companies are encouraged to provide the initial analysis for UE RF impact for MPE in the next RAN4 meeting considering the latest RAN1 progress considering RAN1 status * No UE RF impact for CSI enhancement and link recovery for FR2 serving cells in Rel-17 FeMIMO WI |

Based on the WF, RAN4 is supposed to continue the discussion on the RF impact to the remaining FFS topics in this meeting given the status of other WGs. Therefore, the email discussion using this thread aims to have a common understanding of the RF impact to the RAN4 specification.

To support that target and to make a progress, the discussion summary will try to derive the tentative agreements based on the comments provided in the 1st round discussion. In addition, a WF to capture the common understanding will be discussed during the 2nd round.

# Topic #1: Impact to RF requirements

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2112971 | Samsung | Observation 1: RAN4 is only supposed to discuss the impact to RF requirements due to MPE mitigation after RAN1 design is clear  Proposal 1: No RAN4 requirement assuming simultaneous reception channel/RS with different QCL type D in Rel-17. If needed, the requirements can be discussed in future release  Proposal 2: No RF impact is identified for Multi-panel UE in Rel-17  Observation 2: It would be meaningless having single piece of requirements only for the SRS assumption given no other core requirement for 8 antenna ports  Proposal 3: No requirement for 8 antenna ports unless the full set of requirements for 8 antenna ports is defined in RAN4 |
| R4-2111771 | Nokia, Nokia Shanghai Bell | Proposal: No need to specify simultaneous multi-panel reception requirements unless clear and convincing necessity is found. |
| R4-2113016 | vivo | Observation 1: The reference sensitively power level is not likely to be impacted by multi-panel reception.  Observation 2: According to simulation, the combination gain of 2 panels for spherical coverage can be negligible. Even in more favourable condition the performance difference can still be small, e.g., 1dB etc.  Observation 3: It is also safe to reuse current minimum requirements for multi-panel reception for EIS spherical coverage since it is the baseline performance.  Observation 4: Other receiver requirements are not impacted by multi-panel reception.  Proposal: No impact to the reception requirements for UE supporting multi-panel reception. |
| R4-2113035 | MediaTek | Proposal: Additional reception requirement shall NOT be specified for multi-panel UE in Rel-17 FeMIMO WI. |
| R4-2111770 | Nokia, Nokia Shanghai Bell | Observation 1: The virtual PHR refers to the estimated MPE event with corresponding P-MPR level on each active UE UL beam.  Observation 2: Panel indication is not needed for any MPE mitigation technique.  Observation 3: Impact of the introduction of Virtual PHR on UE RF specification is as follows.   * Introduction of a NOTE to explain a UE capability to be introduced for Virtual PHR and the relation between Virtual PHR and Virtual P-MPR. * Introduction of a definition of Virtual P-MPR which would indicate that in case Virtual PHR is reported, the corresponding Virtual PCMAX, f, c is calculated by replacing P-MPR with Virtual P-MPR in the currently defined PCMAX, f, c. |
| R4-2113017 | vivo | Observation 1: The MPE related enhancement discussed and concluded in RAN4 are focused on P-MPR reporting which is mainly defined in RAN2 specs with a few minor changes in RAN4 spec.  Observation 2: RAN1 discussion is still on-going and the main scheme involves extension P-MPR to per-beam or per-panel level.  Observation 3: Currently RAN4 does not have any per-beam or per-panel maximum power related definition, and this may impact the use of per-beam/per-panel P-MPR definition if agreed by RAN1.  Proposal 1: Discuss in RAN4 whether per-beam or per-panel P-MPR can be utilized in RAN4. Further conclusion and input from RAN1 is also needed.  Proposal 2: The possible modification to virtual PHR, and also scheme based on SSBRI(s)/CRI(s)/L1-RSRP does not have RAN4 impact.  Proposal 3: P-MPR mapping can be re-used even if extended to per-beam or per-panel. |

## Open issues summary

Based on the latest approved WF and submitted contributions, sub-topics on the topic of the impact to RF requirements can be organized as follows:

* Sub topic 1-1: Impact for multi-panel reception
* Sub topic 1-2: Impact for MPE
* Sub topic 1-3: Impact for SRS enhancement

According to the observation of latest agreements in other WG, it seems RAN1 is still going forward to the final design for these objectives. Since there has not been able to progress much unfortunately, moderator suggest focusing on finding some common understanding of each sub-topic in this meeting.

### Sub-topic 1-1: Impact for multi-panel reception

In the last meeting, it was agreed that no additional transmission requirement is required for the multi-panel UE impact in the Rel-17 WI. Instead, RAN4 agreed with the further check if any impact to the reception requirements is needed considering RAN1 status. Sub-topic 1-1 is about the check to confirm RAN4’s understanding of the multi-panel UE impact. Given the input contributions, from moderator’s point of view, it is doable to make the conclusion in this meeting.

**Issue 1-1-1: Impact for multi-panel reception**

* Proposals
  + Option 1: No impact
  + (No other proposal)
* Recommended WF
  + Option 1 (Supported by all contributions)

### Sub-topic 1-2: Impact for MPE

As shared by all contributions, the Rel-17 MPE mitigation solution is still under discussion in RAN1 although their options were tried down selected, i.e., option 1A and option 2A with multiple alternatives. Also, there is common understanding that RAN4 should wait for the concrete MPE solution in RAN1 before making a decision on the UE RF impact. In this meeting, in order to make a progress as much as possible in RAN4, moderator suggests discussing the possible impact of the candidate options as proposed in some input contributions.

**Issue 1-2-1: Possible impact of** **per-beam or per-panel P-MPR (if agreed finally)**

* Proposals
  + Option 1: Yes, per-beam or per-panel P-MPR can be utilized in RAN4
  + Option 2: No impact
* Recommended WF
  + Collecting companies view (no consensus needed)

**Issue 1-2-2: Possible impact of virtual PHR/P-MPR (if agreed finally)**

* Proposals
  + Option 1: At least, introduction of virtual PHR is needed in RAN4
  + Option 2: At least, introduction of virtual P-MPR is needed in RAN4
  + Option 3: Yes, introduction of both virtual PHR/P-MPR are needed in RAN4
  + Option 4: No impact
* Recommended WF
  + Collecting companies view (no consensus needed)

### Sub-topic 1-3: Impact for SRS enhancement

In the last meeting, some companies pointed out that RAN4 should wait until the full set of requirements for 8 antenna ports before discussing the impact of the SRS enhancement. On the other hand, some companies proposed that the configured power, or IL reporting shall be considered for this impact. Sub-topic 1-3 is to continue the discussion for the consensus on the impact for the SRS enhancement, which could not be captured in the last WF.

**Issue 1-3-1: Impact for SRS switching for up to 8 antennas**

* Proposals
  + Option 1: No, until a full set of 8 port requirements is defined
  + Option 2: FFS
* Recommended WF
  + Option 1 (No other contribution)

## Companies views’ collection for 1st round

### Open issues

**Sub topic 1-1: Impact for multi-panel reception (Issue 1-1-1)**

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| --- | --- |
| **Company** | **Comments** |
| MediaTek | Support “Option 1” |
| Apple | Since RAN1 is still working on multi-panel, it is a bit difficult for RAN4 to determine the related impacts. We agree with what some other companies proposed that RAN4 can firstly exclude the scenario of simultaneous multi-panel reception. Depending on RAN1 design, we can further determine if there is any reception related impact. |
| Nokia | Option 1 |
| OPPO | Option 1. No matter multi-panel reception or single panel the requirements are same. |
| Huawei | Option 1 |
| vivo | Support Option 1 |
| Samsung | Option 1. As noted in every paper, RAN4 still can use the current requirement on the Rx even if RAN1 introduces the multi-panel reception. |
| Qualcomm | We disagree with Option 1.IF this option is adopted, how can this feature be used? we believe that we should seriously study which requirements are needed and how to develop them. Also, it is necessary to study how to test this feature. |
| ZTE | Tend to agree with Qualcomm, if no requirements and test procedure defined, how to verify UE performance at the end . |

**Sub topic 1-2: Impact for MPE (Issue 1-2-1 and 1-2-2)**

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| **Company** | **Comments** |
| MediaTek | Fine to “wait for the concrete MPE solution in RAN1 before making a decision on the UE RF impact.”; we have no particular comment so far. |
| Apple | Agree with MTK  Regarding virtual P-MPR/PHR reporting, our understanding is that this is one of the solutions under discussion in RAN1. It is proposed to hold the discussion until RAN1 has their conclusion. |
| Nokia | **Issue 1-2-1:** Option 1  Per-beam P-MPR is utilized but as the specification, we don’t need to change the Pcmax formula itself. Per-beam P-MPR aspect itself is specified in RAN1/2. In RAN4, the per-beam P-MPR, i.e. virtual P-MPR is replaced with the existing P-MPR in configured power formula when Pcmax to be used in virtual PHR is calculated.  **Issue 1-2-2:** Option 2  The reason is elaborated in Issue 1-2-1. We don’t need to discuss PHR itself. |
| OPPO | Same view as MTK. |
| Huawei | Agree with MTK, before we get clear inputs from RAN1, there is no need for RAN4 to have further discussion. |
| vivo | Issue 1-2-1:  Currently the Pcmax related definition is per-UE and no discussion has been made for the applicability of per-beam or per-panel P-MPR yet. Especially for FR2, it seems there are some possible ways to utilize them, e.g. using maximum for them make it per-UE. We can also consider other means of extension for the configured maximum power part if per-beam/panel P-MPR can be agreed.  Issue 1-2-2:  Option 4. Virtual PHR is an existing concept and it is not clear why a new virtual P-MPR concept is needed. |
| Samsung | Issue 1-2-1: We think RAN4 can still use the current Pcmax without a change. Even if RAN1 agrees with that, RAN4 can discuss simply focusing on other means while keeping the formular  Issue 1-2-2: We believe what RAN4 can do for the virtual PHR is to consider the NOTE if needed |
| Qualcomm | Issue 1-2-1: Per beam or per pan P-MPR can be further discussed but this is very difficult to implement and accuracy is likely to be very poor.  Issue 1-2-2: Either option can be considered depending on the final RAN1 agreement. Difficult to say without knowing the details of virtual PHR. |

**Sub topic 1-3: Impact for SRS enhancement (Issue 1-3-1)**

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| --- | --- |
| **Company** | **Comments** |
| MediaTek | No strong view, but we are fine on ”Option 1: No, until a full set of 8 port requirements is defined.” |
| Apple | RAN1 related status is a bit unclear. Until it becomes clear, RAN4 can start the related discussion and decision. |
| Nokia | Option 1  In any case, RAN needs to make clear how to handle this. |
| OPPO | Option 1. |
| Huawei | Option 1 |
| vivo | Option 1. |
| Samsung | Option 1. Single requirement only for SRS would be meaningless. |
| Qualcomm | Option 1 is basically saying that this feature is useless, we might just as well tell RAN1 to stop working on this feature in this release. We think requirements can be considered. If needed, RF requirements for 8Rx can be defined since they would be trivial. |
| ZTE | In Rel-18, there are new WIDs for 8Rx for UE, maybe we could consider the SRSswitching for up to 8 antennas in Rel-18 together with other UE demod requirements; |

## Summary for 1st round

### Open issues

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| --- | --- |
|  | **Status summary** |
| **Sub-topic #1 (Impact for multi-panel reception)** | **1st round summary:**  Most companies (6) support Option 1 (no impact for multi-panel reception).  Other companies (3) want to further check if there is any impact depending on RAN1 design.  Given the input contributions and majority view during 1st round, it is observed that the Option 1 could be taken as a tentative agreement since all the submitted contributions propose that the possible enhancement can be evaluated by existing requirements, i.e., EIS spherical coverage. However, consensus was not achievable.  **Tentative agreements:**  None  **Candidate options:**  Option 1: No impact. The possible enhancement can be evaluated by existing requirements  Option 2: FFS  **Recommendations for 2nd round:**  Continue the discussion with the revised options and WF. Clear and convincing necessity is required for the new option 2. A WF will follow. |
| **Sub-topic #2 (Impact for MPE)** | **1st round summary:**  As notified before the meeting, this topic does not need the consensus in this meeting given that RAN1 is still going forward to their final design. It would be enough to check the companies’ view on the possible solutions being discussed in RAN1 from RAN4’s perspective.  Some companies provide their view on the possible RAN4 impact of per-beam P-MPR or virtual PHR. Similar views are found that it would be no/little impact to RAN4 even though those are finally introduced in RAN1.  The other companies want to wait and see the clear solution from RAN1 before the discussion on the impact.  **Tentative agreements:**  None. Companies are encouraged to check and analyze the RAN4 impact of the MPE enhancements considering the RAN1 progress in the next meeting.  **Candidate options:**  Further comments are welcome with the same options  **Recommendations for 2nd round:**  Continue the discussion with the WF |
| **Sub-topic #3 (Impact for SRS enhancement)** | **1st round summary:**  Most companies (7) support Option 1 (No, until a full set of 8 port requirements is defined).  Other companies (2) want to further check if there is any impact depending on RAN1 design.  Given the input contribution and majority view during 1st round, it is observed that the Option 1 could be taken as a tentative agreement. However, consensus was not achievable.  **Tentative agreements:**  None  **Candidate options:**  Option 1: Wait until the new WI on 8Rx UE for the full set of the requirements  Option 2: Start the related discussion with the SRS enhancement  **Recommendations for 2nd round:**  Continue the discussion with the revised options and WF. It can be concluded in the next meeting depending on RAN or RAN1 discussions. |

## Discussion on 2nd round (if applicable)

**Sub-topic 1-1: Impact for multi-panel reception**

* *[Option 1: No impact. The possible enhancement can be evaluated by existing requirements]*
* *[Option 2: FFS]*

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| **Company** | **Comments** |
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**Sub-topic 1-2: Impact for MPE (per-beam or per-panel P-MPR, and virtual PHR/P-MPR)**

* Further comments are welcome

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| **Company** | **Comments** |
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**Sub-topic 1-3: Impact for SRS enhancement**

* *[Option 1: Wait until the new WI on 8Rx UE for the full set of the requirements]*
* *[Option 2: Start the related discussion with the SRS enhancement]*

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| **Company** | **Comments** |
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# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on FeMIMO impacts to RF requirements | Samsung | To capture the discussion summary and possible agreements |
|  |  |  |
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**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-2112971 | MPE mitigation techniques | Nokia, Nokia Shanghai Bell | Noted |  |
| R4-2111771 | Multi-panel reception impact on Rx requirements | Nokia, Nokia Shanghai Bell | Noted |  |
| R4-2112971 | RF requirements for further enhancements on MIMO | Samsung | Noted |  |
| R4-2113016 | Discussion on impact of multi-panel reception requirements | vivo | Noted |  |
| R4-2113017 | Discussion on impact of MPE requirements | vivo | Noted |  |
| R4-2113035 | Proposal on FR2 FeMIMO multi-panel reception requirement | MediaTek | Noted |  |
|  |  |  |  |  |

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

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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)