**3GPP TSG-RAN WG4 Meeting # 97-e R4-2016955**

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

**Agenda item:** 7.9.1

**Source:** Moderator (Samsung)

**Title:** Email discussion summary for [97e][111] NR\_eMIMO\_UE\_RF

**Document for:** Information

# Introduction

*Briefly introduce background, the scope of this email discussion and provide some guidelines for email discussion if necessary.*

In Rel-16 work item enhancements on MIMO for NR, the following features are identified for potential RAN4 RF core requirement impact, which are listed as objectives in WID [RP-192271], while RAN plenary further decided that the target of requirements for the reduced PAPR pi/2-BPSK DMRS shall be limited in FR1 [RP-20047], as follows:

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| - Specify core requirements associated with the items specified by RAN1 [RAN4]   * + Identify impact on RF requirements for the reduced PAPR pi/2-BPSK DMRS for FR1 and, if needed, specify RF requirements   + Identify impact on RF requirements for the uplink full power transmission and, if needed, specify RF requirements |

In last RAN4 meeting (RAN4#96-e), the expected RAN4 work for enhancements on MIMO for NR had been completed with CR approved as follows:

For UE RF requirement for pi/BPSK:

* CR (R4-2011942) to TS38.101-1 to introduce UE RF requirement for pi/2 BPSK DMRS if IE powerBoostPi2BPSK=0.

For uplink full power transmission:

* CR (R4-2011762) to TS38.101-1 to introduce Full Power Transmission UE Requirement for FR1;
* CR (R4-2011920) to TS38.101-2 to introduce Full Power Transmission UE Requirement for FR2.

And RAN4 achieved agreement to further discuss MPR issues for all 2TX related PC2 and PC3 UEs as follows:

**Agreement**

* For PC2 and PC3, MPR issues related to 2TX, including UL-MIMO, uplink full power transmission, and TxD, will be further discussed in TEI16.

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

* 1st round: TBA
* 2nd round: TBA

This email thread is used to handle the maintenance issues for eMIMO UE RF core requirements, with the following plan to organize the discussion:

* 1st round: Discussion on issues based on companies’ contribution input.
* 2nd round: Achieve agreements for how to proceed as much as possible based on the group’s consensus.

# Topic #1: Maintenance Work for eMIMO UE RF

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

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2016480 | Huawei, HiSilicon | Observation 1: PC3 MPR can cover both 1T and 2T cases in the specification. Only PC2 MPR needs to be further evaluated for 2Tx implementation based on per UE defined unwanted emissions.  Observation 2: ULFPTx mode 1 is implemented by TxD actually, have different MPR for ULFPTx and TxD will broke the consistency of requirements for the same implementation.  Observation 3: According to the study of PC1.5, it is reasonable to define one set of MPR requirements for both UL MIMO and TxD.  Proposal 1: Only PC2 MPR for 2Tx should be further specified.  Proposal 2: One set of MPR requirements should be adopted for both UL MIMO (including ULFPTx) and TxD. |
| R4-2016481 | Huawei, HiSilicon | CR for TS 38.101-1: correction of Pi/2 BPSK |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 1-1: MPR for UL-MIMO ULPFTx

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 1-1-1: MPR for UL-MIMO ULFPTx**

* [Background] As a package agreed in last RAN4 meeting, RAN4 agreed that “For PC2 and PC3, MPR issues related to 2TX, including UL-MIMO, uplink full power transmission, and TxD, will be further discussed in TEI16.”
* Proposals from Huawei:
  + Proposal 1: Only PC2 MPR for 2Tx should be further specified.
  + Proposal 2: One set of MPR requirements should be adopted for both UL MIMO (including ULFPTx) and TxD.
* Recommended WF
  + Suggest to discuss P1 and P2, and if P2 is agreeable to the group, the discussion can be merged with TxD discussion under AI.7.19.2.2. Companies’ views are collected in 1st round discussion.

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| LGE | Sub topic 1-1: MPR for UL-MIMO ULPFTx  **Issue 1-1-1: MPR for UL-MIMO ULFPTx**  LGE support both P1 and P2. So RAN4 can discuss on MPR requirements for UL-MIMO and Tx diversity together.  Sub topic 1-2:  ….  Others: |
| OPPO | Ok with proposal 1 and 2. |
| Qualcomm | 1-1:  On P1, it is fairly hard to make an agreement not to do something. For example, we had many agreements not to work on TXD but yet the work continues. We have not seen any simulation results or technical analysis on the proposed PC2 TxD MPR, only the proposed same table for many meetings so it is impossible for RAN4 to determine if the analysis only applies to PC2. Not ok with proposal 1, however, we are fine to write the CR whenever we have consensus on how to write it, with PC2 MPR only and e.g. reserved tables for PC3.  On P2, we are fine about the intended idea but would prefer to word it the following way: *For UE with TxD implementation, same MPR and A-MPR as for UL MIMO for the corresponding UE power class applies.*  In general, before agreeing to the CR, RAN4 needs to find a way how the network knows if UE applies TxD or general MPR. |
| vivo | Not that ok for proposal 1, since MPR for PC3 may also need some specification.  Ok for proposal 2, as aligned in the TxD discussion. |
| Skyworks | On proposal 1: in my paper in TxDiv thread (I thought it would where this discussion occurs) we do not agree: PC3 is not needed only for PC3+PC3 case. Also for PC2 there is two cases that are implemented in UEs: PC2 using two PC2 PAs (as I explain in my paper that one can be derived from PC1.5 MPR already agreed) and PC2 with two PC3 PA. Finally we have looked at PC3 with two PC5 PAs for NRU and this may be studied in the future. The key is to differnciate those case properly for the requirement.  Proposal 2 is also Skyworks proposal in TxDiv thread. We still need to agree there that it should cover both single stream (correlated AM) and dual stream cases (uncorrelated AM) for UL MIMO |
| Huawei, HiSilicon | Sub topic 1-1:  If PC3 MPR is not applicable for both UL MIMO and TxD, then the requirements defined in Rel-16 are not correct.  For the PC2 MPR requirements, we do proposed the values based on our evaluation for a long time, and we think that the time is enough for companies to do their own evaluation. But unfortunately, we just see repeated objection without concrete proposals. Talk is cheap. We really want to see constructive suggestions and evaluation results to make progress in RAN4.  As discussed in our contrition, since TxD cannot be configured by gNB, there is no way for the network to know that UE applies TxD even the UE has two UL transmission capability. That’s the reason we think that the requirements should be defined for UE supporting 2Tx rather than for TxD.  Sub topic 1-2: |
| Apple | We think that UL MIMO and TxD could use the same MPR. Therefore, we tend to proposal 2. |
| Samsung | Okay with P2, but for P1, when RAN4 has the discussion for ULFPTx, it is not agreed that only PC3+PC3 is considered for UL-MIMO PC3, so what is the justification if the intention is to restrict the implementation to PC3+PC3. If the proponent do have such intention, prefer RAN4 has clear agreement on that. |

### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| R4-2016481  (CR for TS 38.101-1: correction of Pi/2 BPSK) | Company A |
| Company B |
| Qualcomm: Do not agree with CR.  PAPR’s of PBD waveforms are either similar or lower than ZC DMRS/pi/2 BPSK data waveforms for equivalent filtering. Therefore, it is a conservative assumption that the same MPRs should apply for Pi/2 BPSK as ZC BPSK. Obviously, the reference to ‘A-MPR’ is a typo, it should have been ‘MPR’. We will bring a CR to the next meeting to fix it |
| Huawei: Do we have any evaluation of Pi/2 BPSK for intra-band CA in Rel-16? The change already exceeded the WI scope, the corresponding for UL intra-band CA is a separate WI. If needed, it should be discussed in UE RF FR1 WI. |

## 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.*

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|  | **Status summary** |
| **Sub-topic#1-1** | **Issue 1-1-1: MPR for UL-MIMO ULFPTx**  [Moderator] Different views received on P1, while P2 seems to be the common understanding which is also aligned with the agreement from 5th Nov (Thu) GTW session for Rel-16 TxD, i.e.:  “Whether 2 Tx MPR should be the same MPR requirement for TX Diversity and UL MIMO for the same power class.   * Proposals   + Option 1: Yes   + Option 2: No.   + Agreement   + Option 1”   *Tentative agreements:* *One set of MPR requirements should be adopted for both UL MIMO (including ULFPTx) and TxD.*  *Recommendations for 2nd round:*  *The above tentative agreement can be captured in Chairman Notes and no WF is needed for ULFPTx itself.*  *For whether or not “*Only PC2 MPR for 2Tx should be further specified*”, the discussion can be combined with TxD email thread to avoid overlapping discussion.* |

*Recommendations on WF/LS assignment*

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

### CRs/TPs

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

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| R4-2016481 | *Based on 1st round of comments collection, diverse view received on CR on pi/2 BPSK DMRS waveform for intra-band CA, moderator recommend the CR “to be revised”. If no consensus reached in 2nd round, suggest to come back with CR in next meeting.* |

## Discussion on 2nd round (if applicable)

*Based on Chairman notes updated after 1st round, the following agreement is captured:*

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| Chair: It is agreed that one set of MPR requirements should be adopted for both UL MIMO (including ULFPTx) and TxD |

*Given that, the remaining issue is just the discussion on the revised CR, which will be handled by the sub-email thread on this CR.*

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| R4-2016813  (revised from R4-2016481) | *Based on 2nd round discussion, different views were received on the proposal of removing the relevant requirement of Pi/2 BPSK for UL CA in CR R4-2016481. Based on that, the proposal is hard to be agreed in this meeting, so it is recommended that:*  *- Original CR (R4-2016481) is “postposed”*  *- Revised CR (R4-2016813) is not available yet, so it can be “withdrawn”.* |