**3GPP TSG-RAN WG4 Meeting # 96-e R4-2011556**

**Electronic Meeting, 17-28 Aug., 2020**

**Agenda item:** 9.1

**Source:** Moderator (T-Mobile USA)

**Title:** Email discussion summary for 96e[123] LTE\_NR\_B41\_Bn41\_PC29dBm

**Document for:** Information

# Introduction

This e-mail discussion targets completion of the 29 dBm HPUE Work Item. The remaining issue is agreement on MPR and A-MPR for 29 dBm HPUE UL MIMO and Tx Diversity in NR band n41.

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

* 1st round: Companies to provide comments for the 1st round by Wednesday 5pm UTC Aug. 19
* 2nd round: TBA

# Topic #1: MRP and A-MPR for PC1.5 UL MIMO and TxD

*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** |
| [**R4-2009943**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009943.zip) | Apple Inc. | **Proposal:** Define PC1.5 UL MIMO MPR according to Table2.

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| --- | --- |
| Modulation | MPR (dB) |
| Edge RBallocations | Outer RBallocations | Inner RBallocations |
| DFT-s-OFDM | Pi/2 BPSK | 5.5 | 3.0 | 1.0 |
| QPSK | 5.5 | 3.0 | 1.0 |
| 16 QAM | 5.5 | 4.0 | 2.0 |
| 64 QAM | 5.5 | 4.0 | 3.0 |
| 256 QAM | 7.5 |
| CP-OFDM | QPSK | 5.5 | 4.0 | 2.0 |
| 16 QAM | 5.5 | 4.5 | 2.5 |
| 64 QAM | 5.5 | 5.0 | 4.0 |
| 256 QAM | 9.5 |

Table2: Proposal for PC1.5 UL-MIMO MPR |
| **Re**v\_R**4-2011449** | T-Mobile USA | **Observation 1: The original UL-MIMO MPR definition appears to assume that for each Tx chain, 3dB lower output power results in 3dB of lower emissions power, a 1:1 backoff ratio. This implies an assumption that a 2Tx UL-MIMO design would simply use two copies of the same Tx chain hardware (PA, etc.) used for 1Tx, for the same total power. (e.g. PC3 UL-MIMO would use two Tx chains identical to what is used for 1Tx PC3.)****Observation 2: If the “at each antenna connector” language in the original LTE UL-MIMO and Rel-15 NR UL-MIMO MPR specifications was an error, the relaxation of MPR proposed in [9] is not justified by fixing the language to what it should have been, “as the sum of powers from each antenna connector.”****Observation 3: Despite possibly double-counting the relaxation needed for summing the antenna connector powers, the MPR relaxations proposed in [9] may still be reasonable projections for outer allocations, because 2Tx R-IMD is not accounted for in either the original UL-MIMO MPR definition or in [9].****Observation 4: An extremely conservative upper bound estimate for PC1.5 MPR and A-MPR allowances would be to add 3dB to the corresponding MPR and A-MPR values for PC2, which would allow no transmit power benefit for PC1.5.****Observations 5: The rationale and methodology used in [9] could also be applied to DFT-S-OFDM MPR allowances to estimate values for Transmit Diversity.****Observation 6: The difference between emission from TxD and UL-MIMO are small, generally <= 0.5 dB.****Observation 7: Inner allocations appear to have large margins against OOBE and ACLR specification with low MPR, and MPR increases do not appear to be a effective tool for potential EVM issues.****Proposal 1: That CP-OFDM MPR for PC1.5 for outer and edge allocations be based on PC2 values from [9] plus 1.5dB, and that DFT-S-OFDM MPR for PC1.5 for outer and edge allocations be projected using the same methodology.****Proposal 2: That CP-OFDM MPR for PC1.5 for inner allocations be based on PC2 values from [9] without further additions, and that DFT-S-OFDM MPR for PC1.5 for inner allocations be based on the methodology from [9] with no further additions.****Proposal 3: That NS\_04 A-MPR values for PC1.5 be based on corresponding PC2 A-MPR values, plus 1.5 dB.** |

## 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 PC1.5 UL MIMO and Tx Diversity

*Sub-topic description: Agreement is needed on MPR for PC 1.5 HPUE and UL MIMO Tx Diversity.*

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

**Issue 1-1: MPR**

* Proposals
	+ Option 1: Apple proposal in [R4-2009943](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009943.zip)
	+ Option 2: T-Mobile USA proposal in Rev\_R4-2011449 that merges data from R4-2009943 as well as previous data from Skyworks and LGE.
* Recommended WF
	+ Approve Option 2.

### Sub-topic 1-2 A-MPR for PC1.5 UL MIMO and Tx Diversity

*Sub-topic description: Agreement is needed for A-MPR for PC 1.5 HPUE and UL MIMO Tx Diversity.*

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

**Issue 1-2: TBA**

* Proposals
	+ Option 1: T-Mobile USA proposal in Rev\_R4-2011449
	+ Option 2: N/A
* Recommended WF
	+ Approve Option 1.

## Companies views’ collection for 1st round

### Open issues

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| --- | --- |
| **Company** | **Comments** |
| Skyworks | Sub topic 1-1: One aspect to clarify on MPR is applicability and the settings for the two contributions:Are both contributions aiming at MPR for 2 stream UL MIMO which should be the worst case for ET?Is this is the case the TxDiv or 1 stream UL MIMOMPR should be lower since signals are correlated (for ET).Please can it be clarified for both contributions? And then the tables need to clarify the signal conditions.Also we need to agree which cases are captured in the spec and where: UL MIMO section with text in general section pointing there (or vice-versa). It should also be aligned with the PC2 case. The tables need to point at 2Tx implementation for the general one and 1 or 2 layer for UL MIMO.Before the revision of R4-2011449 the difference between edge and outer was >3dB in some cases which cannot be or otherwise the region needs to be larger than 2RB. With the revision both Sub topic 1-2: It should be feasible to derive A-MPR once the MPR is settled. |
| LGE | Sub topic 1-1: We are not sure that the measurement results in R4-2009943 have been measured at each antenna connector or UE level. Need to check.LGE needs some time to check the proposal MPR in the option 2.Sub topic 1-2: LGE needs some time to check the proposal A-MPR. |
| Apple | Issue 1-1:The proposal made in our contribution is for UL MIMO with one layer or TxD. Meaning that the Tx signals are highly correlated. rIMD is taken into account. A proposal for 2 layer MIMO was not made as not enough measurements were done until deadline. Issue 2-1A-MPR proposal seems to be fine. But would like to ask for second round to get some additional time to check the values. |
| T-Mobile US | Sub topic 1-1: We support Option 1, but could also accept Option 2.Agree with Skyworks that 2 stream UL-MIMO is worst case. Proposed MPR is to cover both UL MIMO and 1 stream TxDiv, for simplicity. Measurements show small (<1dB) difference, but we are not opposed to two different tables to allow better optimization for TxD. Detailed signaling is TBD. Current language of “closed loop spatial multiplexing” seems to distinguish between UL-MIMO and TxD well enough. Language and placement for tables should align with UL-MIMO vs. TxD for PC2. CR R4-2010060 places TxD in Section 6.2 and UL-MIMO in 6.2D, but other arrangements could be acceptable.Sub topic 1-2Agree with Skyworks that NS\_04 A-MPR can be revisited once MPR is agreed. |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

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| **CR/TP number** | **Comments collection** |
| [**R4-2010060**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010060.zip) | CR for 38.101-1: Introduction of Power Class 1.5 (To be revised based on the conclusion of the MPR/A-MPR discussions)  |
| [SoftBank]1) On UE co-ex (final modification), Note 19 is not for Japan (n38 to protect n7 Rx that could be next to each other), so Japan-related comment is not needed. 2) In ACLR table, there is a typo (31dBm -> 31dB). |
| Skyworks: the CR must be aligned with the PC2 case in terms of where and how MPR is captured. |
| Huawei, HiSilicon: Since both UL MIMO and TxD are supported by PC1.5, how to handle the remaining issue of ULFPTx as well as TxD in TEI16 with this WI? In our view, though MPR/A-MPR, ACLR are the main requirements for PC1.5, without some related changes in ULFPTx and TxD in other topics, the new power class cannot be supported well. For the MPR table, there is a reference in 6.2.2 in general requirements, which is supposed for TxD, but no reference in the MIMO MPR clause for this table. Also it would be better to make it clear in the table title that the MPR requirements are for 2Tx.  |
| [**R4-2010061**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010061.zip) | CR for 38.307: Introduction of Power Class 1.5 |
| 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.*

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| --- | --- |
|  | **Status summary**  |
| **Sub-topic#1-1** | ***Tentative agreements:*** *Skyworks: Need to clarify: Are both contributions for 2 stream UL MIMO (worst case for ET)* *Response: The Apple data is for Single stream. The data in Rev\_R4-2011449 showed <0.5 dB delta between correlated and un-correlated streams.* *LGE: We are not sure that the measurement results in R4-2009943 have been measured at each antenna connector or UE level. Need to check.**Response: Apple confirms that measurements were done with equal power on both Tx chains and MPR in R4-2009943 is for the UE relative to 29 dBm.* *LGE: Need time to check values****Candidate options:****Option 1: Apple values from R4-2009943 for Tx Diversity. Add 0.5 dB to account for non-correlated streams for 2 layer UL MIMO. (Apple trying to update data)**Option 2: T-Mobile USA values from Rev\_R4-2011449 for both Tx Diversity and 2 layer UL MIMO.****Recommendations for 2nd round:*** *Decide between Option 1 and Option 2.*  |
| **Sub-topic#1-2** | ***Tentative agreements****: Revisit A-MPR once MPR is agreed**Candidate options:**Recommendations for 2nd round: Approve A-MPR in revision of Rev\_R4-2011449.* |
| **CR in R4-2010060** | ***Tentative agreements****: Incorporate changes from Softbank and Skyworks and Huawei.* *To Huawei: Related to ULFPTx, there are some issues in ULFPTx that will apply to PC1.5, but aren’t those issues are being worked in [112]? Is there something that is missing here?**Candidate options:**Recommendations for 2nd round: Approve A-MPR in revision of Rev\_R4-2011449.* |

*Recommendations on WF/LS assignment*

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

### 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**  |
| Rev\_R4-2011449 | *Need an official tdoc number for this revised proposal.*  |
| [**R4-2010060**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010060.zip) | *Based on 1st round of comments from Softbank, Skyworks and Huawei, and with the final agreed MRP and A-MPR “to be revised”*  |
| R4-2010061 | *Based on 1st round of comments “agreeable” conditioned on agreement on the revised CR for 38.101-1.* |

## Discussion on 2nd round (if applicable)

**Issue 1-1: MPR**

* Proposals
	+ Option 1: MPR values for TxD (single stream) from R4-2009943. Apple to confirm if relaxation is needed for uncorrelated streams.
	+ Option2: T-Mobile USA to provide official version of Rev\_R4-2011449
* Recommended WF
	+ Choose between Option 1 and Option 2.

**Issue 1-2: A-MPR**

* Proposals
	+ T-Mobile USA to revise A-MPR in Rev\_R4-2011449 based on the resolution of the MPR discussions.

**Issue 1-3: Revision of CR in R4-2010060**

* Proposals
	+ T-Mobile USA to revise CR in R4-2010060 based on input from Softbank, Skyworks and Huawei and final MPR/A-MPR decisions
	+ Huawei requested to provide specific suggestions related to comments on ULFPTx.

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| **Company** | **Comments** |
| LGE | Sub-topic 1-1: After checked, the MPR value in option 2 is feasible for PC1.5 UE supporting TxD and UL-MIMO. Option 2.Sub-topic 1-2: Since the option 2 is chosen in the sub-topic 1-1, should keep A-MPR in Rev\_R4-2011449.Sub-topic 1-3: Further check the revised CR when it’s available in the inbox. |
| Skyworks | * 1. We are OK with option 1 but since we have seen pulling effect between the two PAs in our measurements we believe option 2 is probably safer at this point.
	2. A-MPR can be revised according to 1-1 decision
 |
| Apple | Issue 1-1: According to our measurements with uncorrelated streams, region dependent MPR increase is required. However, we did not investigate further into the pulling issue brought up by Skyworks. As Option 2 seems to be agreeable to other companies we will be fine with this option. |
| Skyworks | Issue 1-1: to address the potential issue may be we could have the QPSK values in [] if we find any problem with pulling issues. We believe this is more liquely a test setup issue (need to adjust the phase to avoid PB) but it may affect results both ways.Issue 1-2 A-MPR, same as above |

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| **CR/TP number** | **Comments collection** |
| Revision of R4-2010060 | Company A: |
| Company B: |
|  |

## 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**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |