**3GPP TSG-RAN WG4 Meeting # 98-e R4-210XXXX**

**Electronic Meeting, 25th January – 5th February, 2021**

**Agenda item:** 9.34

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Email discussion summary for [98e][132] HPUE\_PC1\_5\_n77\_n78

**Document for:** Information

# Introduction

This document summarizes the email discussion on topics related to Power Class 1.5 in Bands n77 and n78 in Agenda 9.34. The discussion is divided into two topics:

Topic #1: UE RF assumptions

Topic #2: RF exposure regulatory aspects

# Topic #1: UE RF assumptions

In order to conduct the work, especially to derive MPR and A-MPR, it is beneficial to adopt assumptions.

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2100287**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100287.zip) | LG Electronics France | **Consideration for RF architecture for n77/n78 PC1.5 UE**  Observation 1: For PC1.5 UL-MIMO requirements, the architecture with 2PA (26dBm +26dBm) and 2 Tx antenna used as baseline in Rel-16.  Proposal 1: RAN4 should consider above basic simulations assumptions in for MPR/A-MPR requirements for PC 1.5 UE at n77/n78 in Rel-17.  Proposal 2: If Proposal 1 is reasonable to derive n77/n78 MPR/A-MPR requirements for smart phone type UE, then RAN4 can reuse MPR requirement in Table 6.2.2-4 for PC1.5 UE with dual Tx in TS38.101-1.  Proposal 3: RAN4 can derive A-MPR requirements based on the above simulations assumptions in section 3 for PC1.5 NR UE in n77/n78.   * 2 Tx antennas and 2 PA with 26dBm +26dBm * Antenna isolation of 10dB * Post PA loss of 4dB * Equal power per Antenna * Allow UL contiguous/non-contiguous resource allocation * NR DFT-s-OFDM/QPSK with 30kHz SCS * NR 60MHz CBW * Various allocation combinations with range of aggregate BWs, with focus on “worst case” combinations (assumed to be near-equal allocation BWs). * Determine back-off required to meet the regional regulations such as Additional SEM, Additional SE and specific ACLR limits * Goal is to take data from multiple sources and determine whether or not define new A-MPR curves accommodating different implementations. |
| [**R4-2100515**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100515.zip) | Apple Inc. | **Considerations for PC1.5 with n77 and n78**  Observation 1: PC1.5 is achieved via dual Tx chains as there is no 29dBm power amplifier deployed in UEs and requires higher power backoff compared to single Tx operation.  Observation 2: PC1.5 MPR was developed for single and dual layer UL-MIMO operation but not for TxD.  Proposal 1: PC1.5 should not be used for TxD as the discussion is not finished in RAN4. Support for TxD can be added later if required.  Proposal 2: If improvements for power backoff are considered for n77 and n78 then the relevant measurement assumptions (Antenna isolations of 10 dB, 4 dB post PA loss and 26dBm Tx chains) shall be reused to obtain reliable results. |
| [**R4-2102283**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2102283.zip) | Huawei, HiSilicon | **Consideration on adding PC 1.5 for n77 and n78**  Proposal 1: Add Power Class 1.5 to band n77 and n78 in Table 6.2.1-1 and Table 6.2D.1-1 as shown above.  Proposal 2: Reuse the existing MPR requirements in Clause 6.2.2 for band n77 and n78 PC 1.5.  Proposal 3: No A-MPR is needed for band n77 or n78 PC 1.5.  Proposal 4: Reuse the existing power reduction mechanism in Clause 6.2.4 for band n77 and n78 PC 1.5 in order to fulfil the regulatory SAR requirements. |
| [**R4-2102417**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2102417.zip) | Qualcomm Incorporated | **PC 1.5 for bands n77 and n78**  Observation: Two approaches are available to derive requirements for FWA and mobile UE. The minimum requirement is based on mobile UE with the expectation that FWA can easily meet this, or two sets of requirements are defined according to each device type.  Proposal 1: It is proposed to evaluate whether the assumptions to derive performance requirements for FWA should be modified from those previously used for mobile UE.  Proposal 2: General requirements such as Tx power tolerance, spurious emissions, and signal quality are already defined in the specifications. SAR mechanisms including the 25% default value for uplink duty cycle should be reconsidered for FWA and modified if needed.  Proposal 3: No new emission requirements are needed for PC1.5 in Bands n77 and n78 and no new A-MPR appears to be needed for coexistence. However, the need for NS and A-MPR are to be further studied for power backoff reduction on a band-specific per-deployment basis in n77 and n78. |
| [**R4-2102930**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2102930.zip) | Skyworks Solutions Inc. | **Discussion on band n77 PC1.5 operation**  Observations:   * For the smartphone UE case, n77/n78 PC1.5 operation should be able to reuse the Release 16 MPR as the antenna isolation assumptions should be similar. * Whether both Tx Diversity and UL MIMO is supported for Band n77 and n78 PC1.5 operation should be clarified |

## Open issues summary

### Sub-topic 1-1: Smartphone MPR

It was recognized by several companies that the prior work on PC1.5 in Band n41 was focused on mobile handset UE. During that work, a number of assumptions were agreed as listed below

* Antenna isolation of 10 dB
* Post PA loss of 4 dB
* Two 26 dBm Tx chains (NR)
* Equal Power on both transmit chains
* Various channel and allocation BWs, with focus on “worst case” allocations
* RB size, allocation position, waveform, and modulation should be the same between two transmitters
* Results for both CP-OFDM and DFT-S-OFDM are welcome, with the priority being CP-OFDM because it is expected to be worst case
* Determine back-off required to meet OOBE, ACLR and EVM specifications
* Goal is to take data from multiple sources and define A-MPR curves for PC1.5 UL MIMO and Transmit diversity accommodating different implementations

*For mobile handheld UE, i.e., smartphone, can the same assumptions be also applied for PC1.5 in bands n77 and n78?*

*If so, can the same MPR be used, maybe in square bracket to give companies an opportunity to check?*

### Sub-topic 1-2: MPR both Tx Diversity and UL MIMO to TxDiv

An observation was made in R4-2100515 that the MPR already included in the specification does not apply to TxDiv case, but only to single or dual layer UL MIMO. On the other hand, it is commented in R4-2102930 that PC 1.5 MPR specified in Rel-16 applies to both Tx Diversity and UL MIMO.

*Does the existing MPR specified for PC1.5 apply to both TxDiv and UL MIMO? Or does TxDiv MPR still need to be specified? If existing MPR does not apply to TxDiv, what are the differences between TxDiv and single layer UL MIMO that would cause an MPR difference?*

### Sub-topic 1-3: FWA MPR

An FWA device is quite different from a smartphone and has a different set of constraints from cost, size, power consumption perspective as well as different set of requirements in number of bands supported, mobility, etc. Therefore, it seems reasonable that the assumptions for deriving MPR for FWA may not be the same as for smartphone.

*Should assumptions be reconsidered for FWA, or should the same assumptions and requirements for smartphone also apply to FWA (not including the SAR/MPE which is treated separately as Topic #2)?*

*Are there any suggestions or proposals on which assumptions would change and their new value or range of values?*

### Sub-topic 1-4: Additional emission requirements for n77/n78

No new emission requirements for band n77 or band n78 have been identified in any of the submitted contributions.

*Do companies agree that no new emission requirements apply and there is no need for any new NS for the purpose of signaling additional spurious emission requirements?*

### Sub-topic 1-5: A-MPR

Pending agreement on sub-topic 1-4, there are no new emission requirements in Band n77 and n78 for PC1.5. On the other hand, a number of companies presented thoughts on A-MPR deriviation, assumptions, etc.

*What is the need for A-MPR for PC1.5 in Band n77 and n78?*

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| Qualcomm | Sub topic 1-1: For mobile handset UE it is reasonable to reuse the same assumptions for the UE front end parameters for Band n77/n78 as was used for Band n41 PC1.5. From a UE perspective, if the same assumptions are used, then it is also reasonable to expect that the same MPR would be the outcome, especially since MPR is independent of band. However, we would like to further check the MPR with additional measurements. We also need to consider the PC1.5 MPR from a system perspective. If MPR values are large, then there is little to no value in PC1.5 compared to PC2.  Sub topic 1-2: It is our understanding that the same MPR applies for TxDiv as for UL MIMO. However, we also acknowledge that TxDiv is an ongoing discussion, so we should not preclude the possibility for a change in understanding if warranted.  Sub topic 1-3: Assumptions for FWA should be evaluated on their own rather than copied from mobile handset UE as the devices are very different and the same assumptions are not likely to apply.  Sub topic 1-4: Agree  Sub topic 1-5: As it was expressed during discussion of the WID, many companies wanted to ensure that power backoff requirements were defined only for n77/n78 and not applied generally. Although it isn’t our preferred method, A-MPR is one possible way to enable band specific power backoff requirements.  ….  Others: |
| Verizon | Sub-topic 1-1: It is fine for RAN4 to consider two 26 dBm Tx chains and other RAN4 assumptions for the UE front end parameters and for both PC1.5 band 77 and 78. We are support companies to further check the PC1.5 MPR values from a system perspective. The larger MRP values would be not valuable for PC1.5 and possibly lead to next higher power classe.  Sub-topic 1-2: Yes, the MPR should be applicable to both Tx Diversity and UL MIMO if it is possbile. Sub-topic 1-3: The FWA device should be in different from a smartphone and have a different set of constraints of bands supported. Therefore, it is reasonable to have different power tolerance, emsissoin and SAR mechanisms for uplink in assumptions from smartphone. Sub-topic 1-4: Agree to have no additional emission requirements for n77/n78  Sub-topic 1-5: We support RAN4 to consider A-MPR improvement for band n77/n78 |
| LGE | Sub topic 1-1: Smartphone MPR  *For mobile handheld UE, i.e., smartphone, can the same assumptions be also applied for PC1.5 in bands n77 and n78? 🡪 LGE: Yes.*  *If so, can the same MPR be used, maybe in square bracket to give companies an opportunity to check? 🡪 LGE: same MPR can be used for PC1.5 UE in n77/n78*  Sub-topic 1-2: MPR both Tx Diversity and UL MIMO to TxDiv  *Does the existing MPR specified for PC1.5 apply to both TxDiv and UL MIMO? Or does TxDiv MPR still need to be specified? If existing MPR does not apply to TxDiv, what are the differences between TxDiv and single layer UL MIMO that would cause an MPR difference?*  *🡪 LGE: same MPR will be applied to both TxDiv and UL-MIMO UE*  Sub-topic 1-3: FWA MPR  *Do companies agree that no new emission requirements apply and there is no need for any new NS for the purpose of signaling additional spurious emission requirements? 🡪 LGE : No strong view whether apply same requirements or not. If RAN4 specify the different RF requirements between smartphone UE and FWA UE in n77/n78, then need to analyze the required new emission requirements.*  Sub-topic 1-4: Additional emission requirements for n77/n78  *Do companies agree that no new emission requirements apply and there is no need for any new NS for the purpose of signaling additional spurious emission requirements? 🡪 LGE: Need to study the global regulatory requirements in n77/n78 to support PC1.5 UE. Based on RAN4 can decide whether to define new NS to meet the additional spurious emission requirements.*  Sub-topic 1-5: A-MPR  *What is the need for A-MPR for PC1.5 in Band n77 and n78? 🡪 LGE: It is related the sub-topic 1-4. Based on the regulatory requirements, we can further discuss what is the different parameters from MPR parameters and additional requirements to specify the A-MPR requirements.* |
| Skyworks | 1-1: we agree that current PC1.5 MPR is applicable to n77 PC1.5 smarphone smarphone use case. Since it is MPR that is already specified we don’t see that brackets can be used.  1-2: for PC1.5 the MPR is meant for both TxDiv and Ul MIMO but since there are discussion on how TxDiv should be evaluated in test we can wait for the discussion to conclude to confirm MPR applies to both.  1-3: how to handle FWA case is not clear yet, if we recognize there are less constraints for this and better performance might be achievable we need first to agree to a common set of assumptions and agree how to capture the specifics in the spec  1-4: no need for new NS as we are not aware of any specific regulation in n77/n78  1-5: as there is no new NS we do not see that A-MPR is needed and we think that A-MPR is not the right way to handle FWA case if it was the intention since this must rather be associated with a UE signaling or at least a specific test. |

### 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.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
|  | Company A |
| Company B |
|  |
|  | 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:* |

*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** |
| 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)

## 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*

|  |  |
| --- | --- |
| **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”* |

# Topic #2: RF exposure regulatory aspects

An important part of the evaluation is the consideration of regulatory aspects. In particular, requirements of SAR and MPE shall be considered.

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2100912**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100912.zip) | Samsung | **Regulatory information on RF exposure for FWA devices**  Observation 1: Most of the countries are currently enacting the exposure regulations for mobile devices in compliance with the ICNIRP 1998 Guidelines and/or FCC regulations.  Observation 2: SAR value is specifically specified for the EMF compliance as criteria by human body and frequency range.  Observation 3: For handheld UEs for FR1, the device can be determined as used in close proximity to the body, and the SAR criteria are applied as the evaluation parameters.  Observation 4: For UEs for FWA operations, the device can be determined as maintained 20 cm separation distance to the body at least, and the MPE criteria are applied as the evaluation parameters.  Observation 5: High-power UEs for FWA operations should have a different mechanism with the current PC1.5 requirements of the SAR handling.  Observation 6: It is recommended to carry out the study on the quantitative impact, and derive new requirements to handle the RF exposure regulation for the FWA UE. |

## Open issues summary

### Sub-topic 2-1: Smartphone SAR

A mechanism to facilitate SAR compliance by reporting *maxUplinkDutyCycle-PC2-FR1* has been agreed for PC1.5 when the work was done with Band n41. The default duty cycle limit is 25% if nothing is reported; otherwise, it is half the reported value since the same IE is used for PC2 reporting as well.

*Can the existing SAR mechanism and 25% default value be reused for PC1.5 smartphone in Band n77/n78?*

### Sub-topic 2-1: FWA SAR or MPE

An FWA device is significantly different from a smartphone UE that is held next to the user’s head. It has been proposed in R4-2100912 that a different mechanism is defined for PC1.5 FWA devices rather than to reuse the SAR mechanism for handheld UE’s. It is also proposed that MPE should be used as the evaluation criterion rather than SAR.

*Do companies agree that a different mechanism should be defined for FWA to comply with RF exposure requirements? What are the elements of this new mechanism?*

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Sub topic 2-1: Yes  Sub topic 2-2: Yes. We expect that duty cycle will also play a key role in containing RF exposure, but the transmit power level may also be considered.  ….  Others: |
| LGE | Sub-topic 2-1: Smartphone SAR  *Can the existing SAR mechanism and 25% default value be reused for PC1.5 smartphone in Band n77/n78? 🡪 LGE: Yes, RAN4 can consider same SAR mechanism*  Sub-topic 2-2: FWA SAR or MPE  *Do companies agree that a different mechanism should be defined for FWA to comply with RF exposure requirements? What are the elements of this new mechanism? 🡪 LGE: basically, FWA is not come close to the user. So RAN4 can have different mechanism will be defined for FWA UE.* |
| Skyworks | 2-1: same duty cycle restrictions and handling that current PC1.5 should apply  2-2: for FWA MPE should apply thus duty cycle may be different but does this needs a specific UE type, power class, declaration?? May be the FWA UE can signal its max duty cycle anyhow as this is allowed |

### 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.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
|  | Company A |
| Company B |
|  |
|  | 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:* |

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

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

## 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*

|  |  |
| --- | --- |
| **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”* |