**3GPP TSG RAN#90e RP-20xxxx**

**e-Meeting, December 7th – 11th, 2020**

**Agenda item:** 9.1.4

**Source:** Moderator(Qualcomm Incorporated)

**Title:** Email Summary on Introduction of high-power devices operation use cases over Band n77

**Document for:** Discussion/Decision

# Introduction

In this document, the summary of the e-mail discussion on the proposal to introduce power classes with higher output power (PC1 and PC1.5) for band n77. The proposal is in the following contribution:

* RP-202280 New WID on high-power devices operation use cases over Band n77 Verizon

# Proposals

RP-202280 is a new work item proposal with the following objectives:

### 4.1 Objective of SI or Core part WI or Testing part WI

The objective of this work is to develop RF requirements that are applicable for HPUE and FWA operations over the NR band n77, including

1. Define new feature to enable single component carrier UL operation and dual-PA equipped devices
   1. enable NR band n77 Power Class 1.5 (29dBm) for both high power mobile and FWA devices, and
   2. enable NR band n77 Power Class 1 (31dBm) for FWA devices

to be utilized for standalone NR 2x2 UL MIMO and antenna diversity

1. Define requirements, including Tx power tolerance, MPR, A-MPR, IBE and ACLR for both Power Class 1.5 an Power Class 1. Improve A-MPR/MPR for both 29dBm and 31dBm band n77 in scope.
2. Ensue Tx duty cycle requirements sufficient to meet FCC SAR limit for UE and FWA devices and meet all of the regulatory requirements
   1. Solve the issues related to HPUE and FWA in use of 29dBm and 31dBm power classes if there are impacts
3. Assess the impact on eNB requirements required to support a 29dBm and 31dBm UE power class
4. Enhance the hardware requirements for high power devices
   1. improve the antenna isolation for FWA devices, and
   2. allow the PC2 UE device to deliver 28dBm power based on already present in the UE in carry 23 dBm and 26 dBm capable transmitters that can operate concurrently (R4-2016439)

### 4.2 Objective of Performance part WI

NOTE: Leave empty if the WI proposal does not contain a RAN performance part.

## Initial Email Discussion

### Companies comments

Questions to be handled in the initial phase of the e-mail discussion:

1. Do you agree with the approval of the WID on adding PC1 and PC1.5 support for band n77? If no, elaborate why. If yes but with changes in the objective, please also included comments on the next questions.

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| **Company** | **Views** |
| Bell Mobility | Yes and also for n78 as per the revised RP-202808 |
| Ericsson | Support |
| Huawei, HiSilicon | Since the WI proposal is spectrum related, we think the WI should be focused on PC1.5 for band n77. General requirements for PC1 are not defined yet, which should be included in the Rel-17 non-spectrum related UE RF FR1 WI if needed. PC1 should be removed from this WI. Our following comments for Q2 are for PC1.5 related objectives. |
| Verizon | To Bell Mobility: yes the n78 is in scope!  To Hauwei: Either PC1.5 or PC1 is the spectrum related. The objective of item is to initialize and define the related requirement for both n77 and n78. |
| OPPO | For clarification, the n77 here means the whole band or the parts that specific for US only, i.e. 3700 – 3980 MHz? And whether PC1 related requirements will be defined in this WI or Rel-17 FR1 enhancement WI? |
| Intel | We are ok with the general WID. Please see comments on the individual objectives below. |

1. Do you have any comments on the proposed objectives?

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| **Company** | **Views** |
| Bell Mobility | Please capture objectives as in the revised tdoc RP-202808 |
| Ericsson | Regardnig the objective:   * Assess the impact on eNB requirements required to support a 29dBm and 31dBm UE power class   Our understanding is that the new UE power class should not necessitate any network upgrades by any involved operators and thus it would help to clarify the objective as follows:  Assess any impact at the gNB of a 29dBm and 31dBm UE power class. The existing gNB requirements shall be applied |
| Qualcomm Incorporated | For objective 2,  Define requirements, including Tx power tolerance, MPR, A-MPR, IBE and ACLR for both Power Class 1.5 an Power Class 1. Improve A-MPR/MPR for both 29dBm and 31dBm band n77 in scope.  If there is improvement found for MPR, it would not be restricted to Band n77 but could apply generally.  For objective 5,  Enhance the hardware requirements for high power devices   * 1. improve the antenna isolation for FWA devices, and   the improvement should not be limited to FWA device but also to mobile devices that are capable. Suggest to include an objective   * 1. introduce new signaling or existing signaling to enable the UE to indicate to the network whether it supports improved A-MPR and MPR |
| Huawei, HiSilicon | 1. The term of HPUE used in the objectives are not consistent. What’s the meaning of high power mobile? Does it include other type of mobile UE devices besides the hand held UE? It would be better to make it clear of the UE types considered in the WI.  2. General UE RF requirements for PC1.5 are already defined in the specification. Only additional requirements, e.g. A-MPR should be specified for PC1.5 for n77. Any improvement for general requirements should be considered in non-spectrum UE RF FR1 WI.  3. Band n77 is a global used band, we prefer that the additional requirements for other applicable regions should be considered as well, not just based on FCC limits. And it’s not clear what’s the meaning of “Ensure Tx duty cycle requirements”, is it based on duty cycle capability or fixed duty cycle? Similar to other HPUE WIs, we would like to have some options for SAR solutions in the WID.  4. Not clear what’s the impact for BS requirements with introduction of new power class for n77. Some clarification is needed.  5. For the enhancement of the hardware requirements for high power devices, which was discussed in last RAN4 meeting, but no consensus was reached. Improving antenna isolation should be a feasibility study rather than a dedicated objective in the WID. Allowing the PC2 UE device to deliver 28dBm exceeding the power class reported by the UE may have SAR issue and possibly violate the regulatory requirements, which should not be considered in the WI. |
| Verizon | To Ericsson: yes, the comment will be reflected in revised item!  To Qualcomm: yes, the comments will be reflected in revised item!  To Huawei:   * For 1, Ok we will remove ‘HPUE’ and replace it to “new power UE device”. * For 2, Not quite follow the logic, but the scope of this work is for both n77 and n78. * For 3, It is clearly stated the FCC rule is for North American operations. This is based on all of the supporting companies’ requests. Of course, we welcome other inputs for operators are interested in this work! * For 4, The objective is modified. Thanks Ericsson! * For 5, As indicated few lines above, the FCC SAR limit is an objective. |
| Apple | We have the following questions for clarifications:   1. Is the intended HPUE to support UL MIMO only or including single layer transmission? The latter would depend on the outcome of pending Tx diversity requirements if the implementation is expected to be from dual-PA. 2. We already have PC1 defined for n14 which is based on single-PA implementation. How do we differentiate the output power capability and the associated requirements (such as MPR) between FWA PC1 for n77/n78 and PC1 for n14 where the former is expected to be based on dual-PA implementation? 3. What does the objective 5b mean?   “allow the PC2 UE device to deliver 28dBm power based on already present in the UE in carry 23 dBm and 26 dBm capable transmitters that can operate concurrently (R4-2016439)” Does it mean the power sum of 23 dBm and 26 dBm is 28 dBm? If so, can we still call this device as PC2 UE? Or should this be considered a new feature to be listed in objective 1? |
| LGE | For Objective 2, we propose as follow since the MPR/A-MPR were defined in Rel-16. It is not clear what is the enhanced factors for MPR/A-MPR improvements.  Define Tx requirements, including UE maximum output power with power tolerance, MPR, A-MPR, IBE and ACLR for both Power Class 1.5 an Power Class 1. ~~Improve A-MPR/MPR for both 29dBm and 31dBm band n77 in scope.~~  For Objective 5, we propose as follow  Enhance the hardware requirements for high power devices   * 1. improve the antenna isolation for FWA devices only, and   2. allow the PC2 UE device to deliver up to 26dBm total maximum output power per UE as same in Rel-16. ~~based on already present in the UE in carry 23 dBm and 26 dBm capable transmitters that can operate concurrently (R4-2016439)~~   To QC, RAN4 already agreed to use 10dB antenna isolation for 29dBm handheld device in Rel-16. The improvement of antenna isolation is only for FWA device only. Also LGE agree the Apple comment for objective 5b. The 28dBm power UE is not PC2 UE. |
| OPPO | 1. For clarification, is only dual-PA be considered for FWA n77 PC1.5 and PC1?  2. If these HPUEs in n77 is targeting US spectrum only, better to be clarified in the WID.  3. The following item should be studied and discussed in normal FR1 enhancment WIs as has been done in last meeting. The max power should include both 28dBm and 29dBm.   1. allow the PC2 UE device to deliver 28dBm power based on already present in the UE in carry 23 dBm and 26 dBm capable transmitters that can operate concurrently (R4-2016439)   4. The improvement of A-MPR/MPR should be clearly targeted if included comparing to existing requirements. |
| Intel | 1) In objective 1 “Antenna diversity” is not clear. Is it “transparent TxD”? If so, we suggest to clarify this. We also prefer to wait for conclusions of Rel-16 work for this before the Rel-17 on this topic starts.  2) For UL MIMO 29dBm HPUE, we suggest to consider assumption of 26dBm+26dBm PAs. For 31dBm HPUE, consider assumption of 28dBm+28dBm PAs.  3) Since WID is for NR HPUE, in objective 4 need to change eNB to gNB.  4) For “improve the antenna isolation for FWA devices” – we are overall fine. Is it intended for MPR evaluations? If so, we suggest to clarify this in the objectives.  5) The objectives include FWA and high power mobile devices, meantime FR1 specs typically do not differentiate different device types and requirements are agnostic of device type. One suggestion is to make the objectives agnostic to device types and add a note that the requirements are aimed for FWA and high power mobile devices use cases. |
| Skyworks | On objective 5b, this can only be applicable to inter-band case since for intra-band the MPR wouldnot apply properly (which reference?, how does it works for intra-band non-contiguous CA with 1 PA per CC? wich CC get 23dBm?). the objective if agreed should be restricted to inter-band case.  For PC1.5 our assumption is that this is for single CC only as for non-contiguous intra-band CA with equal PSD/equal backoff 29dBm can only be achieved for equal BW allocation. |
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1. Any other comments?

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| **Company** | **Views** |
| T\_Mobile | This would be an NR WID. Shouldn’t the impacted specification be TS 38.101-1 and not TS 36.101? Also, RAN#93 is not June 2021. |
| Verizon | To T\_Mobile: Thanks! Typos will be corrected. |

### Summary of the initial email discussion

## Intermediate Email Discussions

# Conclusion

# References

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