**3GPP TSG-RAN Meeting #93e RP-21xxxx**

**Electronic Meeting, September 13 - 17, 2021** (Revision of)

**Source: China Telecom, Qualcomm**

**Title: New WID: Increasing UE power high limit for CA and DC**

**Document for: Approval**

**Agenda Item: 9.1.4**

3GPP™ Work Item Description

For guidance, see [3GPP Working Procedures](http://www.3gpp.org/About/WP.htm), article 39; and [3GPP TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm).
Comprehensive instructions can be found at <http://www.3gpp.org/Work-Items>

# Title: Increasing UE power high limit for CA and DC

## Acronym: Power\_Limit\_CA\_DC

## Unique identifier: xxxx

NOTE: For new WIs/SIs leave the Unique identifier empty or you can make a proposal for an Acronym.

 If this is a RAN WID including Core and Perf. part, then Title, Acronym and Unique identifier refer to the feature WI.

 Please tick (X) the applicable box(es) in the table below:

|  |  |
| --- | --- |
| **This WID includes a Core part** | **X** |
| **This WID includes a Performance part** |  |

## 1 Impacts

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Affects:** | UICC apps | ME | AN | CN | Others (specify) |
| **Yes** |  | X |  |  |  |
| **No** | X |  | X | X |  |
| **Don't know** |  |  |  |  |  |

## 2 Classification of the Work Item and linked work items

### 2.1 Primary classification

This work item is a … *{Tick one box. "***Feature** */* **Building Block** */ Work Task" form a hierarchical structure. E.g. no Building Block can be proposed without a corresponding parent Feature. The full structure of all existing Work Items is shown in the 3GPP Work Plan in* *ftp://ftp.3gpp.org/Information/WORK\_PLAN* *}*

|  |  |
| --- | --- |
| X | Feature |
|  | Building Block |
|  | *Work Task* |
|  | Study Item |

NOTE: Normally, Core/Perf./Testing parts in RAN WIDs are Building Blocks. Only if they are under an SA or CT umbrella, we define them as work tasks. If you are in doubt, please contact MCC.

### 2.2 Parent and child Work Items

|  |
| --- |
| Parent and child Work Items  |
| Unique ID | Title | Nature of relationship |
|  |  | *{mandatory text: "parent WID" or "child WID"}*  |

NOTE: RAN agreed some time ago, that it describes the feature WI + Core/Perf. part WI or Testing part WI in one WID. Therefore the table above should just include the feature WI Unique ID and title and Nature of relationship is "parent WID".

### 2.3 Other related Work Items and dependencies

*{List here other Work Items which relate to the proposed one but are not part of the hierarchical structure, such as preceding SI or a preceding WI (e.g. if you further enhance a topic).}*

|  |
| --- |
| Other related Work Items (if any) |
| Unique ID | Title | Nature of relationship |
|  |  |  |

NOTE: Also related or dependent WIs in other TSGs should be indicated.

## 3 Justification

The SAR solution for high power UE for inter-band CA/SUL and EN-DC have been completed in Rel-17 and Rel-16. In which, the involved power class cases include PC3+PC3, PC3+PC2, PC2+PC3, PC2+PC2 for the corresponding bands within the combination. For PC1.5, the single carrier supporting in Band n41 has been completed, in Band n77/78/79 is targeted to be completed in Sept. 2021. It could be anticipated that CA or DC supporting PC1.5 will be most probably proposed in near future. Thus there will be a huge amount of power class coming out for CA or DC, like PC1.8 (PC3+PC2), PC1.5 (PC2+PC2), PC1.3 (PC3+PC1.5) etc, which could be enumerated by combinations of PC3, PC2 and PC1.5.

Besides to define the new power classes for CA or DC, an alternative way is to modify the power high limit, which is illustrated below:

The UE transmission power is set between PCMAX\_L and PCMAX\_H as defined in 38.101, the power class for CA will have impact to both PCMAX\_L and PCMAX\_H. The power high limit PCMAX\_H in 38.101 is expressed as

PCMAX\_H = MIN{10 log10 ∑ pEMAX,c , PEMAX,CA, PPowerClass,CA }

Where, the parameter PPowerClass,CA represents CA power class. Because the PC1.5 CA is comprised of two PC2 PAs i.e. PC2+PC2, which shares the same architecture and ability with PC2 CA in PC2+PC2 case. The power high limit could be same between PC1.5 CA and PC2 CA from UE implementation point, which means the PPowerClass,CA is reluctant in power high limit PCMAX\_H. From simplifying the spec point, it seems not friendly to define so many power classes as mentioned in the first paragraph.

Thus, making some improvement to the power high limit PCMAX\_H  will have the following benefits

- Fully utilize the UE power high ability in each tx chain, without high limit cap.

- Reduce the number of power classes definition for high power CA or DC, make the spec to be more friendly.

It worth to mention that this topic has been discussed under HPUE SAR WI for several meetings in RAN4, and in RAN4 #99e meeting, according to approved WF R4-2107741, the latest progress is the discussion was converged to two options. One is to modify the power high limit, the other is to define new power class.

Because the HPUE SAR WI 880097 is closed on schedule for SAR solution, many companies including operators are still interested in this improvement. Considering 2 quarters left for Rel-17, this WI is proposed to continue work on the improvement for UE power high limit for CA and DC.

## 4 Objective

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

The objectives of the core part are as follows:

1. Consider the two options and study the feasibility and impacts for option 1.
	* Option 1: Improvement on power high limit
		+ Allow UE to transmit the sum of the individual rated PA power classes by lifting the restriction from the Power Class for UL inter band CA or DC, i.e., PPowerClass,CA is replaced with 10\*log10∑ pPowerClass,c
	* Option 2: Definition of a new power class for CA and DC
		+ Introduce new power classes with necessary requirements
	* To respect the previous RAN4 agreement, option 1 and option 2 are prioritized, and other option is not precluded if it is justified.
2. If the consensus for 1) is option 1, then specify higher maximum output power for dual PA equipped UE’s for CA and DC
	* Replace the power class with sum or modified sum in PCMAX\_H in CA/DC
	* All associated core requirements are also to be specified
	* SAR mechanisms are modified, if needed, to allow for higher transmit power
	* Example combination as CA\_n1A-n78A (23dBm+26dBm) is considered when specifying the band-combination specific core requirements.
3. The target scenario is inter-band CA and inter-band DC

### 4.2 Objective of Performance part WI

None

### 4.3 RAN time budget request (not applicable to RAN5 WIs/SIs)

NOTE: For all RAN related WIs/SIs which are not led by RAN WG5 the WI/SI rapporteur has to fill out the attached Excel table to request time budgets for corresponding RAN WG meetings.
The Excel table has to be filled out for all affected RAN WGs and up to the target date of the WI/SI.
One time unit (TU) corresponds to ~ 2 hours in the meeting.
If no TU is needed leave the field empty otherwise enter a number >0 in the field.

 For revisions of already approved WI/SI descriptions: Please remove the Excel table from the WID/SID's zip file. The time budgets are already recorded. If you want to modify them, then this has to be done via the status report and not via a revised WID/SID.

 If this WID is covering Core and Performance part, then please fill out one line for each part in the attached Excel table.

**additional comments to the time budget request in the attached Excel table:**

## 5 Expected Output and Time scale

|  |
| --- |
| **New specifications** *{One line per specification. Create/delete lines as needed}* |
| Type | TS/TR No. | Title | For info at TSG#  | For approval at TSG# | Remarks |
|  |  |  |  |  |  |

*{Note 1: Only TSs may contain normative provisions. Study Items shall create or impact only TRs.
"Internal TR" is intended for 3GPP internal use only whereas "External TR" may be transposed by OPs.}*

NOTE: If this is a RAN WID including Core and Perf. part, then all new Core part specs have to be listed first and then all new Perf. part specs. Indicate "Core part" or "Perf. part" under Remarks for each spec.
By default a new specs can only be new for one of both parts.

|  |
| --- |
| **Impacted existing TS/TR** *{One line per specification. Create/delete lines as needed}* |
| TS/TR No. | Description of change  | Target completion plenary# | Remarks |
| 38.101-1  | Introduce improvement for power high limit for CA to the spec of NR User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone | RAN#95e | Core part |
| 38.306 | Add impacts on 38.306 User Equipment (UE) radio access capabilities, if needed | RAN#95e | Core part |
| 38.331 | Add impacts on 38.331 Radio Resource Control (RRC) Protocol specification, if needed | RAN#95e | Core part |
|  |  |  |  |

NOTE: If this is a RAN WID including Core and Perf. part, then all new Core part specs have to be listed first and then all new Perf. part specs. Indicate "Core part" or "Perf. part" under Remarks for each spec.
If an existing spec is affected by both (Core part and Perf. part), then it has to be listed twice with appropriate approval dates.

## 6 Work item Rapporteur(s)

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## 7 Work item leadership

RAN WG4

Secondary responsibility: RAN WG2

## 8 Aspects that involve other WGs

*{Specify all the other WG(s) to be involved and, if specific, their task. E.g.: "SA2, SA3, SA5. CT6 for storage, and potentially SA4". If not applicable, indicate "None" or "None identified yet".}*

NOTE: For RAN WIDs: Section 8 applies only toWGs outside of TSG RAN because RAN WG aspects have to be covered in section 4.

## 9 Supporting Individual Members

|  |
| --- |
| Supporting IM name |
| China Telecom |
| Qualcomm |
| Verizon |
| AT&T |
| US Cellular Corporation |
| T-Mobile USA |
| Telecom Italia |
| ZTE |
| Sanechips |
| Orange |
| Deutsche Telekom |
| Vodafone |
| [Ericsson] |
| [Nokia] |
| [Nokia Shanghai Bell] |