3GPP TSG RAN WG1 Meeting #121 R1-250xxxx

**St Julian’s, Malta, May 19th – 23rd, 2025**

Source: Moderator (ZTE)

Title: Summary#1 of discussion on transmission power reduction for STxMP in TS 38.213

Agenda Item: 7

**Document for: Discussion and Decision**

# Introduction

In this contribution, the summary of discussion on transmission power reduction as per the following draft CR in [1] was provided.

* **TS 38.214 V18.6.0**

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| 7.5 Prioritizations for transmission power reductionsFor single cell operation with two uplink carriers or for operation with carrier aggregation or for operation with a candidate cell configured by *LTM-Config* or for operation with multiple panel simultaneous uplink transmission, if a total UE transmit power for PUSCH or PUCCH or PRACH or SRS transmissions on serving cell(s) or on a candidate cell, if any, in a frequency range in a respective transmission occasion $i$ would exceed $\hat{P}\_{CMAX}(i)$, where $\hat{P}\_{CMAX}(i)$ is the linear value of $P\_{CMAX}(i)$ in transmission occasion $i$ as defined in [8-1, TS 38.101-1] for FR1 and [8-2, TS 38.101-2] for FR2, the UE allocates power to PUSCH/PUCCH/PRACH/SRS transmissions according to the following priority order (in descending order) so that the total UE transmit power for transmissions on serving cell(s) or on a candidate cell, if any, in the frequency range is smaller than or equal to $\hat{P}\_{CMAX}(i)$ for that frequency range in every symbol of transmission occasion $i$. If the UE transmits SRS on multiple SRS resources according to Clause 6.2.1.4 of [6, TS 38.214], the UE allocates power so that all REs of the SRS transmission have same power.For the purpose of power allocation in this clause, if a UE is provided *uci-MuxWithDiffPrio* and the UE multiplexes HARQ-ACK information in a PUSCH, a priority index of the PUSCH is the larger of (a) the priority index of the PUSCH according to clause 9 and (b) the larger priority index of the HARQ-ACK information. When determining a total transmit power for serving cells or a candidate cell, if any, as described in Clause 21 in a frequency range in a symbol of transmission occasion $i$, the UE does not include power for transmissions starting after the symbol of transmission occasion $i$. The total UE transmit power in a symbol of a slot is defined as the sum of the linear values of UE transmit powers for PUSCH, PUCCH, PRACH, and SRS in the symbol of the slot. - PRACH transmission on a candidate cell, if any, as described in Clause 21- PRACH transmission on the PCell- PUCCH or PUSCH transmissions with larger priority index - For PUCCH or PUSCH transmissions with same priority index - PUCCH transmission with HARQ-ACK information, and/or SR, and/or LRR, or PUSCH transmission with HARQ-ACK information of the priority index- PUCCH transmission with CSI or PUSCH transmission with CSI- PUSCH transmission without HARQ-ACK information of the priority index or CSI and, for Type-2 random access procedure, PUSCH transmission on the PCell- If the UE is configured with prioSCellPRACH-OverSP-PeriodicSRS-r17- Aperiodic SRS transmission or PRACH transmission on a serving cell other than the PCell - Semi-persistent and/or periodic SRS transmission- otherwise,- SRS transmission, with aperiodic SRS having higher priority than semi-persistent and/or periodic SRS, or PRACH transmission on a serving cell other than the PCell In case of same priority order and for operation with carrier aggregation, the UE prioritizes power allocation for transmissions on the primary cell of the MCG or the SCG over transmissions on a secondary cell. In case of same priority order and for operation with two UL carriers, the UE prioritizes power allocation for transmissions on the carrier where the UE is configured to transmit PUCCH. If PUCCH is not configured for any of the two UL carriers, the UE prioritizes power allocation for transmissions on the non-supplementary UL carrier. |

# Discussion

In RAN1#120 meeting, the following three understandings were reached from companies on whether/how to specify transmission power reduction in RAN1 to guarantee the total UE transmit power does not exceed the liner value of $P\_{CMAX}(i)$ for STxMP transmission scheme [2].

* Understanding#1: It is up to UE implementation to ensure the maximum output power limitation, e.g., UE always assumes the limitation is met and then transmits simultaneous uplink transmission dependent to lower bound of per panel/TCI state PUMAX.
* Understanding#2: It can be handled by RAN4 for further limitation reduction for the upper bound, e.g., ΔMPRSTxMP.
* Understanding#3: To specify transmission power reduction in RAN1 spec, e.g., the case of CA operation, SUL or LTM.

Consequently, we have the following analyses of the above understandings:

* In understanding#1, it assumes that the total UE transmit power for STxMP always cannot exceed the liner value of $P\_{CMAX}(i)$ according to the boundary of PUMAX,f,c,k, PUMAX,f,c and PTMAX,f,c as specified in section 6.2K.4 in TS 38.101-2, where the sum of per-panel power limitation for STxMP can be greater than the existing power limitation for a given power class but the sum of actual transmission power for STxMP cannot be greater than the existing power limitation for a given power class.
* In understanding#2, it is similar to understanding#1 that the total UE transmit power for STxMP always cannot exceed the liner value of $P\_{CMAX}(i)$ due to the newly introduced ΔMPRSTxMP with 3dB is applied to simultaneous transmission. As a result, the total transmission power from two panels simultaneously cannot exceed EIRPmax.
* In understanding#3, it assumes that the total UE transmit power for STxMP could wrongly exceed the liner value of $P\_{CMAX}(i)$as specified in TS 38.101-2 if without any specifications on transmission power reduction in RAN1.

Basically, it should be noticed that RAN4 specification is to capture how to define maximum output power limitation (as in understanding#1 or understanding#2) while RAN1 specification is to capture how to specify transmission power reduction when it exceeds such limitation (as in understanding#3). For example, the rule of transmission power reduction was specified in section7.5 in TS 38.213 for scenarios involving two uplink carriers, carrier aggregation and LTM, but the maximum output power limitation for these scenarios was specified respectively in TS 38.101-2. In this sense, it can be ensured that the total UE transmit power can NOT exceed the liner value of $P\_{CMAX}(i)$ as specified in TS 38.101-2, and the power reduction rule can follow the priority as specified in TS 38.213.

***Observation 1:*** *From the perspective of specifications, RAN4 specification is to capture how to define maximum output power limitation while RAN1 specification is to capture how to specify transmission power reduction based on priority rule when it exceeds such limitation.*

Likewise, for STxMP in a single carrier of a single serving cell, the total UE transmit power for simultaneously transmitted PUSCH or PUCCH on the serving cell in a frequency range in a respective transmission occasion *i* can exceed the linear value of $P\_{CMAX}(i)$ in transmission occasion *i*. Then, transmission power reduction should also be operated to allocate power to the PUSCH/PUCCH transmissions by reusing the legacy priority rule so that the total UE transmit power for transmissions on the serving cell is not greater than $P\_{CMAX}(i)$ in transmission occasion *i.* In this way, at least it can be practical and beneficial to the case of UCI multiplexed on MDCI based PUSCH+PUSCH transmissions. For example, when joint HARQ-ACK feedback is configured or when the UCI does not include HARQ-ACK, the PUSCH associated with CORESET pool index 0 that multiplexed with UCI should be prior to the PUSCH associated with CORESET pool index 1 without UCI multiplexing. Similarly, when separate HARQ-ACK feedback is configured, the PUSCH (which is associated with CORESET pool index 0 or 1) multiplexed with UCI should be prior to the PUSCH (which is associated with CORESET pool index 1 or 0) without UCI multiplexing.

***Proposal 1:*** *Support to reuse the mechanism on transmission power reduction as specified in TS 38.213 for multiple panel simultaneous uplink transmission of a single carrier of a single serving cell so that the total UE transmit power for PUSCH/PUCCH does not exceed the liner value of* $P\_{CMAX}(i) in transmission occasion i$*.*

**Contact Information**

For any potential offline discussions, please provide the contact information in the table below:

Table 0 Contact Information

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**Company Input**

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| **Company** | **Input** |
| Mod | Companies are welcome to provide comments by taking the following questions into consideration.* Q1: Do you agree with ***Proposal 1*** to reuse the legacy rule of transmission power reduction for STxMP in RAN1 specification, i.e., TS 38.214? If not, please share your understanding of the above discussion.
* Q2: If your answer to Q1 is yes, do you agree with the draft CR provided in [1]? If not, please provide anything for improvement.
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# Conclusion

[TBD]

# References

1. R1-2503681, Draft CR on transmission power reduction for STxMP in TS 38.213, ZTE Corporation, Sanechips
2. R1-2501597, Summary#2 of discussion on transmission power reduction for STxMP in TS 38.213, ZTE