**3GPP TSG-RAN WG4 Meeting # 106 R4-2302838**

**Athens, Greece, 27 February –03 March, 2023**

**Agenda item:** 9.28.4

**Source:** Moderator (Samsung)

**Title:** Topic summary for [106][145] NR\_MIMO\_evo\_DL\_UL\_UERF

**Document for:** Information

# Introduction

*Briefly introduce background, the scope of this email discussion (e.g. list of treated agenda items) and provide some guidelines for email discussion if necessary.*

In the latest approved updated WID on Rel-18 MIMO evolution for downlink and uplink, the following objectives has been captured for RAN1. RAN4 is also mentioned to specify necessary core requirements for the enhancements listed in the WID:

|  |
| --- |
| 1. Study, and if justified, specify CSI reporting enhancement for high/medium UE velocities by exploiting time-domain correlation/Doppler-domain information to assist DL precoding, targeting FR1, as follows:
	* Rel-16/17 Type-II codebook refinement, without modification to the spatial and frequency domain basis
	* UE reporting of time-domain channel properties measured via CSI-RS for tracking
2. Specify extension of Rel-17 Unified TCI framework for indication of multiple DL and UL TCI states focusing on multi-TRP use case, using Rel-17 unified TCI framework.
3. Study, and if justified, specify larger number of orthogonal DMRS ports for downlink and uplink MU-MIMO (without increasing the DM-RS overhead), only for CP-OFDM,
	* Striving for a common design between DL and UL DMRS
	* Up to 24 orthogonal DM-RS ports, where for each applicable DMRS type, the maximum number of orthogonal ports is doubled for both single- and double-symbol DMRS
4. Study, and if justified, specify enhancements of CSI acquisition for Coherent-JT targeting FR1 and up to 4 TRPs, assuming ideal backhaul and synchronization as well as the same number of antenna ports across TRPs, as follows:
	* Rel-16/17 Type-II codebook refinement for CJT mTRP targeting FDD and its associated CSI reporting, taking into account throughput-overhead trade-off
	* SRS enhancement to manage inter-TRP cross-SRS interference targeting TDD CJT via SRS capacity enhancement and/or interference randomization, with the constraints that 1) without consuming additional resources for SRS; 2) reuse existing SRS comb structure; 3) without new SRS root sequences
	* Note: the maximum number of CSI-RS ports per resource remains the same as in Rel-17, i.e. 32
5. Study, and if justified, specify UL DMRS, SRS, SRI, and TPMI (including codebook) enhancements to enable 8 Tx UL operation to support 4 and more layers per UE in UL targeting CPE/FWA/vehicle/Industrial devices
	* Note: Potential restrictions on the scope of this objective (including coherence assumption, full/non-full power modes) will be identified as part of the study.
6. Study, and if needed, specify the following items to facilitate simultaneous multi-panel UL transmission for higher UL throughput/reliability, focusing on FR2 and multi-TRP, assuming up to 2 TRPs and up to 2 panels, targeting CPE/FWA/vehicle/industrial devices (if applicable)
	* UL precoding indication for PUSCH, where no new codebook is introduced for multi-panel simultaneous transmission
		+ The total number of layers is up to four across all panels and total number of codewords is up to two across all panels, considering single DCI and multi-DCI based multi-TRP operation.
	* UL beam indication for PUCCH/PUSCH, where unified TCI framework extension in objective 2 is assumed, considering single DCI and multi-DCI based multi-TRP operation
		+ For the case of multi-DCI based multi-TRP operation, only PUSCH+PUSCH, or PUCCH+PUCCH is transmitted across two panels in a same CC.
7. Study, and if justified, specify the following
	* Two TAs for UL multi-DCI for multi-TRP operation
	* Power control for UL single DCI for multi-TRP operation where unified TCI framework extension in objective 2 is assumed.

For the case of simultaneous UL transmission from multiple panels, the operation will only be limited to the objective 6 scenarios. |

As highlighted above, the WID includes some objectives which may have the impact on UE RF requirements.

Therefore, this summary has three major topics including RAN4 workplan, UE RF impact and potential reply LS to RAN1 on STxMP of Rel-18 NR MIMO evolution. Moderator has tried to capture most relevant proposals and observations of all companies provided to this meeting, and it is expected that main session covers every Issue noted here online. Companies are encouraged to think about and provide their view on each Issue for online discussion.

Regarding the reply LS to RAN1, Topic #3, RAN4 received the LS long ago, and its first discussion was August 2022. From moderator’s perspective, it is the time to have the reply LS to RAN1 for their remaining discussions, and better understanding of the STxMP from RAN4’s view. At least, the current discussion status can be provided for RAN1 in this meeting.

# Topic #1: Workplan

*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** |
| [**R4-2301929**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_106/Docs/R4-2301929.zip) | Samsung | Following RAN4 work plan for Rel-18 MIMO evolution WI is proposed:

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| --- | --- |
| Meeting | Target Plan |
| RAN4#106 (Feb, ’23) | * Agree overall work plan for core and performance part
* Discuss and identify potential impact on UE RF requirements
* Discuss and identify potential impact on RRM core requirements
* Rely LS to RAN1 if any conclusion reached (for R1-2205639 and R1-2205593)
 |
| RAN4#106-Bis (Apr, ’23) | UE RF | * Initiate discussion on UE RF requirements of identified impact
* Continue to check other impact on UE RF requirement
 |
| RRM Core | * Discuss and identify which RRM requirements need to be developed to support MIMO evolution
 |
| RAN4#107 (May, ’23) | UE RF | * Continue to discuss UE RF requirements of identified impact
 |
| RRM Core | * Further discussions on UE RRM requirements impact for MIMO evolution features
* Discuss the possible signalling impact (e.g. UE capabilities, network flag)
 |
| RAN4#108 (Aug, ’23) | UE RF | * Continue to discuss and define UE RF requirements of identified impact
 |
| RRM Core | * Continue to discuss and decide the solution for the RRM enhancement
* Provide draft CR on TS38.133 for the RRM enhancement
 |
| RAN4#108-Bis (Oct, ’23) | UE RF | * Continue to discuss and define UE RF requirements of identified impact
* Review draft CRs for endorsement if any
 |
| RRM Core | * Provide draft CR on TS38.133 for RRM core part, endorsed if possible.
* Discuss and decide test case lists and related parameters
 |
| RRM Perf | * Initial discussion on RRM performance part requirements impact
 |
| Demod | * Initial discussion on demod/CSI requirements, discuss and identify which demod/CSI requirements need to be extended
 |
| RAN4#109 (Nov, ’23) | UE RF | * Agree RAN4 CR to finalize the RF core requirements
 |
| RRM Core | * Agree RAN4 CR to finalize the RRM core requirements
 |
| RRM Perf | * Further discussion on RRM performance part for MIMO evolution, provide draft CR on TS38.133 if any
 |
| Demod | * Further discussion on demod/CSI requirements, define scenario parameters in order to align simulation cases
 |
| RAN4#110 (Feb, ’24) | RRM perf  | * Further discussion on RRM performance part for MIMO evolution, provide draft CR on TS38.133 if any
 |
| Demod | * Further discussion on demod/CSI requirements, provide initial simulation results to align results from companies, provide draft CR if any
 |
| RAN4#110-bis (Apr, ’24) | RRM perf | * Provide draft CR on TS38.133 for RRM performance part, endorsed if possible.
 |
| Demod | * Provide simulation results and continue to discuss demod/CSI requirements, provide draft CR, endorsed if possible.
 |
| RAN4#111 (May, ’24) | RRM perf | * Further work on the draft CRs and Agree RAN4 CR to finalize the RRM performance part
 |
| Demod | * Further work on the draft CRs and Agree RAN4 CR to finalize the demod/CSI part
 |

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## Open issues summary

*Before Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 1-1: Proposed workplan for UE RF

*Sub-topic description: As the RAN4 discussion gets started, a draft workplan has been proposed by the rapporteur company. According to the chairman’s guidance, this summary will capture RF part only, and the final workplan for Rel-18 NR MIMO in RAN4 will follow with both RF and RRM parts for the approval.*

*Open issues and candidate options before meeting:*

**Issue 1-1: Is the proposed workplan agreeable (for RF part only)?**

* Proposals
	+ Option 1: Yes
	+ Option 2: No, need modification (please share the concern and alternative)
* Recommended WF
	+ Option 1

# Topic #2: UE RF requirements

*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** |
| [**R4-2300638**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_106/Docs/R4-2300638.zip) | Nokia, Nokia Shanghai Bell | Observation 1: The EIRP relaxations are used in UL CA requirements (on two different CC for inter-band UL CA) in the consideration of the UE spherical coverage and the performance of UE in TS 38.101-2. Similar studies are also needed for multi-panels, multi streams UE design for same CC or different CC use cases in FR2. Proposal 1: If the UE RF architecture scope is limited to a scenario where the 2 active Tx chains are associated to 2 different panels (i.e. 2 independent antenna modules), then no relaxations should be introduced for Rel-18 UL MIMO operations. |
| [**R4-2300639**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_106/Docs/R4-2300639.zip) | Nokia, Nokia Shanghai Bell | Observation 1: the maximum power limit is per UE. Therefore, UE with a single active panel and UE with multiple active panels for UL MIMO have the same maximum power limit e.g. 35 dBm.Observation 2: The maximum radiated power is achieved that each TCI state is served with a UE panel individually reaching the maximum power class limit and that the two TCI states are in the same angular direction (QCL Type-D).Observation 3: For FR2 Rel-18 UL MIMO multiple types of architectures could be considered. It may be beneficial to assess the scope of the discussion.Proposal 1: Clarify whether the scope of the discussion should be limited to some types of UE RF architectures e.g. where each active Tx chain is associated with different panels. |
| [**R4-2300661**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_106/Docs/R4-2300661.zip) | InterDigital | Observation 1: Current power class definitions from 38.10-2 are clear and applicable.Proposals 1: The current defined power classes shall be considered further as reference for any power limitation discussions while defining the new requirements for STxMP case.Proposal 2: Consider the Multi-Rx assumptions for panel and beam relation for further STxMP discussions.Observation 2: The TCI state associated with a beam definition is important for the Pcmax per beam definition as it is linked to the measured pathloss at the reference point.Observation 3: The EIRP power may or may not be shared to respect the EIRPmax and this depends on the UE implementation and beamforming capabilities.Observation 4: Signaling the UL power sharing status for STxMP mDCI case for a combination of TCI states is enough for the gNB(s) to optimally operate the scheduler(s).Proposal 3: The following answers can be provided to the RAN1 questions: |
| [**R4-2300706**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_106/Docs/R4-2300706.zip) | Qualcomm | Proposal 1: RAN4 to adopt the definition of panel as used in RAN1 discussions:

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| ‘Panel’ is defined as one or multiple as combination of below depending on different UE implementation: 1. Unit of antenna group to control beam independently
	1. Within a panel, one beam can be selected and used for UL transmission.
	2. Across different panels, multiple beams (each selected per panel) may be used for UL transmission
	3. ‘Beam’ is assumed to mean spatial filter associated with transmission or reception
2. Unit of antenna group to control its transmission power
3. Unit of antenna group to have a common UL timing
 |

Observation: ‘Total power concept’ does not have an agreed definition or agreed validity for FR2 UEs in RAN4.Proposal 2: RAN4 to focus on the configured Tx power requirement while addressing ‘power limitation’ for STxMP in FR2. Proposal 3: RAN4 to confirm that it is feasible to implement a per-TCI state configured power inequality. |
| [**R4-2301539**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_106/Docs/R4-2301539.zip) | Vivo | Observation 1: A basic understanding of “Panel” have been reached for multi-Rx DL study.Proposal 1: Try to have a unified understanding of “Panel” for UL.Proposal 2: Confirm the feasibility of “per-panel power limitation”, but whether/how to define specific requirements can be left for later discussion.Proposal 3: Leave the reply of the questions related to detailed requirements postponed.Proposal 4: Using per-TCI state configuration as a starting point for related requirements discussion.  |
| [**R4-2301540**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_106/Docs/R4-2301540.zip) | Vivo | Observation 1: For mTRP related objectives, only simultaneous multi-panel UL transmission (STxMP) may have impact for RAN4 UE RF requirements.Observation 2: The following requirements and test related issues may need to be considered for UE RF impact:* Maximum output power / configured output power
* Beam correspondence
* Test configuration/procedure such as probe number
* Test Metric

Observation 3: The UE RF impact for STxMP may be complicated and also related to current Rel-18 Multi-Rx WI. The deployment need may also be less than multi-Rx since no handheld UE was considered. Observation 4: 8Tx related features have RAN4 UE RF impact, at least for FR1.Observation 5: 4Tx requirements is still under discussion in Rel-18. Observation 6: CSI & DMRS enhancement would not have UE RF requirements.Proposal 1: Study simultaneous multi-panel UL transmission for RAN4 UE RF impact for CPE/ FWA/ vehicle/ industrial devices and decide whether and how to introduce them into Rel-18. Proposal 2: Postpone 8Tx related discussion to later release in RAN4. |
| [**R4-2301624**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_106/Docs/R4-2301624.zip) | Xiaomi | Proposal 1: STxMP apply to PC1/PC2/PC4/PC5 UE in FR2.Proposal 2: STxMP can reuse the similar panel assumption as DL reception, at least below bullets are still valid for STxMP:* + Panel’ is defined as a group of antenna element that controls beam independently and has the following attributes
		- * Within a panel, one beam can be selected and used for UL transmission.
			* Across different panels, multiple beams (each selected per panel) may be used for UL transmission
			* ‘Beam’ is assumed to mean spatial filter associated with UL transmission.
	+ Confirm that a physical panel with dual polarization is assumed as two “panels”.
 |
| [**R4-2301760**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_106/Docs/R4-2301760.zip) | Huawei, HiSilicon | Observation 1: RAN1 has not introduced any concept like “Panel ID” till now and it is RAN4 common understanding that RF requirements have been established following panel agnostic principle. Proposal 1: RAN4 can consider to only specify demod requirements instead of RF core requirements for FR2 STxMP operation in Rel-18.Proposal 2: RAN4 should establish a view about possible UE hardware architecture implementations for realizing STxMP operation.Observation 2: (Architecture #1) For the UE RF architecture that using independent AIP, RF front end and IF module to realize STxMP operation:* Independent power control for each UL transmission link can be supported.
* Over two panels, up to 4 layers and up to 2 TBs with independent UL precoder selection can be supported if baseband capability could be further enhanced.
* The overall gain for this most expensive choice should be further clarified considering all foreseeable implementation difficulties, e.g., additional relaxation for the actual transmission power of each link to overcome heat dissipation.

Observation 3: (Architecture #2) For the UE RF architecture that using independent AIP and RF front end to realize STxMP:* Independent power control for each UL transmission link can be supported.
	+ The power imbalance could be restricted by the dynamic range capability of FE module since IF module is shared.
* SDM repetition transmission can be supported.
* A good balance between implementation costs and performance gain.

Observation 4: (Architecture #3) For the UE RF architecture that using independent AIP to realize STxMP:* Independent power control for each UL transmission cannot be supported.
* SDM repetition transmission can be supported.

Proposal 3: RAN4 can take Architecture #2 as a start for the RF discussion on STxMP operation in Rel-18.Observation 5: The minimum output power requirement may need reconsideration for STxMP operation.Observation 6: Per UE power control for STxMP operation is feasible.Observation 7: From RAN4 perspective, the feasibility of per panel power control for STxMP operation depends on the following situations:* If Architecture #3 will be used to support STxMP operation, per panel power control is infeasible.
* If Architecture #1/#2 will be used to support STxMP operation, per panel power control is infeasible.
	+ For Architecture #2, there would be a limitation for the power imbalance between two panels.
	+ For both Architecture #1 and #2, all power limitation concepts as listed in Annex shall be considered when the UE determines the transmission power for each panel.

Observation 8: The current RAN1 progress on power control design is not pending on RAN4 discussion, a comprehensive reply instead of yes/no can be provided by RAN4 if it is necessary.  |
| [**R4-2302501**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_106/Docs/R4-2302501.zip) | Samsung | Proposal 1: Both STxMP and 8Tx UL are targeting CPE/FWA/vehicle/Industrial devices only as limited by WID for Rel-18 MIMO.Observation 1: It is the time to have the reply LS to RAN1 for their remaining discussions, and better understanding of the STxMP from RAN4’s point of view.Observation 2: Whether the impact of STxMP on UE RF requirements fully depends on the future discussion in RAN4 because both per-panel and per-UE based power control for STxMP.Observation 3: Power limitation per panel for STxMP can be considered in RAN4 for defining related per-panel based requirementsObservation 4: Approach to specify the whole concept of per-panel based requirements definitely requires lots of impact on the RAN4 RF requirementsObservation 5: As long as the total power of the active panels can be kept as the current single panel transmission, it would be the least effort approach for RAN4.Observation 6: Total power concept for the dual transmission was not preferred looking back on the previous RAN4 discussions.Observation 7: RAN4 has multiple options to define the UE RF requirement for STxMPProposal 2: RAN4 has to consider both performance benefits and workload aspects during the WI discussion in Rel-18.Observation 3: RAN1 is still checking various options for multiple features to support 8Tx operations from RAN1 perspective.Proposal 3: RAN4 should resume the discussion in the future based on the ongoing 4Tx study of the UE RF framework, architecture and requirements, and 8Tx market demand.Observation 9: It is expected that nothing will be newly introduced in terms of the power control for multi-TRP enhancementsProposal 4: RAN4 to remove the topic of power control for multi-TRP enhancements from the UE RF workplan of Rel-18 MIMO evolution. |
| [**R4-2302735**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_106/Docs/R4-2302735.zip) | Ericsson | Observation 1: The regulatory MPE requirements need to be met by the UE regardless the number of beams the UE is transmitting. Depending on beam directions for the same configured maximum output power(s) the MPE requirements could be either met or not met while the UE only has a control on the power amplifiers.Observation 2: In conclusion, for STxMP scenario it is complicated for a UE to simultaneously handle the regulatory MPE requirements and the total radiated power requirements. |

## Open issues summary

*Before Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 2-1: [STxMP] FR2 power class applicability

*Sub-topic description: It should be noted that both STxMP and 8Tx UL are targeting CPE/FWA/vehicle/Industrial devices only as limited by WID for Rel-18 MIMO. RAN4 has to have the common understanding of targeting devices before starting the discussion.*

*Open issues and candidate options before meeting:*

**Issue 2-1: Applied FR2 UE power class for STxMP**

Proposals

* + Option 1: PC1/PC2/PC4/PC5 only (Xiaomi, Samsung)
	+ Option 2: Others
* Recommended WF
	+ Option 1

### Sub-topic 2-2: [STxMP] UE architecture assumption

*Sub-topic description: RAN4’s view about possible UE hardware architecture implementations is necessary to clarify whether the scope of the discussion should be limited to some types of UE RF architectures (Nokia). Some examples of the UE architecture are provided (Huawei).*

|  |
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| **Option 1** |
| **Option 2** |
| **Option 3** |

*Open issues and candidate options before meeting:*

**Issue 2-2: RAN4 should consider one of following UE architecture assumptions for STxMP in Rel-18**

* Proposals
	+ Option 1: Independent IF, FE and antenna modules
	+ Option 2: Independent FE and antenna module (Huawei)
	+ Option 3: Independent antenna module
	+ Option 4: Others
* Recommended WF
	+ TBA

### Sub-topic 2-3: [STxMP] Panel definition

*Sub-topic description: One controversial part in previous RAN4 discussion was defining “panel” for STxMP. It is indeed conceptually difficult to set up a new concept of per-panel power limitation without a basic understanding of “Panel”. RAN4#106 has some proposals on the “panel” based on earlier RAN1 assumption, and agreed one from multi-RX WI.*

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| **Option 1 – based on assumption for multi-Rx discussion*** ‘Panel’ is defined as a group of antenna element that controls beam independently and has the following attributes
	+ Within a panel, one beam can be selected and used for DL reception.
	+ Across different panels, multiple beams (each selected per panel) may be used for DL reception.
	+ ‘Beam’ is assumed to mean spatial filter associated with reception.
 |
| **Option 2 – based on assumption used in RAN1**‘Panel’ is defined as one or multiple as combination of below depending on different UE implementation: 1. Unit of antenna group to control beam independently
	1. Within a panel, one beam can be selected and used for UL transmission.
	2. Across different panels, multiple beams (each selected per panel) may be used for UL transmission
	3. ‘Beam’ is assumed to mean spatial filter associated with transmission or reception
2. Unit of antenna group to control its transmission power
3. Unit of antenna group to have a common UL timing
 |

*Open issues and candidate options before meeting:*

**Issue 2-3: RAN4 definition of “panel” for STxMP discussion in Rel-18**

* Proposals
	+ Option 1: Based on multi-Rx WI (InterDigital, vivo, Xiaomi)
	+ Option 2: Based on RAN1 discussion (Qualcomm)
	+ Option 3: Others
* Recommended WF
	+ Option 1

### Sub-topic 2-4: [STxMP] Per-panel power control

*Sub-topic description: Per-panel based power control for STxMP assumed in the RAN1 LS are still applicable given the RAN1 discussion. During the previous discussion on the LS, it is proposed to adopt ‘per-TCI’ based configured output power for ‘per-panel’ power limitation.*

*Open issues and candidate options before meeting:*

**Issue 2-4: Feasibility of ‘per-panel’ power limitation for STxMP**

* Proposals
	+ Option 1: RAN4 confirms the feasibility of “per-panel” power limitation (InterDigital, Qualcomm, vivo, Samsung)
	+ Option 2: Others
* Recommended WF
	+ Option 1

**Issue 2-5: ‘Per-TCI state’ configured power for ‘per-panel’ power limitation**

* Proposals
	+ Option 1: Starting point for further related requirements discussion (InterDigital, Qualcomm, vivo)
	+ Option 2: Others
* Recommended WF
	+ Option 1

### Sub-topic 2-5: [STxMP] Per-UE power control

*Sub-topic description: Per-UE based power control for STxMP assumed in the RAN1 LS are still applicable given the RAN1 discussion. During the previous discussion on the LS and also in Rel-17 discussion on inter-band UL CA, RAN4 found no consensus on ‘total power limitation’.*

*Open issues and candidate options before meeting:*

**Issue 2-6: Feasibility of ‘per-UE’ power limitation for STxMP**

* Proposals
	+ Option 1: RAN4 can consider ‘per-UE’ power limitation for STxMP (Huawei, Samsung)
	+ Option 2: Others
* Recommended WF
	+ Option 1

**Issue 2-7: Method to specify ‘per-UE’ power limitation**

* Proposals
	+ Option 1: Reuse legacy requirement for STxMP (Huawei, Samsung)
	+ Option 2: Define new requirements as ‘total power concept’ for STxMP (Samsung)
	+ Option 3: Others
* Recommended WF
	+ TBA

### Sub-topic 2-6: [STxMP] Others about UE RF requirements

*Sub-topic description: Other aspects about UE RF requirement than the configured output power are proposed for STxMP operation.*

*Open issues and candidate options before meeting:*

**Issue 2-8: Current defined power classes shall be considered further as reference for any power limitation discussions while defining the new requirements for STxMP case.**

* Proposals
	+ Option 1: Agreeable (InterDigital)
	+ Option 2: Others
* Recommended WF
	+ Option 1

**Issue 2-9: No relaxations should be introduced for Rel-18 UL MIMO for the case if 2 active Tx chains are associated to 2 different panels.**

* Proposals
	+ Option 1: Agreeable (Nokia)
	+ Option 2: Others
* Recommended WF
	+ TBA

**Issue 2-10: STxMP scenario should be carefully considered to simultaneously handle the regulatory MPE requirements and the total radiated power requirements.**

* Proposals
	+ Option 1: Agreeable (Ericsson)
	+ Option 2: Others
* Recommended WF
	+ Option 1

### Sub-topic 2-7: [STxMP] Plan for Rel-18

*Sub-topic description: Study simultaneous multi-panel UL transmission for RAN4 UE RF impact for CPE/ FWA/ vehicle/ industrial devices and decide whether and how to introduce them into Rel-18. RAN4 has to consider both performance benefits and workload aspects during the WI discussion in Rel-18 (1540, 2501)*

*Open issues and candidate options before meeting:*

**Issue 2-11: How/Whether to introduce RAN4 requirements of STxMP in Rel-18**

* Proposals
	+ Option 1: Focus on defining ‘per-TCI’ configured power (Qualcomm)
	+ Option 2: Study overall STxMP first and decide whether and how to introduce them (vivo, Samsung)
	+ Option 3: Demod requirement only (Huawei)
	+ Option 4: Others
* Recommended WF
	+ TBA

### Sub-topic 2-8: [8Tx] Plan for Rel-18

*Sub-topic description: RAN1 is still checking various options for multiple features to support 8Tx operations from RAN1 perspective. However, since nothing is decided yet for the RF performance, it is premature to decide whether it has an impact to UE RF requirement. Moreover, RAN4 has a Rel-18 WI having 4Tx on a single carrier for CPE/FWA/vehicle/industrial devices.*

*Open issues and candidate options before meeting:*

**Issue 2-12: Postpone 8Tx related discussion to later release in RAN4**

* Proposals
	+ Option 1: Agreeable (vivo, Samsung)
	+ Option 2: Others
* Recommended WF
	+ Option 1

### Sub-topic 2-9: [mTRP enh] Plan for Rel-18

*Sub-topic description: WID has an objective on power control for UL single DCI for multi-TRP operation that might have impact on UE RF requirement. However, it is expected that nothing will be newly introduced in terms of the power control for multi-TRP enhancements according to RAN1 status.*

*Open issues and candidate options before meeting:*

**Issue 2-13: No UE RF discussion is expected according to the RAN1’s status**

* Proposals
	+ Option 1: Agreeable (Samsung)
	+ Option 2: Others
* Recommended WF
	+ Option 1

# Topic #3: Reply LS (to R1-2205639)

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2300663**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_106/Docs/R4-2300663.zip) | InterDigital | [Draft] Reply LS on UE power limitation for STxMP in FR2 |
| [**R4-2300706**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_106/Docs/R4-2300706.zip) | Qualcomm | [Draft] Reply LS on UE power limitation for STxMP in FR2 |
| [**R4-2301539**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_106/Docs/R4-2301539.zip) | vivo | [Draft] reply LS on UE power limitation for STxMP in FR2 |
| [**R4-2301596**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_106/Docs/R4-2301596.zip) | MediaTek | Draft reply LS on UE power limitation for STxMP in FR2 |
| [**R4-2302502**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_106/Docs/R4-2302502.zip) | Samsung | [Draft] Reply LS on UE power limitation for STxMP in FR2 |

## Open issues summary

*Before Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 3-1: Answer to Q1

*Sub-topic description: Q1 is to ask whether Assumption 1 (Power limitation per panel for STxMP) is feasible.*

*Open issues and candidate options before meeting:*

**Issue 3-1: Proposed answers to Q1**

* Proposals
	+ Option 1: “Yes” (InterDigital, Qualcomm, Samsung)
	+ Option 2: “Yes. However, whether and how to introduce per-panel power limitation or similar concept and/or requirements in RAN4 is still under discussion.” (vivo)
	+ Option 3: “Yes, there should be a power limitation per panel for STxMP from RAN4 perspective.” (MediaTek)
	+ Option 4: Others
* Recommended WF
	+ Option 1

### Sub-topic 3-2: Answer to Q2

*Sub-topic description: Q2 is to ask whether Assumption 2 (A total power limitation per UE over all UE panels used for STxMP) is feasible.*

*Open issues and candidate options before meeting:*

**Issue 3-2: Proposed answers to Q2**

* Proposals
	+ Option 1: “Yes” (InterDigital, Qualcomm, Samsung, vivo)
	+ Option 2: “Yes, there should be a total power limitation per UE over all UE panels for STxMP from RAN4 perspective.” (MediaTek)
	+ Option 3: Others
* Recommended WF
	+ Option 1

### Sub-topic 3-3: Answer to Q3

*Sub-topic description: Q3 is to ask whether the total power limitation per UE over all UE panels used for STxMP or the sum of per-panel power limitation for STxMP can be different from (greater than) the existing power limitation for a given power class.*

*Open issues and candidate options before meeting:*

**Issue 3-3: Proposed answers to Q3**

* Proposals
	+ Option 1: “RAN4 confirm that existing UE RF requirements are framed so standards compliance implies regulation compliance (clause 6.5x in TS38.101-2). For any additional limitation like the sum over all panels of the per-panel power limitation for STxMP, would be defined in RAN4 if necessary.” (Qualcomm, vivo, Samsung)
	+ Option 2: “RAN4 confirm that existing UE RF requirements are framed so standards compliance implies regulation compliance (see Annex and clause 6.5x in TS38.101-2). For any additional limitation like the sum over all panels of the per-panel power limitation for STxMP, would be defined in RAN4 if necessary, during the WI in RAN4.” (InterDigital)
	+ Option 3: “The total power limitation per UE over all UE panels used for STxMP shall be the same as the existing power limitation for a given power class, but not the sum of per-panel power limitation.” (MediaTek)
	+ Option 4: Others
* Recommended WF
	+ Option 1

### Sub-topic 3-4: Answer to Q4

*Sub-topic description: Q4 is to ask whether both assumptions can/shall be applied to a same UE, and what is the relationship between the per-panel power limitation and total power limitation if both are applied (e.g., the sum of per-panel power limitation can be larger than the total power limitation per UE, or should be always the same).*

*Open issues and candidate options before meeting:*

**Issue 3-4: Proposed answers to Q4**

* Proposals
	+ Option 1: “Based on currently defined power classes definitions, the relationship will be defined by RAN4 within Pcmax requirement for STxMP mDCI case which is not currently developed.” (InterDigital)
	+ Option 2: “It is believed that both assumptions are feasible, and both assumptions shall be applied to a same UE. The per-panel power limitation would be defined in latter stage if necessary, and the per-UE power limitation should be applicable at all the time. ‘Limitation’ here applies to regulatory compliance rather than a configured power requirement.” (Samsung)
	+ Option 3: “It is believed that both assumptions are feasible, and both assumptions shall be applied to a same UE. The per-panel power limitation would be defined if deemed necessary, and the per-UE power limitation would be applicable at all the time. ‘Limitation’ here applies to regulatory compliance rather than a configured power requirement. RAN4 can confirm that it can define the configured transmitted power requirement per-TCI for STxMP.” (Qualcomm)
	+ Option 4: “As for question 1. The per-panel power limitation is still under discussion.” (vivo)
	+ Option 5: “Both assumptions shall be applied to a same UE, i.e., the actual power for each panel shall not be larger than the power limitation for the panel for STxMP, and the total actual power per UE shall not be larger than the total power limitation per UE over all UE panels for STxMP. Moreover, the sum of per-panel power limitation can be larger than the total power limitation per UE over all UE panels for STxMP.” (MediaTek)
	+ Option 6: Others
* Recommended WF
	+ TBA