**3GPP TSG**

3GPP TSG-RAN WG4 Meeting # 104-e R4-22xxxxx

**Online Meeting, Aug. 2022**

**Title:** [Draft] Reply LS to RAN1 on UE power limitation for STxMP in FR2

**Response to:** -

**Source:** RAN4

**To:** RAN1

**Contact Person:**

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**Send any reply LS to: 3GPP Liaisons Coordinator,** **mailto:3GPPLiaison@etsi.org**

**1. Overall Description:**

RAN4 would like to thank RAN1 for LS on UE power limitation for STxMP in FR2. RAN4 responses to RAN1 questions are below. We continue to use the following definitions for Assumptions 1 and 2:

* Assumption 1: Power limitation per panel for STxMP
* Assumption 2: A total power limitation per UE over all UE panels used for STxMP

RAN4 also assume that ‘panel’ refers to a radiating structure dedicated for association with a unique TCI state.

***Question 1: From RAN4 perspective, is Assumption 1 is feasible?***

Assumption 1 is feasible from an implementation perspective. RAN4 have not studied what requirements should apply on the UE corresponding to assumption 1, however.
RAN4 is discussing the implementation.

Ask the question of definition of panel and power limitation.

***Question 2: From RAN4 perspective, is Assumption 2 is feasible?***

Assumption 2 is feasible from an implementation perspective, and the following issues need further study:

1. how to sum up the two “EIRP” in different directions.
2. study UL performance impact.

RAN4 have not studied what requirements should apply on the UE corresponding to assumption 2, however.

***Question 3: In either of Assumption 1 or Assumption 2, 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?***

RAN4 confirm that existing UE power class definitions comply with common regulations for TRP and EIRP (clause 6.2x.1 in TS38.101-2). Any additional limitation like the sum over all panels of the per-panel power limitation for STxMP can be chosen to be greater than the existing power limitation for a given power class without consequence to UE’s ability to comply with regulation, due to the existing power class definitions.

***Question 4: If both Assumption 1 and Assumption 2 are feasible, 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)?***

The sum of per-panel power limitation is not comparable with total power limitation in the general case. RAN4 confirm that the per-panel power limitation values can be the same as total per-UE power limitation values. Both requirement types can be satisfied simultaneously, and the detail can be left to implementation. RAN4 already covers assumption 2 (per-UE power limits from the power class definitions) and additional per-UE limits are not necessary for regulation compliance.

Discussion:

Huawei: the wording panel is mentioned by RAN1 LS several times. But we have no agreement on definition of panel. The concept of power limitation exist in RAN2 spec and LS. We should align the wording. For the answer to question 3, I wonder if the understanding towards the power class is aligned.

Qualcomm: for panel, we try to use the concept of RAN1 wording. They have common understanding. We can send LS to Ran1 to check the definition of panel or send our suggestion about the definition. Do not fully understand the definition of power limitation and problem. The power limitation is like power class we have today.

Apple: to questions, we can tell RAN4 is going to discuss according to power class. There is no panel definition. If we have suddenly introduce the panel, it will impact the UE implementation. RAN1 should have way to work without exposing the UE implementation. The easy reply is to that RAN4 is discussing the implementation..

Vivo: tend to share the same view as Huawei and Apple about the panel definition. In multi-Rx, whether there is panel wording in the spec is under discussions. There will be risk that RAN4 won’t define the requirement and signaling based on RAN1 design. We should reply to RAN1 based on clear understanding.

OPPO: we agree the comment about power limitation from companies. Power limitation include max EIRP and max TRP. This is our understanding. Question 1 and 2 answer OK for us. Need more discussion for 3 and 4.

Huawei: Regarding the definition without RAN4, we have no consensus. The basic concepts should be made clear. The actual power limitation is the actual transmit power from UE between min EIRP and max EIRP.

Qualcomm: As way forward, we try to come up with definition and make formal definition about what the power limitation is and ask for RAN1 what they intend.

Verizon: the question is from RAN1. It is not Ran4 internal. We should add question to ask to RAN1 what panel is. We just understand what it the fundamental requirement.

Samsung: we do understand the concern. The current LS cover concerns. Current version is enough. We just need add the question of panel and power limitation.

Apple: for question 1, we cannot say it is feasible. It will expose the UE implementation.

Agreement:

* Ask the question of definition of panel and power limitation to RAN1.

**2. Date of Next TSG WG RAN4 Meetings:**

TSG-RAN WG4 Meeting #104Bis-e Oct. 2022 online

TSG-RAN WG4 Meeting #105 Nov. 2022 TBD

# Discussion on Question 1

***Question 1****: From RAN4 perspective, is Assumption 1 is feasible?*

Summary from 1st round discussion:

Is assumption 1 (Power limitation per panel for STxMP) feasible? If you think it is not feasible, please further clarify a) it is not feasible from implementation’s perspective or b) it is not feasible from RAN4 current requirement’s perspective

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| **Proposal based on 1st round discussion:** Yes, assumption 1 is feasible. |

*Moderator’s note: Discussion will be transferred to email discussion document at the end of 2nd round, any agreements from discussion will be incorporated into draft LS:*

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| Company | Agree, or include your own reworded proposal here: |
| vivo | The per panel power limitation is feasible but it is hard to be verified under simultaneous Tx condition when both panels are activated, we cannot get a specific mapping relationship between each panel and Pumax/Ptmax. So it may be better to inform RAN1 the per panel power limitation is hard be guaranteed by RAN4 requirement. The suggested wording is :“Yes, assumption 1 is feasible, however it is difficult to have per-panel requirement in RAN in the case simultaneous Tx condition. |
| Xiaomi | Agree the proposal |
| Huawei | First there is no clear definition of “panel” in RAN1 spec, whether a single physical panel or multiple panel that will be used for single TCI state is quite up to UE implementation. Thus we think RAN4 should avoid further misalignment if we rush to a simple feedback in this meeting. From RAN4 perspective, we think it is not feasible from RAN4 current requirement’s perspective given that the regulation is defined per UE. |
| Qualcomm | The LS includes a definition of panel and the answers apply to that. If there is an alternative definition of panel, we can discuss that too.Also it may be useful to differentiate implementation ability from determining a RAN4 requirement. We have not work on this WI and RAN1 know this, so they are not looking for how we would set up a requirement.So we are not aligned with Vivo on this aspect. Perhaps we can break the response to: Assumption 1 is feasible from an implementation perspective. RAN4 have not studied what requirements should apply however. |
| Huawei | We would like to better explain our views.From the regulatory perspective, the max EIRP requirement cannot be violated for the single band single CC case which could be a common understanding after related Rel-17 discussion in RAN4. For STxMP, there could be a risk for violation, e.g. when the angular offset between two Tx beam is relatively small.From implementation perspective, the max TRP requirement was defined by RAN4. Some critical factors like co-existence and thermal issue have been carefully considered for the derivation of this requirement. Like QC has pointed out, RAN4 has not studied on STxMP, thus we think it is inappropriate to directly say that it is feasible. |
| Samsung | We would like to focus on the Q1 itself which is about feasibility of per-panel power limitation. We do not have to consider ‘in-case’ for the reply that shall be based the concrete scenario of STxMP in the later stage. QC’s revision is acceptable. |
| InterDigital | Probably QC’s approach is the right one. |
| Apple | We consider Qualcomm’s suggestion to split the consideration of the question into implementation and requirement feasibility tracks useful. On the implementation side, we understand the question to imply whether potential power control procedures per panel could be feasible; on the requirement size we agree that RAN4 has not yet studied what requirements should apply. One aspect which is quite clear, however, is that regulatory limits and emissions requirements apply to the UE independently of any panel considerations.Our suggested response here would be:RAN4 will discuss further the feasibility and implications of Assumption 1 on UE implementation, as well as what requirements should apply in case of Assumption 1. From the perspective of regulatory and emissions requirements, they apply to the UE independently from Assumption 1. |
| Nokia | Agree with the answer |

# Discussion on Question 2

***Question 1****: From RAN4 perspective, is Assumption 2 is feasible?*

Summary from 1st round discussion:

Most companies agreed with Option 1. At the same time, there are two issues to further discuss: how to sum up the two “EIRP” in different directions and there could be performance issue in the UL.

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| **Proposal based on 1st round discussion:** Yes, assumption 2 is feasible, and the following issues need further study:1. how to sum up the two “EIRP” in different directions.
2. Per panel (or per TCI state) power would be reduced and may affect UL performance.
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*Moderator’s note: Discussion will be transferred to email discussion document at the end of 2nd round, any agreements from discussion will be incorporated into draft LS:*

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| Company | Agree, or include your own reworded proposal here: |
| vivo | Ok with proposal |
| Xiaomi | Agree the proposal |
| Huawei | Agree. |
| IDC | Agree. However, we explained in our contribution that some side conditions may need to be accounted for, |
| Apple  | OK with the proposal |
| Nokia | Agree with FFS that it should be clarified whether this assumption would limit achievable EIRP per panel (in case that both panels are directed in the same direction or in different directions) |

# Discussion on Question 3

***Question 3****: In either of Assumption1 or Assumption 2, 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?*

Summary from 1st round discussion:

Most companies agreed that UE must comply with regulation. The question to resolve is:

When total power limitation per UE over all UE panels used for STxMP or the sum of per-panel power limitation for STxMP exceeds the existing power limitation for a given power class, do we need a new set of requirements to ensure compliance, or is the existing requirement in Clause 6.5 of 38.101-2 sufficient?

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| **Proposal based on 1st round discussion:** RAN4 confirm that existing UE RF requirements are framed so standards compliance implies regulation compliance (clause 6.5x in TS38.101-2). Any additional limitation like the sum over all panels of the per-panel power limitation for STxMP can be chosen to be greater than the existing power limitation for a given power class without consequence to legality. |

*Moderator’s note: Discussion will be transferred to email discussion document at the end of 2nd round, any agreements from discussion will be incorporated into draft LS:*

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| Company | Agree, or include your own reworded proposal here: |
| vivo | The description is only valid for EIRP but it is noted that the TRP is not only related to the legality. However, the TRP value was also proposed not to change, since it was used for co-existence study in R15, which means if the total TRP is larger than current value, the ACIR need be re-evaluated, and the ACS/ACLR requirement will be also impact. so we prefer separate this issue to 2 cases and the suggested wording can be:“RAN4 confirm that existing UE RF requirements are framed so standards compliance implies regulation compliance (clause 6.5x in TS38.101-2). For EIRP, any additional limitation like the sum over all panels of the per-panel power limitation for STxMP can be chosen to be greater than the existing power limitation for a given power class without consequence to legality.For TRP, the sum over all panels of the per-panel power limitation for STxMP is not expected to exceed the existing power limitation for a given power class” |
| Xiaomi | Similar comments with vivo for TRP, support vivo’s modified wording. |
| Huawei | Since only the per UE power limitation is feasible from RAN4 perspective, we think the proposal here should be: The sum over all panels for STxMP cannot be greater than the existing power limitation for a given power class. |
| Qualcomm | I think we made a mistake in the framing of the proposal – the TRP and EIRP limits are guaranteed by the power class definition, not 6.5 as we stated. The power class definition has the same TRP and EIRP limits for all features (CA, ULMIMO) and this is not expected to change for new features. So any UE that declares its power class will automatically comply with regulation and no further limitations are necessary for regulation compliance. We do not see the point of instituting new requirements in RAN4 that achieve the same goal.RAN4 confirm that existing UE power class definitions comply with common regulations for TRP and EIRP (clause 6.2x.1 in TS38.101-2). Any additional limitation like the sum over all panels of the per-panel power limitation for STxMP can be chosen to be greater than the existing power limitation for a given power class without consequence to legality. |
| Huawei | Like we explained for Question 1, we think the following reply to RAN1 is reasonable:In Assumption 2, the total power limitation per UE over all UE panels used for STxMP cannot be greater than the existing power limitation for a given power class. |
| Samsung | Although we understand the concern from vivo, the change from vivo might have confused them even more like the framed power class is actually not framed between EIRP and TRP. QC’s revision is fine for us.  |
| Apple | We agree with the comments that existing power class requirements shall be met by the UE independently of the particular Tx feature, and the first sentence of Qualcomm’s latest comment is fine for us. Regarding the second sentence, we have two concerns: one with with using the term “legality” and the other with the fundamental implication of introducing a power limitation which is greater than the allowed limit by regulatory. What would be the meaning of such a requirement? Since the UE would need to comply with a regulatory emission limit, which is more stringent, why would the loose requirement be in the spec? We think further discussion is needed to understand the kind of requirement we intend to introduce (this was also covered in the answer to Question 1). So our suggestion is to just have the following sentence:RAN4 confirm that existing UE power class definitions comply with common regulations for TRP and EIRP (clause 6.2x.1 in TS38.101-2). |
| Nokia | Agree with Qualcomm’s proposal. In the case 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, there may be a risk with compliance thus a total power restriction for simultaneous UL transmission  |

# Discussion on Question 4

***Question 4****: If both Assumption 1 and Assumption 2 are feasible, 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)?*

Summary from 1st round discussion: (there is overlap with Q3, no dedicated discussion in round 1). Proposal below is constructed from various Tdoc proposals.

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| **Proposal:** The sum of per-panel power limitation is not comparable with total power limitation in the general case. RAN4 confirm that the per-panel power limitation values can be the same as total per-UE power limitation values. Both requirement types can be satisfied simultaneously and the detail can be left to implementation. RAN4 already covers assumption 2 (per-UE power limits) and additional per-UE limits are not necessary for regulation compliance. |

*Moderator’s note: Discussion will be transferred to email discussion document at the end of 2nd round, any agreements from discussion will be incorporated into draft LS:*

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| Company | Agree, or include your own reworded proposal here: |
| vivo | Agree.Actually this description seems quite general, and some of the details may related to previous question. |
| Xiaomi | Agree |
| Huawei | No need for feedback on Question 4 since it is not RAN4 conclusion that both Assumption 1 and Assumption 2 are feasible. |
| Qualcomm | We also think this information is better to convey to RAN1. |
| Samsung | Agree with this general comment. No easy to answer to this question directly but it is useful information to RAN1 for their discussion. |
| InterDigital | Agree with the proposal. |
| Apple | We are OK with this response |