**3GPP TSG-RAN WG4 Meeting # 99-e R4-2107969**

**Electronic Meeting, 19th – 27th May, 2021**

**Agenda item:** 13.2

**Source:** Moderator (OPPO)

**Title:** Email discussion summary for [99-e][159] NR\_reply\_LS\_RF\_Part1

**Document for:** Information

# Introduction

In this paper, the LS to RAN5 on the UL MIMO ON/OFF time mask requirements and to RAN2 on the LS DC location reporting will be discussed.

# Topic #1: UL MIMO ON/OFF time mask

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2108802 | Qualcomm | We propose a reply LS [2].  We further propose CR content as captured in the Annex of this document. |
| R4-2109368 | Qualcomm | **1. Overall Description:**  RAN4 would like to thank RAN5 for the LS on minimum requirements for Transmit ON/OFF time mask in UL MIMO FR1.  The following clarifications are limited to FR1.  The transmit ON power for UL MIMO is defined as the sum of the output powers measured at each transmit antenna connector. ON power applies to any power level bounded by the maximum output power requirement in sub clause 6.2D.1 and the minimum output power requirement in sub clause 6.3D.1.  The transmit OFF power for UL MIMO is defined at each connector, as documented in sub clause 6.3D.2 in TS 38.101-1.  RAN4 confirms the power definitions above apply to the requirements in 6.3D.3. RAN4 will separately clarify the power definitions in section 6.3D.3 consistent with above understanding to address wording ambiguity. |
| R4-2109684 | vivo | **Observation 1**: There is no specific requirement in RAN4 for the “ON” power defined in ON/OFF mask. The intention is to have a reasonable fully operational and steady status.  **Proposal 1**: Clarify there is no inconsistency issue for current definition.  **Observation 2:** RAN5’s current testing method of summing up the powers can be regarded as a methodology are not really contradicting with RAN4’s requirements.  **Proposal 2:** Explicitly feedback to RAN5 that the current RAN5’s test method does not really contradict to RAN4 requirements.  [Draft] Reply LS On minimum requirements for Transmit ON/OFF time mask in UL MIMO FR1 |
| R4-2110805 | OPPO | Observation 1: The time alignment error between connectors (0.13us) is non-neglectable comparing to the transient period especially UEs with small transient period capability (2us tp/0.5us tpstart).  Proposal 1: Keep UL MIMO ON/OFF time mask requirement defined at each antenna connector.  Observation 2: RAN5 test ON/OFF time mask requirement based on OFF power and ON power before and after the transient period. And for UL MIMO the ON power is measured as sum of the antenna connectors.  Observation 3: RAN5 testing method is different from RAN4 core requirement where the ON/OFF time mask requirement is defined based on each antenna connector.  Proposal 2: Reply RAN5 that the ON/OFF time mask is defined at each antenna connector and UE performance of UL MIMO ON/OFF time mask should be judged based on each antenna connector rather than sum of connectors due to the potential time alignment error between antenna connectors.  **[Draft] Reply LS On minimum requirements for Transmit ON/OFF time mask in UL MIMO FR1** |

## 1.2 Open issues summary

### 1.2.1 Sub-topic #1-1

**Issue 1-1-1: Whether time alignment error between connectors (0.13us) will impact the UL MIMO ON/OFF time mask requirement if measured by the sum of power from each antenna connector?**

*Moderator note: This issue is from paper R4-2110805 where the time alignment error between connectors (0.13us) is compared with the transient period capability (2us tp/0.5us tpstart) and conclude that this TAE will cause the UL MIMO ON/OFF time mask inaccuracy if measured by the sum of power for each antenna connector.*

* Proposals
  + Option 1: Yes
  + Option 2: No
* Recommended WF

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| **Company** | **Comments** |
| ZTE | Option 1, UL MIMO ON/OFF time mask requirement impact, but maybe no performance impact.  In our understanding, if a UE indicates a short transient period capability, e.g., 2us, with TAE 0.13us, the sum of power from both connectors may show a transient period a bit larger than 2us, maximum 2.13us. However, the increment may not impact performance since MIMO receiver can tolerate the TAE. |
| Qualcomm | Option 2: No  We appreciate the paper from Oppo.  In our view, the ON/OFF mask requirement remains at 10us regardless of UE declaration, and so the motivation for this proposal does not exist. In an offline Oppo identified another potential ambiguity in wording which suggests 6.3D.3 covers ON/ON as well as on/OFF requirements because of reference to 6.3.3 and not 6.3.3.2. We are ok to limit the scope of 6.3D.3 to 6.3.3.2 to address this ambiguity. |
| OPPO | Option 1, The requirement defined in UL MIMO refers to the 6.3.3 which is the ON/OFF time mask includes general ON-OFF and ON-ON time masks. The time alignment error not impact the general ON/OFF time mask, however, for the ON-ON time masks with the transient period the time alignment error will have impact on them. |
| Xiaomi | If on off time mask is not measured by each connector, the time alignment error should be considered. |
| Huawei, HiSilicon | Option 1. |
| vivo | Conceptually option 1 is more precise, but the actual performance difference is most likely to be neglectable. In addition, for other UL-MIMO output power which scenarios are actually similar to the ON power in the mask, this alignment errors are not considered |

**Issue 1-1-2: Whether the ON power in UL MIMO ON/OFF time mask need to be changed from single antenna connector to sum of antenna connectors?**

* Proposals
  + Option 1: Yes.
  + Option 2: No.
* Recommended WF

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| **Company** | **Comments** |
| ZTE | Option 2. |
| Qualcomm | No. We prefer ON power for ON/OFF mask to remain consistent with output power definition in other places for UL MIMO (sum of measured powers from connectors) |
| OPPO | Option 2 No. |
| Xiaomi | Option 2 |
| Huawei, HiSilicon | Option 2. |
| vivo | Option 2 |

**Issue 1-1-3: Whether the ON power in UL MIMO ON/OFF time mask applies to any power level bounded by the maximum output power requirement in sub clause 6.2D.1 and the minimum output power requirement in sub clause 6.3D.1? If Yes, then whether this needs to be clarified in the spec?**

* Proposals
  + Option 1: Yes, and it needs to be clarified in the spec.
  + Option 2: Yes, but it doesn’t needs to be clarified in the spec.
  + Option 3: No.
* Recommended WF

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| **Company** | **Comments** |
| Nokia | Option 1 |
| MediaTek | Option 1 or 2 is fine. |
| ZTE | Option 2. This is a common sense on the ON power. |
| Qualcomm | We are proponents of option 1, but are willing to discuss if there is a better way. |
| OPPO | No strong view, maybe Option 2 is enough |
| Xiaomi | Either option 1 or option 2 |
| Huawei, HiSilicon | Option 2. We think that the clarification may not be necessary. |
| vivo | Prefer Option 2. Option 1 can also be discussed if some wording is possible. |

**Issue 1-1-4: If choose option 1 in Issue 1-1-3, then does the proposed changes in R4-2108802 is acceptable?**

* Proposals
  + Option 1: Yes, the changes in R4-2108802 is ok.
  + Option 2: No, further changes are needed for R4-2108802.
* Recommended WF

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| **Company** | **Comments** |
| Nokia | Option 2  The proposed changes look good in8802, but it would be better to clarify what ON state means as well. During on state, UE needs to meet all the accompanied requirements according to power level, though some of the requirements must be met regardless of the power level. |
| MediaTek | Option 1 is fine for now. We do not fully understand the final sentence proposed Nokia, it goes beyond defining what the state is, and seems confusing to us to talk about applicability to other requirements in a generic manner. |
| ZTE | Option 2. We think the current specs is clear enough. |
| Qualcomm | Option 1, but we are open to improving the wording, so ok with option 2 also.  In an offline Oppo identified another potential ambiguity in wording which suggests 6.3D.3 covers ON/ON as well as on/OFF requirements because of reference to 6.3.3 and not 6.3.3.2. We are ok to limit the scope of 6.3D.3 to 6.3.3.2 to address this ambiguity. |
| OPPO | For the UL MIMO ON/OFF time mask, in our view, the requirements in the 6.3.3 all apply to UL MIMO. But we can further discuss on this aspect. |
| Xiaomi | Option 2, we think the text “For UE supporting UL MIMO, the ON/OFF time mask requirements in clause 6.3.3 apply at each transmit antenna connector” in current spec shall be kept. |
| Huawei, HiSilicon | Option 2. Clarification seems not necessary. |
| vivo | Option 2. We do not think it is necessary and precise. |

**Issue 1-1-5: Whether RAN4 needs to confirm RAN5 testing method or focus on the RAN4 requirement clarification?**

* Proposals
  + Option 1: Yes, RAN4 confirm RAN5 testing method is ok/not ok
  + Option 2: No, focus on the RAN4 requirement clarification
* Recommended WF

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| **Company** | **Comments** |
| MediaTek | We assume that RAN5 warrants some response from RAN4 once we have agreed what to do. |
| ZTE | Option 2. Testing method is RAN5’s job. |
| Qualcomm | Option 2 |
| OPPO | Option 2. Clarification of RAN4 requirements is enough. |
| Xiaomi | Option 2 |
| Huawei, HiSilicon | Option 2. |
| vivo | Option 1 may reduce further question from RAN5, while Option 2 can also be accepted. |

## 1.3 Summary for 1st round

### 1.3.1 Open issues

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|  | **Status summary** |
| Issue 1-1-1: Whether time alignment error between connectors (0.13us) will impact the UL MIMO ON/OFF time mask requirement if measured by the sum of power from each antenna connector? | Moderator summary:  Majority of companies support Option 1 and one company think Option 1 is more precise and another company think the time alignment error will not impact UL MIMO time mask if change the current requirement from whole ON/OFF and ON/ON time mask to only general ON/OFF time mask.  Change of UL MIMO requirement may need further study, but this is not the main point of this discussion, and conclusion can based on the current requirements.  Therefore, moderator suggest that the Option 1 is agreed, i.e. time alignment will impact the UL MIMO ON/OFF time mask, but it should be noted that if UL MIMO ON/OFF time mask (6.3D.3) is changed to only the general ON-OFF time requirement (6.3.3.2) and no ON-ON requirement then the impact of time alignment error will be neglectable. |
| Issue 1-1-2: Whether the ON power in UL MIMO ON/OFF time mask need to be changed from single antenna connector to sum of antenna connectors? | Moderator summary:  All but one company think the current UL MIMO ON/OFF time mask requirement should be unchanged, i.e. defined at single antenna connector.  Based on the status, moderator feels that changing requirement from single antenna connector to sum of antenna connectors is less likely to be agreed at the moment. And further discussion can still be happen. LS can based on the current requirements, and if further agreements are achieved in future meetings, then it can update with RAN5. |
| Issue 1-1-3: Whether the ON power in UL MIMO ON/OFF time mask applies to any power level bounded by the maximum output power requirement in sub clause 6.2D.1 and the minimum output power requirement in sub clause 6.3D.1? If Yes, then whether this needs to be clarified in the spec? | Moderator summary:  No majority view is shown among Option 1 and Option 2. The consensus is that the ON power in UL MIMO ON/OFF time mask applies to any power level bounded by the maximum output power requirement in sub clause 6.2D.1 and the minimum output power requirement in sub clause 6.3D.1. No conclusion on adding this consensus to spec.  Moderator suggest to not change spec, but inform RAN5 about the consensus above. |
| Issue 1-1-4: If choose option 1 in Issue 1-1-3, then does the proposed changes in R4-2108802 is acceptable? | Moderator summary:  No change is needed according to issue 1-1-3. |
| Issue 1-1-5: Whether RAN4 needs to confirm RAN5 testing method or focus on the RAN4 requirement clarification? | Moderator summary:  Majority support Option 2, i.e. the LS should focus on the RAN4 requirement clarification. And it is suggest to agree on Option 2. |

## 1.4 Discussion on 2nd round

### 1.4.1 Open issues

**Issue 1-1-6: Whether UL MIMO ON/OFF time mask (6.3D.3) should be changed to from referring to clause 6.3.3 to clause 6.3.3.2 (general ON-OFF time mask) and no ON-ON requirement apply to UL MIMO?**

Option 1: Yes

Option 2: No

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| Moderator note:  This is the follow up discussion of issue 1-1-1, one company propose to change the UL MIMO requirement from all the ON-OFF and ON-ON requirement in clause 6.3.3 to only ON-OFF requirement in clause 6.3.3.2. |

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| **Company** | **Comments** |
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**Issue 1-1-7: Comments on content of “*Reply LS On minimum requirements for Transmit ON/OFF time mask in UL MIMO FR1*”**

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| **Company** | **Comments** |
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### 1.4.2 Companies views’ collection for 2nd round

[OPPO]:

Dear all,

This email is to trigger the discussion on the LS to RAN5 about the UL MIMO ON/OFF time mask. The contents can be found in bellow link and also reproduced below for your reference. If there is any changes needed please comment below for fast exchanges and also upload the changed version. Thanks!

Draft R4-21xxxxx Reply LS of UL MIMO ON OFF time mask-v1.0

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| **1. Overall Description:**  RAN4 would like to thank RAN5 for the LS on minimum requirements for Transmit ON/OFF time mask in UL MIMO FR1 and would like to give following clarification on the minimum requirements for transmit ON/OFF time mask for UL MIMO.  Transmit ON/OFF time mask requirements for UL MIMO are defined at each antenna connector and refers to TS38.101-1 clause 6.3.3 which defines the transient periods allowed for following cases   * between transmit OFF power and transmit ON power * between continuous ON-power transmissions with power change or with RB hopping   It is RAN4 understanding that the potential time alignment error between antenna connectors might have impact on UL MIMO transmit ON/OFF time mask accuracy if measured as sum of antenna connectors especially for UEs with small transient period capability introduced in Rel-16.  **2. Actions:**  **To RAN5:**  **ACTION:** RAN4 respectfully asks RAN5 to take the above into consideration. |

[QC]:

We are not sure we should confirm ‘per connector’ without defining what the per connector ON power is. Everywhere else in the standard, for UL MIMO, output power is defined as sum of measured powers at the connectors.

Further, how do we intend to accommodate Rel-16 TxD UEs, which is also part of Rel-16? We have to accommodate the case of a UE that decides not to transmit on both connectors autonomously. Finally, we do not want to include speculative information ‘….might have impact on…’

We hope to get other company views in case we have missed something.

[OPPO]:

Thanks for your comments! Please find some of our understandings below inline.

We are not sure we should confirm ‘per connector’ without defining what the per connector ON power is. Everywhere else in the standard, for UL MIMO, output power is defined as sum of measured powers at the connectors.

[OPPO] In our understanding, the ON/OFF time mask requirement itself is time rather than power levels and this is same as the single antenna port ON/OFF time mask where no definition of ON power actually. And there will be no “per connector” power in the ON/OFF time mask requirement. The discussion of ON power is just because of RAN5 testing the time mask based on power levels before and after the time mask. So our understanding is that the time mask applies to any power levels below power class, and how to apply power levels in testing is RAN5 issue. Besides, the OFF power now is per connector based requirement, so when evaluate ON/OFF time mask maybe per connector based is more aligned?

Further, how do we intend to accommodate Rel-16 TxD UEs, which is also part of Rel-16? We have to accommodate the case of a UE that decides not to transmit on both connectors autonomously. Finally, we do not want to include speculative information ‘….might have impact on…’

[OPPO] In conformance testing both antenna connectors will have powers transmitted and this has been discussed for a long time in TxD feature, and this will be left to RAN5 in TxD. Regarding the “might have impact on” this is because it depends on UE, if no TAE for a UE then no impact, otherwise there will be impact. If there is better wording to make it more clear, it is welcomed.

[QC]:

Your comments were helpful in understanding your view.

* This missing sentence is the crux of the issue: ‘So our understanding is that the time mask applies to any power levels below power class, and how to apply power levels in testing is RAN5 issue'

RAN5 have specifically asked about how to interpret ‘ON’ power which is defined everywhere else as ‘sum of connector powers’, but in 6.3D.3 we want RAN5 to use it in a per-connector sense. The detail is what needs to be included in the LS – we have to explain what we mean in the requirement. We can decide separately if we want to include this clarification in the standard.

* We have a different understanding than ‘In conformance testing both antenna connectors will have powers transmitted and this has been discussed for a long time in TxD feature’

As we mentioned earlier, a UE may autonomously choose to not transmit from one antenna port in transparent TxD. In that case, the TE has no way of knowing if it is testing the output of the ‘correct’ connector. A UE may experience false failures on the connector it chooses not to transmit on.

In the version below, we have removed information that is not new or conveys no information, and added wording to accommodate the transparent TxD case, which is to clarify RAN4 understanding of UL MIMO transmitter power.

[Link to LS with cm](https://apc01.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.3gpp.org%2Fftp%2Ftsg_ran%2FWG4_Radio%2FTSGR4_99-e%2FInbox%2FDrafts%2F%255B99-e%255D%255B159%255D%2520NR_reply_LS_RF_Part1%2FRound%25202%2FLS%2520on%2520UL%2520MIMO%2520ON%2520OFF%2520mask%2FDraft%2520R4-21xxxxx%2520Reply%2520LS%2520of%2520UL%2520MIMO%2520ON%2520OFF%2520time%2520mask-v1_QC.doc&data=04%7C01%7Cxingjinqiang%40OPPO.COM%7C056118e958c94205e95108d91ed5f94b%7Cf1905eb1c35341c5951662b4a54b5ee6%7C0%7C0%7C637574727799556278%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000&sdata=q17eqsZ%2BhiljTEovmecyCSZdMlc9k4J7ZO6AF3NOiaA%3D&reserved=0)

**1. Overall Description:**

RAN4 would like to thank RAN5 for the LS on minimum requirements for Transmit ON/OFF time mask in UL MIMO FR1 and would like to give following clarification on the minimum requirements for transmit ON/OFF time mask for UL MIMO.

RAN4 confirms that the transmit ON/OFF time mask requirements for UL MIMO are defined at each antenna connector. ~~and refers to TS38.101-1 clause 6.3.3 which defines the transient periods allowed for following cases~~

* ~~between transmit OFF power and transmit ON power~~
* ~~between continuous ON-power transmissions with power change or with RB hopping~~

The per-connector OFF power is defined in 6.3D.2. The per-connector ON power is defined as any power level such that the sum of the measured powers from both connectors:

* meets or exceeds the minimum output power limit as described in sub-clause 6.3D.1
* complies with the requirements of sub-clause 6.2D – transmitter power for UL MIMO
* RF requirements not referenced here also apply (6.4D, 6.5D, etc.)

~~It is RAN4 understanding that the potential time alignment error between antenna connectors might have impact on UL MIMO transmit ON/OFF time mask accuracy if measured as sum of antenna connectors especially for UEs with small transient period capability introduced in Rel-16.~~

**~~2. Actions:~~**

**~~To RAN5:~~**

**~~ACTION:~~** ~~RAN4 respectfully asks RAN5 to take the above into consideration.~~

[OPPO]:

Thanks for the feedback, and the proposed wording is helpful in reaching consensus. Please find further clarification feedbacks/question below.

Regarding the wording of LS, I understand your point, and agree that the clarification of ON power is needed. About the wording, maybe it is better to use the already agreed wording in the 1st round to save the efforts for further alignment, i.e. “the ON power in UL MIMO ON/OFF time mask applies to any power level bounded by the maximum output power requirement in sub clause 6.2D.1 and the minimum output power requirement in sub clause 6.3D.1”.

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| **1. Overall Description:**  RAN4 would like to thank RAN5 for the LS on minimum requirements for Transmit ON/OFF time mask in UL MIMO FR1 and would like to give following clarification on the minimum requirements for transmit ON/OFF time mask for UL MIMO.  RAN4 confirms that the transmit ON/OFF time mask requirements for UL MIMO are defined at each antenna connector. ~~and refers to TS38.101-1 clause 6.3.3 which defines the transient periods allowed for following cases~~   * ~~between transmit OFF power and transmit ON power~~ * ~~between continuous ON-power transmissions with power change or with RB hopping~~   The per-connector OFF power is defined in 6.3D.2. The per-connector ON power is defined as any power level such that the sum of the measured powers from both connectors are bounded by the maximum output power requirement in sub clause 6.2D.1 and the minimum output power requirement in sub clause 6.3D.1   * ~~meets or exceeds the minimum output power limit as described in sub-clause 6.3D.1~~ * ~~complies with the requirements of sub-clause 6.2D – transmitter power for UL MIMO~~ * ~~RF requirements not referenced here also apply (6.4D, 6.5D, etc.)~~   ~~It is RAN4 understanding that the potential time alignment error between antenna connectors might have impact on UL MIMO transmit ON/OFF time mask accuracy if measured as sum of antenna connectors especially for UEs with small transient period capability introduced in Rel-16.~~ |

[QC]:

I think there was a comment in round 1 (Nokia, in 1-1-4) that pointed out that other Tx requirements also have to be met by ON power ‘During on state, UE needs to meet all the accompanied requirements according to power level, though some of the requirements must be met regardless of the power level'.

This is the reason I suggested a more thorough description of ON power, and why our earlier proposal below may not suffice.

Also, would like your thoughts on this scenario:

In the case of transparent TxDiv, if the UE configures itself for output through only one of its connectors, the TE may not see ON power in the other connector. Should the UE be considered non-compliant if it passes on one connector, but has no meaningful power on the second? We may need to treat this aspect also – so now we need to think about defining a valid minimum per-connector ON power which the TE can use to decide whether to apply the requirement to one connector or both.

[OPPO]:

Thanks for your continue feedback. And regarding the requirements have to be met by ON power, we have the same understanding and in our view this is always the case. In RAN5, the Tx requirements are tested by the ON power worst case, i.e. max power, so there is no reason that UE can meet them in max power but cannot meet in lower power. If this happens, then for other cases in lower power may also need to be tested, for example in RAN5 they usually test the power control, EVM, etc. under low power, mid power and high power situations, but only focus on the requirement itself.

Therefore, there is no need to worry about the other Tx requirements in ON power state 

Regarding the scenario of TxD, it is really interesting, and it might happen in the field (even not quite clear of the situation and why UE do that but it is up to UE). However, in the conformance testing, we don’t expect this will happen since in the conformance testing UE is tested under predefined situation, i.e. two Tx transmit. If UE cannot transmit with two Tx and only one Tx could transmit, then it should not be TxD but in single antenna transmission. Maybe this is more suitable to be discussed in RAN5 about the test procedures and test verdicts.

Updated LS as below.

[Draft R4-21xxxxx Reply LS of UL MIMO ON OFF time mask-v1\_QC\_OPPO](https://apc01.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.3gpp.org%2Fftp%2Ftsg_ran%2FWG4_Radio%2FTSGR4_99-e%2FInbox%2FDrafts%2F%255B99-e%255D%255B159%255D%2520NR_reply_LS_RF_Part1%2FRound%25202%2FLS%2520on%2520UL%2520MIMO%2520ON%2520OFF%2520mask%2FDraft%2520R4-21xxxxx%2520Reply%2520LS%2520of%2520UL%2520MIMO%2520ON%2520OFF%2520time%2520mask-v1_QC_OPPO.doc&data=04%7C01%7Cxingjinqiang%40OPPO.COM%7Cb8c36baa7cbc4b84f03708d91f489c0d%7Cf1905eb1c35341c5951662b4a54b5ee6%7C0%7C0%7C637575220099433998%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=Zm0LDcn7QlwYiMeEeK0Xcq9FLc9ZFmZ8CmchT2oAjbc%3D&reserved=0)

[QC]:

I think I would be ok to not list all the Tx requirements.

 On transparent TxD, single Tx transmit is not a corner case. A competitive UE would only turn on its 2nd PA when a single PA is unable to support the required power. This behavior will carry over to conformance testing, and unless transparent  TxD is precluded, we have to consider single Tx output in UL MIMO mode. It is not a RAN5 consideration, we need to first have a clear idea on what the requirement should be.

[OPPO]:

Thanks for your further clarification. The scenario is valid that 2nd PA doesn’t transmit until the 1st PA cannot achieve the desired power. And if this happens then this will also exists in sum power case, and no information can be seen in the 2nd PA. However, if tested by each antenna connector, then RAN5 can make UE transmit in 1st PA then in 2nd PA to see both can meet the requirement or only test 1st PA, this is up to RAN5. This gives more information than the sum power approach.

Above is the thinking for the time being, hope could clarify a little bit.

[QC]:

The problem is that for transparent TxD, the TE or the network does not have control on which PA transmits. So this is not possible: ‘then RAN5 can make UE transmit in 1st PA then in 2nd PA to see both can meet the requirement or only test 1st PA, this is up to RAN5'.

We may need to define a concept of valid ON power range per connector so TE can autonomously decide whether a connector has valid output, or we may be forced to go back to ‘sum power’ approach rather than the ‘per connector’ approach.

[OPPO]:

I think the discussion regarding the TxD is somehow out of scope of this UL MIMO discussion . In TxD, it was decided that the testing related topics are moved to RAN5 like the power split, UE antennas transmitting, etc. So that’s why in our view this is not what we should discuss here. And even we change to sum of power, the ambiguous of one PA transmit but the other doesn’t is still there and no way to distinguish them.

In current version of LS as below, there is no mention about testing, so how to measure like sum or each antenna connector is up to RAN5, this should not be decided in RAN4. And actually in RAN4 ON/OFF time mask there is no “ON power” defined, then how can we define the ON power for each antenna connector? 



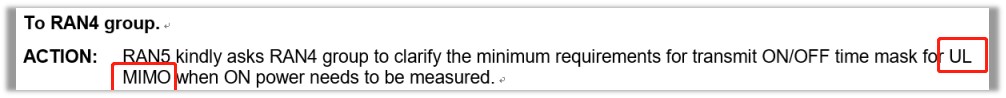
[QC]:

How is transparent TxD out of scope? We need to understand at least amongst ourselves what the requirement should be. I don’t think it is right to hand this off to RAN5 without a clear understanding ourselves.

Also we disagree with this statement: ‘And even we change to sum of power, the ambiguous of one PA transmit but the other doesn’t is still there and no way to distinguish them.' In this case, TE does not look at per connector power, so the condition will be satisfied with one or both connectors transmitting. It is robust to UE choice.

[OPPO]:

Correct me if I am wrong, the LS from RAN5 is only about the UL MIMO and action is as below, and also the referred section in RAN5 LS is 6.3D.3 which are both UL MIMO. And the thread is for UL MIMO ON/OFF time mask. So all the discussion here is for UL MIMO. The discussion of TxD is not within the scope.



We understand the intention of involving TxD, but this should be discussed in TxD and figure out the requirements there. Hope this is clear.

[QC]:

I too hoped we could have an easy way out of this 😊

I think it is fairly clear for Rel-15, what you said is true. For Rel-16 however, D-suffix includes ULFPTx, which in turn includes mode 2 (transparent TxD). In our understanding, all D suffix requirements apply for single layer or 2 layer configurations, as long as *nrofSRS-Ports*=2.

So, I do not share your view that transparent TxD is out of scope in UL MIMO.

[OPPO]:

Understand your point of Rel-16 UL MIMO issues, however that is not the target of this Rel-15 LS. To make it clear and move forward, how about adding some clarification information like below to address your concern? If wording is not proper, please suggest some wording. But according to the discussion, changing the requirements from per connector to SUM might not be the choice from majority companies.

|  |
| --- |
| **1. Overall Description:**  RAN4 would like to thank RAN5 for the LS on minimum requirements for Transmit ON/OFF time mask in UL MIMO FR1 and would like to give following clarification on the minimum requirements for transmit ON/OFF time mask for UL MIMO.  RAN4 confirms that in Rel-15 the clause 6.3D.3, i.e. transmit ON/OFF time mask requirements for UL MIMO are defined at each antenna connector. The per-connector OFF power is defined in 6.3D.2. The per-connector ON power is defined as any power level such that the sum of the measured powers from both connectors are bounded by the maximum output power requirement in sub clause 6.2D.1 and the minimum output power requirement in sub clause 6.3D.1.  RAN4 also would like to clarify that the ON/OFF time mask requirement for UE with Tx diversity is still under discussion, RAN4 will inform RAN5 with that if conclusions are made in Rel-16. |

[QC]:

Just to clarify, I am not pushing for one solution over another, it is about deriving the requirement for all applicable cases through logical arguments.

Your solution below is a good one – as long as we remember to fix this problem also along with other open items in TxD.

[ZTE]:

For the sentence "The per-connector ON power is defined as any power level such that the sum of the measured powers from both connectors are bounded by the maximum output power requirement...",  it implies to me that the power ratio between two connectors can be anything.

Imagine in an ON/OFF time mask test of a UE for UL-MIMO, if one of RF chains is broken, and the other RF chain works, the UE actually can still pass the test for the time mask according to the sentence above, as long as there is a working branch. Is this acceptable? Or I misunderstood something?

[QC]:

Yes, the bit you highlighted was constructed so the UE has some flexibility in the relative power levels.

I appreciate your comment – according to how the requirement seems to be converging, a UE with a broken connector could pass the ON/OFF mask requirements, but other tests will catch the problem, like EVM, max output power, etc. On whether it is ok – valid question 😊

If we want this broken-connector UE to fail the mask test also, perhaps we are back to having to define per-connector max. and per-connector min. ON powers also.

[ZTE]:

Thanks for your response.

If it is acceptable for everyone that a UE with a broken connector passes the time mask test, and the issue can be identfied by other tests eventually, it is ok to me.

However if keeping as it is now, we may need to convey this information to RAN5 in the reply LS and keep them aware of this potential issue in the time mask test.

[vivo]

Thanks for  all the discussions and we are generally fine with the latest on-going version of the feedback, in which the per-connector ON power is retained, with some clarification on a range of sum of power.

With the concept and applicability of “transparent TxD”, our view is that the current requirements being discussed are separated from UL full power transmissions which is grouped into UL-MIMO.

For Aijun’s question, I share some of the previous comments that it may not necessary to require “broken RF chain” would be verified by this ON/OFF mask requirement.

[OPPO]

For the question of broken RF chain, actually it is hard to imagine this kind of UE can pass RAN4 requirements since there are many requirements are checked at each antenna connector. So for UL MIMO with [1, 0; 0, 1] codebook configured the two branches will both transmit and ON/OFF mask will be tested under this condition.

The “any power level” means that the ON/OFF time mask need to be met in any power levels at each antenna connector. Hope this clarifies.

[Draft R4-21xxxxx Reply LS of UL MIMO ON OFF time mask-v2](https://apc01.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.3gpp.org%2Fftp%2Ftsg_ran%2FWG4_Radio%2FTSGR4_99-e%2FInbox%2FDrafts%2F%255B99-e%255D%255B159%255D%2520NR_reply_LS_RF_Part1%2FRound%25202%2FLS%2520on%2520UL%2520MIMO%2520ON%2520OFF%2520mask%2FDraft%2520R4-21xxxxx%2520Reply%2520LS%2520of%2520UL%2520MIMO%2520ON%2520OFF%2520time%2520mask-v2.doc&data=04%7C01%7Cxingjinqiang%40OPPO.COM%7Cafe364e5314e497c256308d91fe7d53c%7Cf1905eb1c35341c5951662b4a54b5ee6%7C0%7C0%7C637575904810198743%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=PFL8DvIZ8IplXCfF9f0Xy2VrC6wHFCKlDB3UzOuO7BQ%3D&reserved=0)

[OPPO]

Formal version has been uploaded.

[https://www.3gpp.org/ftp/tsg\_ran/WG4\_Radio/TSGR4\_99-e/Inbox/R4-2107904.zip](https://apc01.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.3gpp.org%2Fftp%2Ftsg_ran%2FWG4_Radio%2FTSGR4_99-e%2FInbox%2FR4-2107904.zip&data=04%7C01%7Cxingjinqiang%40OPPO.COM%7C605c560e7f2f448e019208d91ffe3dd6%7Cf1905eb1c35341c5951662b4a54b5ee6%7C0%7C0%7C637576000453015690%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=SeYqV3ZgA3qyHtxEoGd9iYRx4TKYf3n1nk5RUSZs1Zo%3D&reserved=0)

[ZTE]:

Thanks for your clarification.

In my view, in the current wording, only the power sum is bounded to the specified (min,max), but not to the value measured at each connector.

Surely other tests will identify a "broken UE". The point is whether or not to allow the "broken UE" passes ON/OFF time mask test, and it is RAN5's job and totally up to RAN5, e.g., if RAN5 does not allow, RAN5 might do something to avoid this in their test design.

What we could do is to remind RAN5 that a broken UE may still be able to pass the ON/OFF time mask test, by conveying the information to RAN5 in the reply LS, which is relevent and could be helpful in their test design for ON/OFF time mask.

### 1.4.3 Summary on 2nd round

The LS R4-2107904 is agreeable.

# Topic #2: DC location reporting for intra-band UL CA

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2111390 | HW | **Proposal 1: we propose Answers to the 2 issues in the LS:**   * **Answer 1:** **RAN4 confirms the DC location reporting does not need to consider SUL in the case of intra-band UL CA.** * **Answer 2: RAN4 confirms the use case of UE reporting Tx DC location info for the second PA (when the UE supports dual PA) when the SCell is deactivated, is not needed.** |

## 1.2 Open issues summary

### 1.2.1 Sub-topic #2-1

**Issue 2-1-1: Does DC location needs to be reported for SUL in the case of intra-band UL CA?**

* Proposals
  + Option 1: Yes
  + Option 2: No
* Recommended WF

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | Option 2, not needed. |
| MTK | Option 2, not needed. |
| Huawei, HiSilicon | Option 2, not needed. |
| OPPO | Option 2 |
| Xiaomi | Option 2 |

**Issue 2-1-2: Whether UE needs to report Tx DC location info for the second PA (when the UE supports dual PA) when the SCell is deactivated?**

* Proposals
  + Option 1: Yes.
  + Option 2: No.
* Recommended WF

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| --- | --- |
| **Company** | **Comments** |
| ZTE | Option 2, not needed. |
| MTK | Option 2, not needed. |
| Qualcomm | Option 2, however, it should be noted that the text in the proponents paper “For alt-2, if Scell is deactivated, the LO for 2nd PA will be moved with the 1st PA, because the 2 RF chains share the LO for this case. There is also no need to report the LO for 2nd PA.” is not correct. The LO will not move with 1st PA but will remain where it was based on 2 PA configuration. This has no impact on the proposal. |
| Huawei, HiSilicon | Option 2, not needed. To QC, understood, for this case whether LO moves depends on UE implementation. Could moderator allocate a new T-doc for our reply LS? |
| OPPO | Option 2. |
| Xiaomi | Option 2 |

## 1.3 Summary for 1st round

### 1.3.1 Open issues

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| --- | --- |
|  | **Status summary** |
| Issue 2-1-1: Does DC location needs to be reported for SUL in the case of intra-band UL CA? | Moderator summary:  Option 2 is agreed, i.e. DC location doesn’t needs to be reported for SUL in the case of intra-band UL CA |
| Issue 2-1-2: Whether UE needs to report Tx DC location info for the second PA (when the UE supports dual PA) when the SCell is deactivated? | Moderator summary:  Option 2 is agreed, i.e. UE doesn’t need to report Tx DC location info for the second PA (when the UE supports dual PA) when the SCell is deactivated |

## 1.4 Discussion on 2nd round

### 1.4.1 Open issues

**Issue 2-1-3: Comments on content of “*Reply LS on DC location reporting for intra-band UL CA*”**

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| --- | --- |
| **Company** | **Comments** |
|  |  |

### 1.4.2 Companies views’ collection for 2nd round

### 1.4.3 Summary on 2nd round

No comment received. The LS in R4-2107903 is agreeable.

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| Reply LS on DC location reporting for intra-band UL CA | Huawei | To: RAN2 |
| Reply LS On minimum requirements for Transmit ON/OFF time mask in UL MIMO FR1 | OPPO | To: RAN5 |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-2108802 | ON/OFF time mask inconsistency issue | Qualcomm | Noted |  |
| R4-2109368 | Reply LS On minimum requirements for Transmit ON/OFF time mask in UL MIMO FR1 | Qualcomm | Noted |  |
| R4-2109684 | Discussion and reply LS On minimum requirements for Transmit ON/OFF time mask in UL MIMO FR1 | vivo | Noted |  |
| R4-2110805 | Reply LS of UL MIMO ON OFF time mask | OPPO | Noted |  |
| R4-2111390 | Reply LS to RAN2 on DC location | Huawei | Noted |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-2107904 | Reply LS On minimum requirements for Transmit ON/OFF time mask in UL MIMO FR1 | OPPO | Agreeable |  |
| R4-2107903 | Reply LS on DC location reporting for intra-band UL CA | Huawei | Agreeable |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents