**3GPP TSG-RAN WG4 Meeting # 98-e R4-21XXXXX**

**Electronic Meeting, 25th January– 5th Febuary, 2021**

**Agenda item:** 7.19.1

**Source:** Moderator (CMCC)

**Title:** Email discussion summary for [98e] [111]\_UE transient period

**Document for:** Information

# Introduction

This email discussion includes contributions in agenda 7.19.1, the targets of email discussion based on companies’ contributions submitted in this e-meeting are as below:

* 1st round:

Provide comments on the CR and discuss the testability issues.

* 2nd round:

Discuss left open issues for 2nd round and strive to approve CR.

# Topic #1: Testability of transient period capability

*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** |
| [**R4-2101460**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101460.zip) | Qualcomm Incorporated | **We propose to define new EVM measurement windows that are designed specifically for each transient period. This will enable precise testing with minimum impact on the test equipment.**  |
| [**R4-2101484**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101484.zip) | Qualcomm Incorporated | **Adding the newly defined shorter transient periods. Resubmission of endorsed Draft CR R4-2011766** |
| **R4-2102629** | Huawei, HiSilicon | **Observation 1: From real channel measurements, TR 38.901 provide up to 9.9us max tap delay span for some Scenarios, which is much larger than CP length.****Observation 2: considering multi-UE scenario, gNB take the FFT window including 10% CP length(i.e. excluding 90% CP). It can ensure 90% CP used for anti-multipath delay spread and UEs’ UL transmission timing difference be considered.** **Observation 3: For Long delay spread scenario, taking FFT window with 50% CP length has much impact on UL performance caused by multi-path delay spread.** **Proposal 1: For 2us shorter transient, define the time mask as: 0.5us in left symbol and 1.5us in right symbol, i.e. the tpstart is -0.5us.** **Proposal 2: For 4us shorter transient, define the time mask as: 1us in left symbol and 3us in right symbol, i.e. the tpstart is -1us.** **Proposal 3: For 7us shorter transient, define the time mask as: 2us in left symbol and 5us in right symbol, i.e. the tpstart is -1us.** **Observation 4: Asymmetrical transient period position is already existed from Rel-15.** **Observation 5: Large power change case cannot be ignored. Further discuss on testability on large power change range issue.****Proposal 4: Values of tpstart for transient period starts before the transmission boundary for type 1 and type 2 as specified in table1 respectively. Type1 and type2 is declared by UE.****Proposal 5: EVM metric for shorter transient is [8%] for 256QAM, [10%] for 64QAM.** |
| **R4-2102684** | Huawei, HiSilicon | **Introduce tpstart as the start line of shorter transient.** |

## Open issues summary

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

### Sub-topic 1-1 CR on introduction of shorter Transient Period Capability

Issue 1-1-1

* CR on introduction of shorter Transient Period Capability
	+ Option 1: If introduce tpstart, define the value for tpstart as in R4-2102684.
	+ Option 2: Shorter transient periods for On-On time mask is introduced and current time masks are clarified that they apply to 10us transient period (From R4-2101484)
* Recommended WF
	+ TBA. Collect companies’ view in 1st round

### Sub-topic 1-2 Testability issues for Transient period

**Issue 1-2-1: For RMS EVM over 1 symbol, how to define EVM measurement procedure in the spec**

* Proposals: defined the procedure as proposed in R4-2101460
* Recommended WF
	+ TBA. Collect companies’ view in 1st round

**Issue 1-2-2: Whether 20dB power change can represent the maximum power change in the network, if not, whether TE can provide the test condition for the maximum power change**

* Proposals
	+ Option 1: 20 dB power step is reasonable for on-on power change.
	+ Option 2: >55dB Large power change range case cannot be ignored.
* Recommended WF
	+ TBA. Collect companies’ view in 1st round

**Issue 1-2-4: Whether RMS EVM with DFT-OFDM measurement similar with LTE can be tested for transient period**

* Proposals
	+ For a transient period/placement that exceeds the CP length, the transient period will be longer than the CP and a similar approach with the current LTE methodology has to be used (only DFT-s-OFDM can be used and some time domain samples have to be removed) in R4-2101460.
* Recommended WF
	+ TBA. Collect companies’ view in 1st round

 **Issue 1-2-5 How to calculate EVM for symbols in which the transient occurs**

* Proposals
	+ Option 1: Test procedure detail that needs to be discussed in RAN5.
	+ Option 2: Transient period is different for ramp up and ramp down, it should be clearly clarified.
	+ Option 3: The EVM should be measured on the last and first symbol and averaged over multiple instances. Also, EVM can be measured on all other symbols against the legacy values based on the legacy measurement windows.
* Recommended WF
	+ TBA. Collect companies’ view in 1st round

 **Issue 1-2-6 EVM budget for symbol where the transient occurs**

* Proposals
	+ Option 1: Keeping EVM budget in square brackets. EVM values can be discussed after agreement is reached on the feasibility of testing transient periods.
	+ Option 2: EVM requirement should decide based on simulation results which can meet network performance on high order modulation. Initiate EVM simulation to evaluate network performance.
* Recommended WF
	+ TBA. Collect companies’ view in 1st round

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| Qualcomm | Issue 1-1-1: we are fine with the introduction of Type 1 which was proposed in the last meeting. We do not think it is a good idea to have two types because the base station cannot optimize the receive window for a certain type of UEs since there will be multiple UEs in the network. There is a corresponding text proposal in R4-2101460 capturing tpstart in the requirements.Option 1 and Option 2 here are not necessarily exclusive. Issue 1-2-1: This is our proposal. We believe the new measurement window should make testing very clear.Issue 1-2-2: This has been discussed for multiple meetings. We already showed multiple times that Option 2 is not a valid network configuration. The analysis in 2629 has the same flaws as previous submission from the same company. It is claimed that IBE is better than 30dB without any evidence even though the spec is a lot more relaxed than this. Also, in the example given is based on some parameters that are not always true and the noise floor is not considered. What would happen if the UE transmitting PUSCH is not so close to the base station and the SNR of the transmission is low? PUCCH SIR will be much lower than -1dB.As we already commented and shown in our papers, 20dB is reasonable from a system point of view and also is enough to ensure the functionality is properly tested.Issue 1-2-4: we support the proposal, this is the same methodology used alreadyIssue 1-2-5: with the new testing window we believe this is very clear. Option 3 should enable very clear testing of this feature.Issue 1-2-6: The values in [] in 1460 have been proposed for a long time. If there were problems, the discussion should have started a long time ago. The proposals in 2629 are too relaxed for 256QAM, this will make the feature useless. They are also based on some assumptions that are not clear, for example if a UE that has a transient of 4.3us should not claim 4us transient period if it won’t meet the requirement. We would prefer to keep the numbers in our proposal or have a mix. |
| Anritsu | Issue 1-1-1: Option 1’ - It looks that R4-2102684 without the description of Type 2 in Table 6.3.3.1-1 is describing the latest proposal of R4-2101460. Could be the compromise between two contributions.Issue 1-2-1: Support the proposal in R4-2101460.Issue 1-2-4: Support the proposal in R4-2101460.Issue 1-2-5: Support option 3.Others: As for the text proposal at the Annex in R4-2101460, we would like to suggest replacing EVMl\_new and EVMh\_new by EVMl\_tp and EVMh\_tp as described in sub-clause 2.3 in R4-2101460. |
| Ericsson | Issue 1-1-1: In a sake of progress, we could compromise introducing the asymetric window and specifying tp\_start for the new smaller transient periods. But, to avoid any additional signalling, we prefer then having only asymetric window (type 1 only). The 2 options are acceptable together.Issue 1-2-1: support proposal in R4-2101460.Issue 1-2-4: support proposal in R4-2101460.Issue 1-2-5: option 3Issue 1-2-6: From the very beginning, we agreed to keep the EVM values in [] and focus on the other aspects of this CR. Let’s then agree this CR first keeping the values in [] for this meeting. |
| Skyworks | Overall, we are looking forward to closing this item and we only have questions for clarification on the benefits of introducing Type 1 tpstart. One concern with using tpstart to (assymetrically) shift the transient period into the first symbol of the following slot (Type 1), is the protection of the first symbol of the “post-event” slot/sub-slot. For type 1, in the case when the first symbol of the slot carries a DM-RS symbol (cf. R4-1909940), we have some concerns on the impact of a high peak EVM on DM-RS demodulation. To the best of our knowledge, contrary to the first symbol of a slot, the last symbol of a slot may not carry a DM-RS symbol. Also, it is our understanding that in general there are more PUSCH symbols in a slot than there are DM-RS symbols. So, to us, from an uplink system performance perspective, it is perhaps more acceptable to impact a PUSCH symbol than a DM-RS symbol, or perhaps balance the impact of the transient peak EVM. We raise the question for clarification purposes only. We would welcome feedback from RAN vendors on the aspect of DM-RS symbol integrity.Issue 1-1-1: When Skyworks proposed the concept of tpstart in RAN4#96-e, this was motivated to address the mismatch between the edges of the created EVM measurement exclusion period (via several FFT proposals (e.g. R4-2011523), vs the edges of the theoretically centered transient period. In R4-2102684, Type 1 tpstart is re-used to introduce a significant transient period asymmetry. Question for clarification: for either Type 1 or Type 2 tpstart, what is the proposal to create an EVM exclusion period that matches the proposed transient periods? Issue 1-2-1: We need time to check if R4-2101460 FFT proposals address the question raised in issue 1-1-1,Issue 1-2-4: We have concerns with this proposal. The baseline assumption from the beginning of this capability has been that, no matter which test methodology is to be agreed, the impact of transients must be verified for CP-OFDM. Issue 1-2-4 appears like a sudden “U-turn” on this baseline. The focus has always been to ensure UE CP-OFDM performance can be verified. Issue 1-2-5: option 3 – As discussed in 1-2-1, details of the R4-2101460 proposed Annex may need minor changes to specify how both EVM is verified in all symbols of the slot.Issue 1-2-6: If anything, the benefits of a UE with faster transients should not result in increasing the peak EVM performance initially proposed in [ ]. |
| Qualcomm | To Skyworks:UL DMRS is not always in the first symbol, we touched on this in the paper from the last meeting. With the asymmetric placement, the only problem could be with 7us, for 2 and 4 the transient should still be within the CP so it would have minimum impact. Even with 7us, the impact would not be any worse than the current 10us. Optimizing this even further for DMRS transmission would be difficult to do.In Issue 1-1-1, our proposal is to set the EVM exclusion period exactly based on tpstart. The proposal should be flexible enough to accommodate any position of the exclusion period.For Issue 1-2-4, isn’t this the same problem that we already have from Rel.15 with CP-OFDM? In theory this could also be tested with CP-OFDM but it would be more difficult. Nonetheless, we are open to have this discussion to fine tune the testing for 7us.Related to the topics discussed in GTW and highlighted by the moderator:EVM measurement exclusion period: our proposal can accommodate the type 1 tpstart, this is already captured in our proposed TPIssue 1-2-2: Huawei is insisting that the power change is possible but still hasn’t provided any good argument even this has been discussed for a long time. In the example in 2629, the UEs seem to be very close to the base station because the UL SNR is very high. What happens if the UE are mid-cell or closer to the cell edge and the UL SNR for the UE transmitting PUSCH is ~15dB? In our understanding the network parameters should work for all UEs in the cell.Issue 1-2-6: An upper bound for the symbol EVM can be calculated based on the assumptions that in half a slot there are 7 symbols and 2 of them can contain transients(1st and last). The UE would still have to meet the legacy EVM across this half a slot so if we assume even a 0% EVM for the symbols without a transient, we can obtain the upper bound for the EVM with the symbol containing the transient. This should be ~ 6.5% for 256QAM and ~15% for 64QAM. Considering that 0% EVM for the symbols without transients is not possible, 5% and 10% were proposed. We are fine to discuss numbers tighter than this but more relaxed numbers do not make sense. |
| Huawei | To Skyworks:We used to have a paper on the relation between SCS and shorter transient. Actually, if we target on the matching TP with the gNB FFT window to optimize the demodulation performance, some shorter transient is not applicable for larger SCS. Such as 7us is not suitable for 30kHz, even with symmetrically position.As Qualcomm commented, DMRS could be configured not in the 1st symbol of one slot. But it still depends on SCS deployment.For front loaded DMRS, 2us and 4us transient would be almost within the CP. Since we have some conclusion during GTW, we will focus on the WF:1. We agree to introduce New EVM window. But the EVM window proposed by QC is not applied to all SCSs. We may need some limitation on the SCS usage for the new EVM window and shorter transient capability. For example, for 4us 30kHz SCS, 3us new exclusion window on the right symbol exceed CP.
2. Power change range, we provide data from 3 vendors on PUCCH/PUCCH P0 configuration. This is considering PUCCH has a lower demod threshold, P0 is not configured as much as PUSCH. The SNR of PUSCH need assumption on cell radius, PL and BS noise floor. I need time to check with data from field. However, such power change range is captured in the real network, this is why we raise it into RAN4. We would like to know from QC, whether 20dB is the maximum power change in real network in your understanding.
3. For EVM value for symbols with transient, data from QC in R4-1916016, for power change every 7 symbols and power change every 14 symbols the degraded EVM is different, 5% and 6.5% respectively. We are not sure about the exclusion window used for this measurement (however it is captured in R4-1916016 it assumes symmetrical position). This is why we say this requirement is highly related to the slot pattern and exclusion window we used, and the 3 issues should be in one package CR. We may need align with the measurement condition firstly. Actually, making this value close to 3.5% may cause larger indicated transient considering the transient response can be lasted for a long time and the unstable is just close to 0 but not really 0.
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### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

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| **CR/TP number** | **Comments collection** |
| [**R4-2101484**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101484.zip) | Company A |
| Company B |
|  |
| **R4-2102684** | Anritsu: As written at the open issue part above, this CR without the description of Type 2 in Table 6.3.3.1-1 can be a base to reflect proposals in R4-2101460 and R4-2102629.  |
| Company B |
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## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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|  | **Status summary**  |
| **Sub-topic#1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

*Recommendations on WF/LS assignment*

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|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

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| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |