**3GPP TSG-RAN WG4 Meeting # 96-e R4-2011552**

**Electronic Meeting, 17-28 Aug., 2020**

**Agenda item:** 7.19.1

**Source:** Moderator (CMCC)

**Title:** Email discussion summary for [96e] [119]\_UE transient period

**Document for:** Information

# Introduction

In RAN4#95-e meeting, RAN4 discussed the feasibility of testing transient period capability and WF was agreed in last meeting (R4-2008477)：

* ***“Option 4 is agreed:*** *RF requirement on transient period capability (section 6.3.3 for on-on time mask ) is introduced in Rel-16. The testability discussion will continue in TEI16 to address the existing issues 1-1-1 to 1-1-10. RAN4 will decide which release to apply the transient period test to UEs once the testability discussion is concluded”*

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:

Discuss the testability issues and provide comments on the CR and LS.

* 2nd round:

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

# 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** |
| **R4-2010915** | Qualcomm Incorporated | **Observation: ~55dB power change between transmission cannot be a typical scenario for real deployments. 20dB should be used for this test.** |
| **R4-2011475** | Huawei, HiSilicon | **Proposal 1: RAN4 agrees to define the relation between UE supported SCS and transient period capability requirement as in Table 1 when implementing RF requirement into TS 38.101-1.**  **Table 1. relation between UE supported SCS and transient period capability requirement**   |  |  | | --- | --- | | UE Supported SCS | Transient period capability requirement | | 15kHz | 7us, 10us | | 30kHz | 4us, 10us | | 60kHz | 2us, 10us | | 15kHz and 30kHz | 7us ,4us and 10us | | 15kHz and 60kHz | 7us ,2us and 10us | | 30kHz and 60kHz | 2us, 4us and 10us | | 15kHz, 30kHz and 60kHz | 2us,4us ,7us and 10us |   **Proposal 2: Transient period capability requirement is specified symmetrically which should be within the time window of the default 10us transient period. It can be seen as below figure:** |
| **R4-2011523** | Skyworks Solutions Inc. | **Proposal 1: To minimize impact on legacy test equipment, the EVM definition that leads to an effective EVM exclusion period shall rely solely on the legacy FFT\_low, FFT\_high measurement windows.**  **Proposal 2: 1μs UE capability is not needed as it brings no benefit to operation at any FR1 SCS (15,30 or 60kHz)**  **Proposal 3: To align as closely as possible the UE declared ‘tp’ with the effective EVM ‘ep’ width, introduce UE ‘tp’ capability of 2.2, 4 and 7.5μs with the set of EVM definitions proposed in Table 3:**  Table 3 EVM definition set counter-proposal to verify UE 'tp' capability declaration   | Counter proposal | | | Evaluation Results | | | | | | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Calculated EVM exclusion period boundaries (μs) | | | Measured EVM exclusion period boundaries (μs) | | | | Reported transient capability (μs) | EVM definition | SCS  (kHz) | Lower Edge | Upper Edge | Exclusion  Period  “Width” | Lower Edge | Upper Edge | Exclusion  Period  “Width” | | 1 | Capability not needed | | | | | | | | | 2.22 |  | 60 | -0.878 | 1.400 | **2.278** | ≈ -0.9 | ≈ +1.2 | ≈**2.1** | | 4 |  | 30 | -1.758 | 2.279 | **4.036** | ≈ -1.7 | ≈ +2.2 | ≈ **3.9** | | 7.5 |  | 15 | -3.515 | 4.036 | **7.552** | ≈ -3.5 | ≈ +4.0 | ≈ **7.5** | | NOTE 1: , , are defined in Annex F  NOTE 2: μs capability is restricted to UEs supporting SCS 60kHz | | | | | | | | |   **Proposal 4: Since 2.2μs ‘tp’ capability brings no benefit to operation at SCS 15kHz or at SCS 30kHz, introduce 2.2μs ‘tp’ capability as being restricted to UEs supporting SCS60kHz.**  **Proposal 5: If no capability is signaled, the default transient period value of 10μs applies and the UE is tested against legacy static EVM requirements only.**  **Proposal 6: When a UE signals a transient period capability, the UE must pass 2 core requirements using time-mask in** Figure 1**:**   * **For the each PUSCH symbols where the transient occurs:**    + **rmsEVM shall not exceed [10%] for 64QAM and [5%] for 256 QAM.**   + **The rms average of the basic EVM is averaged over [108] subframes for each symbol where the transient occurs,** * **For the remaining PUSCH symbols where the transient does not occur:**   + **rmsEVM shall not exceed [8%] for 64QAM and [3.5%] for 256QAM (Table 6.4.2.1-1 requirements),**   + **The rms average of the basic EVM is averaged over [12] subframes.**   **Proposal 7: : When a UE signals a transient period capability, the static EVM does not need to be verified since it is verified in symbols where the transient does not occur (see proposal 6).**  **Observation 8: All measurements presented in this paper verified all EVM definitions using off the shelf commercial NR EVM meter equipment. This proves there are no testability issues.** |
| **R4-2010916** | Qualcomm Incorporated | **RAN4 has discussed the introduction of shorter transient periods and agreed to introduce a new capability for the transient period of 2, 4 or 7us. The UE can support one of these transient periods. If the UE does not signal the support of any value then it will support the legacy value of 10us.**  **Actions to RAN 2:**  **RAN4 respectfully asks RAN2 to take the above agreement into account and define a new UE capability accordingly.** |

## 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 Testability issues for Transient period

**Issue 1-1-3: For RMS EVM over 1 symbol, how to define EVM measurement procedure in the spec**

* Proposals
  + Option 1: Adding a new section/annex for EVM to include symbols with transient period.
  + Option 2: It is not an issue whether we create a new section in TS 38.101, we should ensure the procedure could be correct, aligned among TE vendors, high-precision.
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 1-1-4: 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: no, power change>20dB is common case under real network. If the reference power change for transient period is 20dB, it will have performance impact on network, if the reference power change for transient period is worst case(e.g.58dB), how UE vendor get known our capability without reliable test environment.
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 1-1-5: How to ensure the transient period is symmetrically positioned**

* Proposals
  + Option 1: The exclusion window is defined be symmetric about the symbol boundaries. Symmetric exclusion window has been specified from Rel-15 in TS 38.101-1.
  + Option 2: Need a baseline on how to position transient period.
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 1-1-7: Whether RMS EVM with DFT-OFDM measurement similar with LTE can be tested for transient period**

* Proposals
  + Option 1: There is not a case that we need to remove the influence of transient period with DFT-s-OFDM symbol during the EVM calculation process.
  + Option 2: no. There is not test on transient period for LTE, 25us exclusion window is specified. The concept cannot be used for transient period test.
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 1-1-9: 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.
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 1-1-10: 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.
* Recommended WF
  + TBA. Collect companies’ view in 1st round

### Sub-topic 1-2 CR on introduction of shorter Transient Period Capability

* Proposals
  + Shorter transient periods for On-On time mask is introduced and current time masks are clarified that they apply to 10us transient period ([R4-2010914](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010914.zip))
* Recommended WF
  + TBA. Collect companies’ view in 1st round

### Sub-topic 1-3 LS to RAN2 on Shorter Transient Period Capability

* Proposals
  + RAN4 has discussed the introduction of shorter transient periods and agreed to introduce a new capability for the transient period of 2, 4 or 7us. The UE can support one of these transient periods. If the UE does not signal the support of any value then it will support the legacy value of 10us.
  + RAN4 respectfully asks RAN2 to take the above agreement into account and define a new UE capability accordingly.
* Recommended WF
  + TBA. Collect companies’ view in 1st round

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| Ericsson | Sub topic 1-1:  As mentioned in previous meetings:  Issue 1-1-3: option 1  Issue 1-1-5: option 1  Issue 1-1-7: option 1  Issue 1-1-10: option 1  Sub topic 1-2:  Skyworks made another proposal to specify EVM requirement based on the CR initially proposed, which looks also correct. The transient period values specified in their proposal would also be acceptable to us. As both mehtods look relevant, the choice in between those 2 methods to measure the EVM requirements for transient testability might be done based on implementation complexity for TE.  Sub topic 1-3  This LS shall be sent but it should be revised to add this new capability is per band.  ….  Others: |
| Qualcomm | Sub-topic 1-1:  Issue 1-1-3: Option 1 is preferred. These options do not seem to be exclusive of each other. We of course have to ensure that the procedure is correct and TE vendors agree it is feasible to implement  Issue 1-1-4: Option 1. In our paper we pointed out very clear reasoning on why 58dB should not happen in a real network. 20dB is enough to have a meaningful test.  Issue 1-1-5: Option 1. We can define the measurement window position and this will ensure that transient period is symmetric.  Issue 1-1-7: The issue here is not clear, I believe we already asked for clarifications on what the problem is. The proposed test procedure is excluding the transient period from the measurement window. RMS EVM for each symbol will be tested.  Issue 1-1-9: Option 1. If there is something that is not clear enough such that RAN5 can define the test, it should be pointed out and resolved. The transient period is excluded from the measurement. How the power changes inside this window should not matter.  Issue 1-1-10: Option 1. If someone wanted to propose something else, they had plenty of time to present a counter proposal.  Sub-topic 1-2:  The proposed CR is based on the agreement from the last meeting about exactly which part of the original CR should be agreed for the specs. We are opened to make further clarifications as needed.  Sub-topic 1-3: We can revise the LS or add the feature in the bigger UE feature list discussed in the dedicated thread. We agree that the capability should be per band so that can be revise(this was actually proposed in the feature list discussion). We saw that there are some “fine-tuning” proposals to slightly modify the transient period, we do not think this should be done and we should stick with the proposal that was the base of the agreement in the last meeting. We can further modify the test procedure such that the exact transient period is tested. |
| Huawei | Sub-topic 1-1:  Issue 1-1-3: Option 2. Until now, we don’t see any consensus or standard on the measurement procedure.  Issue 1-1-4: Option 2. Please QC check the P0 configuration for PUSCH and PUCCH respectively. The demodulation threshold is different for PUS and PUCC on gNB side. Different P0 configuration is reasonable.  Issue 1-1-5: Option 2. When measurement exclusion window is symmetrically, but generally gNB do not take FFT window with an symmetrical way. When measurement and gNB implementation is different, how could UE implement with its transient period starting point?  Issue 1-1-7: The problem is: People thinks 1 symbol RMS EVM measurement can just follow LTE measurement procedure defined in TS 36.521, that is not correct. That measurement is based on the assumption the exclusion period is long enough for UE to have stable EVM.  Issue 1-1-9: Option 1.  Issue 1-1-10: Option 2. If we need to decide on the symbol level EVM, simulation can be planned in TEI 16.  Sub-topic 1-2:  See comments in CRs part.  Sub-topic 1-3: we prefer the LS can include the information on the SCS dependency of transient period capability. And the values need to be indeed follow Skyworks proposal. |

### 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** |
| **R4-2011475** | Skyworks:  Proposal 1: we do not agree. From the beginning of these discussions, the transient period capability has been defined per band of operation, with currently discussed 2,4,7usec (R4-2010914), or 2.2, 4, 7.5usec (R4-2011523) or if the UE does not signal any capability, then tp= 10usec as a default transient capability.  Proposal 2: We are confused by what appears to be a contradiction between main body text and proposal 2.  Could you clarify the proposal?  Main body text says “So, it is proposed **to not specify** transient period capability requirement **symmetrically** positioned on the boundary, ….”  P2 says: “*Transient period capability requirement* ***is specified symmetrically*** *which should be within the time window of the default 10us transient period”.* |
| Qualcomm:  We do not agree with the limitations on transient period and SCS that are proposed included in proposal 1. The agreement from last meeting was that we introduce 2, 4 and 7.  For proposal 2, the transient period should be symmetric around the symbol boundary. This transient does not apply only to the first symbol of the slot but also to other symbols of short slots are used. Also, there is no concrete proposal on where exactly the transient should be place. |
| Huawei: To SKWs, P2 is with a mistake, we would like ‘tp’ is not limited symmetrically but need to limit within 10us window, and the 10us window is symmetrically allocated as in Rel-15. This give UE freedom to optimize the transient period implementation for real gNB.  For P1, if UE do not support SCS=60kHz, how we verify on 2us tp for this UE? Then it is allowed to report 2us for such UE because this capability is not possible to verify. |
|  | Skyworks:  To Qualcomm: We are proposing 2.2,4 and 7.5 only to match the UE declared capability value with the value or “width” of the effective EVM exclusion period. We are ok to adopt 2,4,7 as previously discussed as long as:   1. For 4usec UE capability, the EVM definition is corrected. We propose to adopt , verified at SCS 30kHz. This creates an EVM exclusion period which is nearly centred at slot/symbol boundaries, and with a width of approximately 4.036usec, ie with a good “accuracy” compared to the UE declared capability of 4usec, 2. For 2usec UE capability, we can reach consensus on an EVM definition that delivers the best compromise between EVM exclusion period width ‘accuracy’, complexity with regards to FFT measurement windows, and choice of SCS. Our understanding is that in R4-2010915, the EVM exclusion period width is approximately 1.693usec for 2usec capability (verified at 30kHz SCS using ). There are other possible EVM definitions that have been discussed in previous meetings that rely on mandatory support SCS that could be adopted for 2usec, but with different accuracy. We are open to adopting the proposed definition in R4-2010915.   To Huawei: Thank you for the clarification.  About the rationale for proposing 2.2usec verified at SCS 60kHz using , was to rely solely on legacy FFT windows and yet, with that constraint, propose an EVM definition that leads to a reasonably accurate EVM exclusion width, ie not too wide, or not too narrow. Our proposal creates an EVM exclusion period of 2.278 usec vs 2usec UE capability and does not introduce new FFTs. That was the driver for proposing this 2.2usec capability as optional to UEs that supported SCS60 only. But as discussed above, our main concern is technical correctness, so we are open to keep 2usec capability and to adopt EVM definition of R4-2010915. |
| [**R4-2010914**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010914.zip) | Skyworks: About the proposed time-masks where ‘tp’ replaces the default 10μs (sub-clause 6.3.3):  We believe the proposed time masks need an additional time mark/ time stamp which specifies the start position of the EVM exclusion period. This is needed to ensure UE / chipset vendors have a clear indication on the timing instant where the UE may trigger its transient.  For time-mask correction: we propose to add this “new” time label on the horizontal axis, for example by adopting a “new” time-label entitled “tpstart” – see encircled sketch proposal below.    For core requirements, we propose to capture “tpstart” in a new column in the table that contains the EVM exclusion period definition. The table below is an example of this proposal based on the EVM definition set from R4-2010915. The unit to represent “tpstart” and the number of digits could be further discussed.   | Reported transient capability (μs) | EVM definition | SCS  (kHz) | tpstart  (μs) | | --- | --- | --- | --- | | 2.22 |  | 60 | -0.878 | | 4 |  | 30 | -1.758 | | 7.5 |  | 15 | -3.515 | | NOTE 1: , , are defined in Annex F  NOTE 2: μs capability is restricted to UEs supporting SCS 60kHz | | | |   Apple: We have no objection on introducing this feature and capability but would like to know the network behaviors when UEs signal different transient periods. Would the network process the UL signal differently or the difference is only on the resource scheduling side. On the other hand, do we expect Figure 6.3.3.6-4 and Figure 6.3.3.9-3 to look differently when tp is less than 10 s, i.e., without blanked symbol in between SRS or short sub-slot. |
| Qualcomm: to Skyworks: First of all, we think we should stick to the originally proposed values fo 2,4 and 7.  If the measurement window is clear defined then we believe it is clear for a designer where the transient should be placed but we can also introduce such a table if other companies also think it is necessary needed.  To Apple: we believe that if the quality of the UL signal will improve then automatically BLER will improve(less re-transmissions). Also, the outer loop of the scheduler should take care of changing MCS to achieve lower BLERs and increase capacity. Network vendors are probably in a better position to reply.  We were not thinking of any additional changes since these would have a bigger impact on the network side also but this can be discussed in the future. |
| Huawei: we prefer time mask definition as in R4-2011475. Additionally, The 2.2, 4, 7.5 tp proposed by SKWs is correct. The reason already provided before. |
| Skyworks: to Huawei, we believe the proposed fine tuning to the time mask is necessary to clarify the location of the EVM exclusion period edges, ie where is the lower edge using “tp\_start” and where is the upper edge. The upper edge can be calculated using tp\_start + EVM exclusion period width. |
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| **R4-2010915** | Skyworks: we agree with the observation.  In sub-clause 6.4.2.1a, as discussed in our document R4-2011523,   1. We make counter proposal for 4usec UE capability EVM definition, as commented previously in two previous RAN4 meetings. 2. We make counter proposal to change the rmsEVM averaging over [70] subframes to account for the number of symbols over which EVM is measured, 3. We make counter proposal to [15]% requirement for symbols where the transient occurs and 64QAM. 4. We make counter proposal to avoid introducing a new EVM measurement in Annex F4. |
| **Hauwei** | Do not agree with observation, vendors can check the P0 configuration under real 5G network. No gNB vendor configure same P0 for PUCC and PUS. |
| **R4-2011475** | We were also very confused with proposal 2 from Huawei. Is it Huawei’s intention to specify an asymetric transient period now? This would mean UE would need to not only notify its transient period length, but also how this traisnet period is splitted in between 2 consecutive symbols (how long it in previous symbol and how long it is in following symbol). This additional complexity in UE design doesn’t look needed to us. |
| **R4-2010916** | It should also be mentioned in the LS that the new transient capability is per band. |

## 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”* |