**3GPP TSG-RAN WG4 Meeting #97-e R4-2016958**

**Electronic Meeting, 2nd – 13th November, 2020**

**Agenda item:** 7.19.1

**Source:** Moderator (CMCC)

**Title:** Email discussion summary for [97e] [114]\_UE transient period

**Document for:** Information

# Introduction

In RAN4#95-e and RAN4#96-e meetings, RAN4 discussed the feasibility of testing transient period capability, WF and Draft CR were agreed in last meeting (R4-2008477, R4-2011766)：

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

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2014489**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014489.zip) | Qualcomm Incorporated | **In this paper we further discussed the testing issues related to the newly introduce transient periods. 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.** |
| [**R4-2016516**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016516.zip) | Huawei, HiSilicon | **Proposal 1: Specify tpstart for shorter transient period as in table 1.**  **Proposal 2: Further discuss test method based on tpstart definition.**  **Observation 1: Large power change case cannot be ignored. Further discuss on testability on large power change range issue.**  **Proposal 3: Initiate the simulation discussion on symbol level EVM evaluation.** |

## 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

* How gNB take the FFT window
  + Option 1: take FFT window as in R4-2016516
  + Option 2: others
* Recommended WF
  + TBA. Collect companies’ view in 1st round

Issue 1-1-2

* Proposals
  + Introduce tpstart as the start line of shorter transient, the reason is provided in R4-2016516.
* Recommended WF
  + TBA. Collect companies’ view in 1st round

Issue 1-1-3

* Proposals
  + - Option1: If introduce tpstart, define the value for tpstart as in R4-2016516
    - Option2: positioning the transient as close as possible to the symbol boundary is the simplest approach that will offer the best performance in practice. (From R4-2014489)
* 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 R4-2014489
* 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: 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. The calculation is provided in R4-2016516.
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 1-2-3: How to ensure the transient period is symmetrically positioned: discuss in Issue 1-1**

**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 of 7us and 30kHz SCS, 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). But new EVM window is needed. (R4-2014489)
* 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.(R4-2014489)
* 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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 1-1-1:  Issue 1-1-2:  ….  Others: |
| Qualcomm | Issue 1-1-1: gNB will receive signals from multiple UEs with slightly different timings. From each UE it will receive multiple copies of the same signals with different delays. It’s impossible to know a priori where exactly the gNB FFt window will be relative to the UE symbol timing. It is also impossible for the gNB to optimize the FFT window for all the UEs and having different window for each UE is not feasible(would mean as many receivers as UEs at the gNB receiver). As such, we do not think it’s possible for the UE to optimize it’s transient period relative to the gNB FFT timing. R4-2016516 just shows 2 UEs and no fading at the receiver, no clear analysis of how it would be possible to make optimizations in practice. Hence, the only good solution on the UE side is to have a symmetric transient period. If we were to pick an option, it would be option 2 but this discussion doesn’t seem to make much sense in this context.  Issue 1-1-2: We are fine to introduce tpstart but it should be with a symmetric transient as we commented in Issue 1-1-1.  Issue 1-1-3: The proposal in R4-2016516 is arbitrarily picking some numbers, there is no analysis on how those numbers were derived. A similar proposal was shown in the last meeting but Huawei hasn’t replied to the questions raised during the meeting. As commented in Issue 1-1-1, we do not see how it’ possible to optimize the transient placement on the UE side to match the gNB. Option 2 is the only possibility  Issue 1-2-1: The proposal in R4-2014489 is very clear and isolates the transient.  Issue 1-2-2: The analysis in R4-2016516 is flawed, it assumes an IBE of 30dB but the tightest in the specification is 25dB for high order modulation and even more relaxed for other modulations. This automatically takes PUCCH to -6dB and this does not consider inter-cell interference, power control errors or the noise floor. These comments were already made in the last meeting but Huawei has not responded in the 2nd round to the questions raised. Issue should be closed.  Issue 1-2-4: If there is any issue with this methodology, we are open to discuss.  Issue 1-2-5: Option 3. This issue has also been discussed over multiple meetings, it should be closed as there were no valid arguments raised for other options.  Issue 1-2-6: EVM has been proposed for a long time, there was plenty of time for any company to challenge the values or present analysis on why a different value should be chosen. Proposals to reconsider this late are just delaying the process. WE are open to discuss the value between the current value in the specification for the modulation order and the proposed relaxed values (for example for 256 QAM, any value between 3.5 and 5% would be acceptable). Relaxing beyond these values would make the entire requirement useless and such a UE would likely not pass the legacy requirements either. |
| Anritsu | Issue 1-2-1: We are fine with the proposed way in R4-2014489. In addition to the way to define measurement procedure in the spec, EVM calculation with the new FFT window position in R4-2014489 can be implemented along with other legacy FFT windows. We have a small suggestion on the name of EVM with the new FFT window position in R4-2014489. We suggest using EVMl\_tp and EVMl\_tp instead of EVMl\_new and EVMh\_new to express the new EVM more specifically.  Issue 1-2-2: Since the real network behavior is out of our expertise, we would leave the discussion of the possible maximum power change to others. But as we already commented before, the possible power change that test equipment can measure between on to on states is still 20 dB maximum.  Issue 1-2-4: Same understanding with the proposals. |
| Ericsson | Issue 1-1-1: It has never been our intention to optimize the gNB FFT window for each individual UE, this would be too complex, we don’t think we have ever mentioned this possibility.  Issue 1-1-2: We could introduce tp\_start if it clarifies and if justified, as long as it’s fixed values specified in 38.101, but this might not be needed if the transient window is perfectly symetric.  Issue 1-1-3: As Qualcomm mentioned, there is no rationale for the proposed values in option 1, we so prefer option 2 for now.  Issue 1-2-1: We support the proposal, feasibility has been confirmed by TE people.  Issue 1-2-2: That has been extensively discussed in past meetings, option 1.  Issue 1-2-4: this is our understanding.  Issue 1-2-5: option 3. This proposal checks the transient period value and the EVM requirement for the other symbols not impacted by the transient.  Issue 1-2-6: option 1 |
| Skyworks | Issue 1-1-1: we share Ericsson’s view.  Issue 1-1-2: On the introduction of tpstart:  Skyworks suggested the introduction of tpstart at RAN4 #96e to account for the fact that the discussed EVM exclusion periods were not symmetrical at slot boundaries due to inherent cyclic prefix length differences between CP of pre-event slot last symbol and first symbol CP of post-event slot. In our view, tpstart is only needed for such cases. We agree with Qualcomm that transient periods should be symmetric, in which case the introduction of tpstart is not adding much value as it becomes redundant with tp.  Issue 1-1-3: Option 2.  We initially proposed tpstart at RAN4 #96e because we also proposed a set of EVM definitions which created slightly assymetric EVM exclusion periods. Based on the EVM exclusion lower edge/upper edge border analysis, we even proposed some examples of tpstart values that were justified based on the discussed EVM definition set. In R4-2016516, there are no EVM definition proposed, and no such analysis is presented, hence making tpstart proposals difficult to agree.  Issue 1-2-1: We are glad to hear that test equipment is able to handle both legacy and new EVM FFT measurement windows for a given symbol. With that aspect clarified, we are fine with introduction of new measurement windows dedicated to symbols where the transient occurs. This enables verification of both EVM due to transients and legacy EVM in remaining symbols in a single test. To us this is key to minimizing the impact of this feature on test time/cost.  Issue 1-2-2: This item has been discussed several times, including several face to face ad-hoc sessions in Reno 2019, option 1.  Issue 1-2-5: Option 3 based on our proposals at RAN4 #96e. This is key to verifying that effects such as long thermal drift do not impact the remaining symbols of the slot.  Issue 1-2-6: Option 1. |
| Huawei | Issue 1-1-1: gNB take the FFT window based on the first tap with the lowest delay, it will be close to the right side of CP, i.e. exclude all CP.  For other taps with higher delay they are naturally with FFT window within the EVM window RAN4 defines. The distance between FFT windows for first tap and other taps depends on real channel model.  For LOS mode, it is the most importance scenario gNB need to handle with, it is with the first tap as the strongest tap on power. So putting EVM window for gNB side is not unpredictable. To get the biggest gain from gNB FFT window, UE should position transient period totally on the 2nd symbol on the boundary. The benefit is: it is definitely save the 1st symbol, and the 2nd symbol also can be demodulated if transient within the CP. So the choice of UE position on transient period in R4-2014489 is not economical.  Issue 1-1-2: yes, the tpstart should embody the asymmetrical of transient position.  Issue 1-1-3: the reason is provided as above.  Issue 1-2-1: we would like to discuss on time mask firstly. If tpstart is introduced, we believe new EVM window on the symbol capturing transient is needed.  Issue 1-2-2: there is always transmission loss and antenna isolation between UEs. And generally UE IBE is better than 30dBc.  Issue 1-2-4: we would like to discuss on time mask firstly. If tpstart is introduced, we believe new EVM window on the symbol capturing transient is needed.  Issue 1-2-5: we would like to discuss on time mask firstly. If tpstart is introduced, we believe new EVM window on the symbol capturing transient is needed.  Issue 1-2-6: 5% EVM for the symbol with the transient is just raised providing with the UE measurements. Our intension is to get the gain from shorter transient, but after exclude the transient part, the EVM seems much higher than normal EVM. We would like to know, with such EVM requirement, whether the performance gain can be reached? Whether there is performance loss when UE indicates on shorter transient but with 5% EVM or even worse EVM? What is the EVM on the 1st symbol to reach the same performance? |

### 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** |
| [**R4-2014490**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014490.zip) | Company A |
| Company B |
|  |
| [**R4-2016517**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016517.zip) | Company A |
| Company B |
|  |

## 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#1-1** | *Tentative agreements:*  *Sub-topic 1-1-3 CR on introduction of shorter Transient Period Capability*   * Candidate options   + - Option1: If introduce tpstart, define the value for tpstart as in R4-2016516 (Huawei).     - Option2: Positioning the transient as close as possible to the symbol boundary is the simplest approach that will offer the best performance in practice (From R4-2014489)（Qualcomm, Ericsson, Skyworks）.   *Recommendations for 2nd round:*  *[Moderator]: Based on 1st round of comments collection, it seems all companies are OK to introduce the Tpstart. Moderator recommend further discussion on TPstart. and whether 2 sets of TPstart values could be introduced by UE declaration.*  *The testability open issues for transient period can be further discussed on 2nd round discussion..* |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **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*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| [R4-2014490](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014490.zip) | *Return to* |
| [R4-2016517](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016517.zip) | *Recommend to be revised* |

## Discussion on 2nd round (if applicable)

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| --- | --- |
| **Sub-topic#1-1** | **Issue 1-1-3 CR on introduction of shorter Transient Period Capability**   * Proposals   + - Option1: If introduce tpstart, define the value for tpstart as in R4-2016516 (Huawei).     - Option2: Positioning the transient as close as possible to the symbol boundary is the simplest approach that will offer the best performance in practice (From R4-2014489)（Qualcomm, Ericsson, Skyworks）. * Recommended WF   + - Option2 |
| **Sub-**  **topic# 1-2** | **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 R4-2014489 * Recommended WF   + - defined the procedure as proposed in R4-2014489   **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: 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. The calculation is provided in R4-2016516. * Recommended WF   + TBA.   **Issue 1-2-4: Whether RMS EVM with DFT-OFDM measurement similar with LTE can be tested for transient period**   * Proposals   + Option1: For a transient period of 7us and 30kHz SCS, 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). But new EVM window is needed. (R4-2014489) * Recommended WF   + Option1   **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.(R4-2014489) * Recommended WF   + Option3   **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   + Option1 |

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| **Company** | **Comments** |
| XXX | Issue 1-1-1:  Issue 1-1-2:  ….  Others: |
| Qualcomm | Issue 1-1-3: As we commented earlier, we think only Option 2 is viable.  Huawei commented that the gNB FFT window will try to optimize for the 1st tap but the gNB is receiving signals from multiple UEs at the same time so it will be close to impossible to optimize the FFT window for the channel of any single UE. The placement of the window is fixed and gNB will try to control the timing of all UEs such that they fall withing the receive window.  As the transient placement cannot be optimized because of all these variables, the best way is still to have it symmetric. Huawei hasn’t shown any kind of analysis on how to optimize the placement and what the gains are.  Issue 1-2-1: the proposal in R4-2014489 should alleviate all concerns in terms of testability because it clearly captures the signal outside the transient period.  Issue 1-2-2: we commented several times that ~55dB is not possible based on current specs. Huawei is quoting some numbers without any proof. The IBE spec is 25dBc for 256QAM and more relaxed(emissions are higher) for lower order modulation. Parameters in a cell cannot be configured only based on such transmissions (UL 256QAM is probably not even supported by many UEs). We believe those numbers quoted by Huawei from deployments are used in practice with fractional power control(parameter alpha is configured in the cell) but the configuration for this parameter was never shown. What is also not clear is whether there is anything not tested in practice with 20dB change. The gain state of the PA is changed anyway.  Issue 1-2-4: Option 1 is the only proposal  Issue 1-2-5: Option 3, the best way to test the capability is to measure the EVM on the symbols in which it occurs.  Issue 1-2-6: Option 1. We are open to any value between the proposed values and the current EVM values in the specifications(e.g. 3.5% for UL 256QAM) |
| Ericsson | Issue 1-1-3: We agree with the recommended WF, we think option 2 is the best approach. Option 1 would introduce extra complexity for a performance improvement which would need further justification, the proposed adaptation algorithm is also questionable, As commented in 1st round, it has never been our intention to optimize the gNB FFT window for each individual UE.  Issue 1-2-1: Agree with the recommended WF.  Issue 1-2-4: Agree with the recommended WF, option 1.  Issue 1-2-5: Agree with the recommended WF, option 3.  Issue 1-2-6: Agree with the recommended WF, option 1. Final EVM values should be further discussed. |
| Huawei | Issue 1-1-3: We do not agree with the recommended WF.  As explained the FFT window gNB use in the 1st round, gNB only take one FFT window regardless of UE reaching time. But the timing difference between UEs is not too large, but the delay caused by different taps in the channel model would be relative considerable.  GNB vendors need first focus on the LOS channel, while the lowest delay is in the first tap. According to this, gNB implementation position the FFT window in the right side of CP, i.e. the CP is almost excluded. The gain is, we can protect the previous symbol with 100% ensure. But of symmetrical position, the 2 symbols on the boundary may be both impacted.  To be a compromise, we can accept to introduce 2 types of UE, one is with TPstart as shown in our paper, and the other is the symmetrical. Such type could be declared by UE capability.  Issue 1-2-1: we would like to discuss on time mask firstly. If asymmetrical tpstart is introduced, we believe new EVM window on the symbol capturing transient is needed.  Issue 1-2-2: QC do not consider UE to UE distance and antenna isolation between UEs. It is impossible power between 2 UEs are with no loss.  Issue 1-2-4: we would like to discuss on time mask firstly.  Issue 1-2-5: we would like to discuss on time mask firstly. If asymmetrical tpstart is introduced, we believe new EVM window on the symbol capturing transient is needed.  Issue 1-2-6: No simulation in RAN4 showed what is an appropriate EVM required for the symbol occurred with transient. From UL performance, or from EVM threshold, or from the potential gain gNB can get? |

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| **CR number** | **Comments collection** |
| **[R4-2014490](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014490.zip)** | Company A |
| Company B |
|  |
| **[R4-2016829](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014490.zip)**  **(Rev of [R4-2016517](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016517.zip))** | Company A |
| Company B |
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## 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”* |