**3GPP TSG-RAN WG4 Meeting # 98-bis-e R4-210xxxx**

**Electronic Meeting, 12th – 20th April, 2021**

**Agenda item:** 12.1

**Source:** Moderator (Nokia)

**Title:** Email discussion summary for [98-bis-e][227] LS\_reply\_R1-2102245\_IIoT\_URLLC

**Document for:** Information

# Introduction

*Briefly introduce background, the scope of this email discussion (e.g. list of treated agenda items) and provide some guidelines for email discussion if necessary*

*RAN1 request clarification from RAN4 for the purpose of propagation delay compensation in LS R1-2102245. RAN1 listed 2 options:*

* **Option 1**: downlink frame timing detection error is already included in UE transmit timing error (i.e. Te);
* Interpretation: “the reference point” defined in section 7.1.2 in TS 38.133 for UE transmission timing is  ahead of “True arrival timing at UE”, and the timing error limit value Te is given taking downlink frame timing detection error into account, as shown in figure 1 as an example.
* **Option 2**: downlink frame timing detection error is not included in UE transmit timing error (i.e. Te);
* Interpretation: “the reference point” defined in section 7.1.2 in TS 38.133 for UE transmission time is  ahead of the first path detected by the UE, and the timing error limit value Te is given without consideration of downlink frame timing detection error, as shown in figure 2 as an example.

Tdoc’s submitted and handled in this email discussion:

|  |  |  |  |
| --- | --- | --- | --- |
| R4-2104609 | Discussion and draft LS on UE transmit timing error | CMCC | discussion |
| R4-2104648 | Discussion on the reply to LS on UE transmit timing error | MediaTek Inc. | discussion |
| R4-2104725 | Discussion on UE transmit timing error | Nokia, Nokia Shanghai Bell | LS out |
| R4-2104767 | Discussion on UE transmit timing error | CATT | discussion |
| R4-2104822 | On UE Tx transmit timing error and the reply LS | ZTE Wistron Telecom AB | discussion |
| R4-2104853 | Discussion on RAN1 LS on UE transmit timing error for R17 URLLC | Apple | discussion |
| R4-2104984 | Discussion for reply LS of UE transmit timing error | NEC | discussion |
| R4-2106445 | Reply to LS on UE transmit timing error | Intel Corporation | discussion |
| R4-2107031 | reply LS on UE transmit timing error | Huawei, HiSilicon | LS out |
| R4-2107153 | LS response on UE transmit timing error | Ericsson | LS out |

*List of candidate target of email discussion for 1st round and 2nd round*

* 1st round:
  + Select RAN4 reply option.
  + Decide whether to include figure 2.1 from R4-2104767 into the Reply LS.

Companies are invited to provide their views on the two aspects in Sub-topic 1-1 and Sub-topic 1-2 during the 1st round. Based on the input from the companies drafting of Reply LS can be initiated in the 2nd round.

# Topic #1: UE transmit timing error

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2104609 | CMCC | Tdoc Title: Discussion and draft LS on UE transmit timing error  Observation 1: Downlink frame timing detection error is already included in UE transmit timing error requirements (i.e. Te).  Option1 |
| R4-2104648 | MediaTek Inc. | Observation 1: The initial timing error (Te) is based on the DL timing estimation error, which depends on the BW of the signal used  Observation 2: The DL frame estimation/detection timing error was taken into account in the calculation of Te.  Proposal 1: The downlink frame timing detection error is already included in UE transmit timing error (i.e. Te).  Option 1. |
| R4-2104725 | Nokia, Nokia Shanghai Bell | Proposal 1: UE transmit timing error does not include the downlink frame detection error and option 2 in the RAN1 LS is the correct interpretation.  Option 2. |
| R4-2104767 | CATT | Proposal 1: It is proposed to clarify that the option 1 in RAN1 LS is the correct understanding, i.e. downlink frame timing detection error is already included in UE transmit timing error in response LS.  Proposal 2: It is proposed to include Figure 2-1 in the LS response.  Option 1 |
| R4-2104822 | ZTE Corporation | Observation 1: Multiple paths may be detected with a span over a searching window in a 3G RAKE receiver, so it is reasonable to specify the first detected path as the timing reference.  Observation 2: 3G UEs may have a reliable estimate on the true arrival time of downlink frames thanks to the constantly available downlink common pilot channel CPICH, and can even be enhanced by always-on downlink UE-specific DPCCH channel once the connection is setup.  Observation 3: In 4G, UE transmit timing error is to guarantee the uplink signals from different intra-cell UEs at different locations can arrive at BS in an controlled interval, in order to keep the orthogonality among UEs, and 4G UEs may also have an accurate estimate on the true arrival time at UE side based on constantly transmitted signal CRS.  Observation 4: No need to specify detection performance requirements in 3G and 4G.  Observation 5: 5G NR UEs may still need to have a performance requirement on UE transmit timing error similar to that in LTE, but may not obtain an estimate on the downlink frame timing as accurate as in LTE.  Observation 6: In 5G NR, Te should include the detection error on the downlink frame timing.  Proposal 1: Option 1 is taken from RAN4’s understanding.  Proposal 2: Send a reply LS based on the common understanding as shown appendix.  Option 1 |
| R4-2104853 | Apple | Observation 1: downlink timing detection error is included in Te requirement.  Proposal 1: RAN4 is to reply RAN1 that downlink timing detection error is included in UE transmit timing error (Te) requirements.  Option 1 |
| R4-2104984 | NEC | Proposal 1: RAN4 to reply RAN1 that downlink frame timing detection error is already included in UE transmit timing error (i.e. Te).  Option 1 |
| R4-2106445 | Intel | Observation 1: Since there is no way for a UE to know the DL frame timing detection error, it has no choice but to simply use the perceived timing  Observation 2: Test equipment verify the UE transmit timing by comparing the received timing against the transmitted DL signal timing  Observation 3: Although there is no clear requirement specified for DL timing detection error, the UE needs to be good enough to cover detection error in Te to pass the tests  Proposal 1: Reply to RAN1 about the correct interpretation for them to take:  - Downlink frame timing detection error is already included in UE transmit timing error (i.e. Te), but  - Correct interpretation is that the UE takes the detected first DL path as the reference point to apply (NTA + NTA\_offset) ×Tc ahead of the detected path  - Since there is no way for the UE to know the ‘true arrival timing’, RAN4 spec specifies the correct UE behaviour  Option 1 |
| R4-2107031 | Huawei | Proposal 1: Reply to RAN1 that option 1 is aligned with RAN4 understanding of Te requirement  Option 1 |
| R4-2107153 | Ericsson | Observation 1: UE transmit timing is derived by the UE based on the first detected path (in time) of the SSB of the reference cell. The power of the SSB’s first detected path in time is measured at the UE antenna.  Observation 2: The UE transmit timing error (Te) in table 7.1.2-1 in TS 38.133 is defined as function of both SSB SCS and UL SCS.  Observation 3: Te decreases with the increase in SSB SCS due to increase in the sampling rate resulting in decrease in the DL reception errors at the UE.  Observation 4: Te also decreases with the increase in UL SCS to ensure Te is fraction of UL CP  Observation 5: If downlink frame timing detection error was not included in Te then Te will not have any upper bound leading to unpredictable reception error at the BS.  Proposal 1: The downlink frame timing detection error in the UE is included in UE transmit timing error (Te) defined in section 7.1.2, TS 38.133  Option 1 |

## 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

*Sub-topic description:*

*RAN1 request clarification from RAN4 for the purpose of propagation delay compensation in LS R1-2102245. RAN1 listed 2 options:*

* **Option 1**: downlink frame timing detection error is already included in UE transmit timing error (i.e. Te);
* Interpretation: “the reference point” defined in section 7.1.2 in TS 38.133 for UE transmission timing is  ahead of “True arrival timing at UE”, and the timing error limit value Te is given taking downlink frame timing detection error into account, as shown in figure 1 as an example.
* **Option 2**: downlink frame timing detection error is not included in UE transmit timing error (i.e. Te);
* Interpretation: “the reference point” defined in section 7.1.2 in TS 38.133 for UE transmission time is  ahead of the first path detected by the UE, and the timing error limit value Te is given without consideration of downlink frame timing detection error, as shown in figure 2 as an example.

*Open issues and candidate options before e-meeting:*

**Issue 1-1: LS Reply.**

* Proposals
  + Option 1: Option 1 in the RAN1 LS is the correct interpretation according to RAN4.
  + Option 2: Option 2 in the RAN1 LS is the correct interpretation according to RAN4.
* Recommended WF
  + Agree on Option 1. Option 1 in the RAN1 LS is the correct interpretation according to RAN4. Send Reply LS to RAN1 with this conclusion.

### Sub-topic 1-2

*Sub-topic description:*

In R4-2104767 it is proposed to include below figure (Figure 2-1 in R4-2104767) in the LS response:



*Open issues and candidate options before e-meeting:*

**Issue 1-2: include Figure 2-1 from R4-2104767 in the LS response.**

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

## Companies views’ collection for 1st round

### Open issues

Sub topic 1-1, Issue 1-1:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Support the recommended WF. |
| MediaTek | Support the recommended WF. |
| CATT | Support the recommended WF. |
| Intel | Our proposal was not considered included in this discussion.  We proposed to clarify that the UE behaviour specified in 38.133 7.1.2 is correct: the UE uses the detected path as the reference point to apply NTA+NTAoffset instead of ‘true timing’ which is the RAN1 interpretation in option1. We definitely agree that DL frame detection error is already considered in Te though. |
| Apple | Support the recommended WF. |
| OPPO | Support the recommended WF. |
| CMCC | Support the recommended WF. |
| NEC | Support the recommended WF. |
| Huawei | Support the recommended WF. |
| Nokia | We are fine with the recommended WF. Since option 1 in the RAN1 LS is the correct interpretation, Te includes the DL frame timing detection error, the expression in UE transmit timing test cases are not correct. For example in A.4.4.1, “After connection set up with the cell, the test equipment will verify that the timing of the NR cell is within (NTA + NTA\_offset)×Tc ± Te of the first detected path of DL SSB.”, it should the arrival of the DL SSB. Hence we expect the below changes to align the core requirements to be necessary for all UE transmit timing test cases: “After connection set up with the cell, the test equipment will verify that the timing of the NR cell is within (NTA + NTA\_offset)×Tc ± Te of ~~the first detected path of DL SSB~~ the arrival of the DL SSB at the UE.” . This change will be applied for legacy Rel15 test cases. Nokia can volunteer to bring CRs to correct the test cases in next meeting. |
| vivo | Support the recommended WF. |
| Qualcomm | Support the recommended WF. As Intel and Nokia noted, there are inconsistencies in the specifications that should be corrected. |

Sub topic 1-2, Issue 1-2:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We support option 2 (No). RAN4 should only reply to the question raised by RAN1 and avoid including anything additional in the response. This is to avoid any confusion. The RAN4 proposed response in option 1 (issue 1-1) is actually sufficiently clear and enough. |
| MediaTek | Support Option 2 (No).  RAN1 included the figures in their LS to clarify the question and to simplify RAN4 response. Now, including additional information (i.e. a new figure) could cause some confusion to RAN1. Hence, RAN4 should reply to the question with only the selected Option. |
| CATT | We prefer option 1. But would be open for option 2 as well if companies don’t want to include this figure. |
| Intel | Option 2. Confusing material. |
| Apple | Support option 2. RAN4 response in issue 1-1 is clear enough for RAN1. |
| OPPO | Support option 2. Response in issue 1-1 is clear enough. |
| CMCC | We support Option2 to avoid confusion. |
| NEC | Option 2. If we use figure in the reply LS, we may have to clarify the terminology used in the figure. Which in our view is not required. |
| Huawei | We are fine with either option 1 or option 2. |
| Nokia | We support option 2. We do not see any difference compared to Figure 1 in the RAN1 LS. |
| vivo | Support option 2. In RAN1 LS Option 1 itself is clear enough. |
| Qualcomm | Support option 2. |

## 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic #1-1** | During the first round 12 companies provided input to this topic. Based on the submitted paper a recommended WF was proposed:   * Agree on Option 1. Option 1 in the RAN1 LS is the correct interpretation according to RAN4. Send Reply LS to RAN1 with this conclusion.   11 companies supported the recommended WF.  All 11 companies support that option 1 in the RAN1 LS is the RAN4 understanding:   * **Option 1**: downlink frame timing detection error is already included in UE transmit timing error (i.e. Te); * Interpretation: “the reference point” defined in section 7.1.2 in TS 38.133 for UE transmission timing is  ahead of “True arrival timing at UE”, and the timing error limit value Te is given taking downlink frame timing detection error into account, as shown in figure 1 as an example.   1 company want to clarify the reply to account:   * Downlink frame timing detection error is already included in UE transmit timing error (i.e. Te), but   + Correct interpretation is that the UE takes the detected first DL path as the reference point to apply (NTA + NTA\_offset) ×Tc ahead of the detected path   Based on this discussion it is proposed to send Reply LS back to RAN1 based on Option 1 and that the ‘downlink frame timing detection error is already included in UE transmit timing error (i.e. Te)’ as baseline.  *Tentative agreements:*   * downlink frame timing detection error is already included in UE transmit timing error (i.e. Te);   Interpretation: “the reference point” defined in section 7.1.2 in TS 38.133 for UE transmission timing is  ahead of [proposals], and the timing error limit value Te is given taking downlink frame timing detection error into account.  *Candidate options:*  *As candidate options for the [proposals] for 2nd discussion:*  *Proposal 1:* “True arrival timing at UE”  *Proposal 2: ‘*the first path detected by the UE*’*  *Recommendations for 2nd round:*  Discuss further the LS wording based on above starting template. |
| **Sub-topic #1-2** | Second topic for discussion was whether to include the listed figure in the Reply LS to RAN1. Companies could choose options yes/no to the question whether to include the figure in the Reply LS. Of the 12 companies who voiced their opinion the preferences were:   * Option 1 (Yes): 1 * Option 2 (No): 10   1 company was neutral.  Based on the company preferences it is proposed not to include the figure in the Reply LS.  *Agreements:*  RAN4 will not include the figure in the Reply LS.  *Recommendations for 2nd round:*  Sub-topic 1-2 is closed. No further discussion needed |

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *No CRs or TPs* |

## Discussion on 2nd round

### Sub-topic 1-5

Sub-topic description:

During the 1st round discussion on the Reply LS to RAN1 it was pointed out by some companies that the current option 1 is not directly agreeable as RAN4 response and hence need further discussion.

A Reply LS wording attempt has been collected by the moderator:

* downlink frame timing detection error is already included in UE transmit timing error (i.e. Te);

Interpretation: “the reference point” defined in section 7.1.2 in TS 38.133 for UE transmission timing is  ahead of [Text proposal], and the timing error limit value Te is given taking downlink frame timing detection error into account.

As candidate options for the [Text proposal] following two options have been identified:

*Text proposal 1:* “True arrival timing at UE”

*Text proposal 2: ‘*the first path detected by the UE*’*

Please evaluate among the two text proposals (inserted in the Reply above) which text proposal is preferred. If none of the proposed text proposals are agreeable, please provide a concrete text proposal as part of the company comments.

**Issue 1-5:** Which of the two text proposal options are agreeable:

* + Option 1: Text proposal 1.
  + Option 2: Text proposal 2.
* Recommended WF
  + More discussion needed

## Companies views’ collection for 2nd round

### Open issues

Sub topic 1-5, Issue 1-5:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Issue1-5: Option 2.  Timing requirements are based on the first detected path in time. We suggest to also include ‘in time’ to avoid any misinterpretation e.g.  “the first path detected (in time) by the UE”  or  “the first detected path in time” |
| NEC | May be to avoid any confusion we feel both options can be included. For example:  “downlink frame timing detection error is already included in UE transmit timing error (i.e. Te);  Interpretation: “the reference point” defined in section 7.1.2 in TS 38.133 for UE transmission timing is  ahead of true arrival timing at UE (i.e. first path detected by the UE), and the timing error limit value Te is given taking downlink frame timing detection error into account.” |
| ZTE | Issue 1-5: Option 1.  As stated in our contribution, “the first path detected” is inherited from 3G era, which is based on RAKE receiver with a multi-path searcher. In both 4G and 5G, there is no such multi-path searcher, so “first path detected” does not apply. |
| Apple | Option 2.  We don’t have definition of “True arrival timing at UE” in our spec. but in our spec “the first detected path” is being used.   |  | | --- | | 7.1.2 Requirements The UE initial transmission timing error shall be less than or equal to ±Te where the timing error limit value Te is specified in Table 7.1.2-1. This requirement applies:  - when it is the first transmission in a DRX cycle for PUCCH, PUSCH and SRS, or it is the PRACH transmission, or it is the msgA transmission..  The UE shall meet the Te requirement for an initial transmission provided that at least one SSB is available at the UE during the last 160 ms. The reference point for the UE initial transmit timing control requirement shall be the downlink timing of the reference cell minus . The downlink timing is defined as the time when the first detected path (in time) of the corresponding downlink frame is received from the reference cell. *N*TA for PRACH is defined as 0. |   We shall use the same wording as being used in our spec. |
| Huawei | Option 1.   |  | | --- | | It’s clear that UE determines the UL transmit timing based on the first path detected (in time). It is noted that the “reference point” in section 7.1.2 is for the Te requirements but not for the actual UE timing. In our view, this means the “reference point” is used to determine the ideal UL timing, so it should be based on the “True arrival timing”. 7.1.2 Requirements The UE initial transmission timing error shall be less than or equal to ±Te where the timing error limit value Te is specified in Table 7.1.2-1. This requirement applies:  - when it is the first transmission in a DRX cycle for PUCCH, PUSCH and SRS, or it is the PRACH transmission, or it is the msgA transmission..  The UE shall meet the Te requirement for an initial transmission provided that at least one SSB is available at the UE during the last 160 ms. The reference point for the UE initial transmit timing control requirement shall be the downlink timing of the reference cell minus . The downlink timing is defined as the time when the first detected path (in time) of the corresponding downlink frame is received from the reference cell. *N*TA for PRACH is defined as 0. |   On the other hand, to avoid possible confusion, we propose that in the LS reply we do not refer to the option 1 in RAN1 LS, but just state the RAN4 understanding about how UE determines its UL timing and what Te requirement means, e.g.  UE determines the UL transmit timing based on the first path detected (in time). Te is the difference between the actual UL transmit timing and an “ideal” UL transmit timing which is determined based on the “True arrival timing at UE”. |
| CMCC | Issue 1-5: Option1  We agree with Intel that the UE behavior is “UE uses the detected path as the reference point to apply NTA+NTAoffset”. The following description in 7.1.1 of TS 38.133 is correct:  7.1.1 Introduction  The UE shall have capability to follow the frame timing change of the reference cell in connected state. The uplink frame transmission takes place before the reception of the first detected path (in time) of the corresponding downlink frame from the reference cell.  But the Reference point in this issue is which point should be considered for UE timing error calculation, it is corresponding to the highlight part of the following description. It should be the point ahead of “True arrival timing at UE”, or else the Te won’t include the DL timing detection error.  7.1.2 Requirements  The UE initial transmission timing error shall be less than or equal to ±Te where the timing error limit value Te is specified in Table 7.1.2-1. This requirement applies:  - when it is the first transmission in a DRX cycle for PUCCH, PUSCH and SRS, or it is the PRACH transmission, or it is the msgA transmission..  The UE shall meet the Te requirement for an initial transmission provided that at least one SSB is available at the UE during the last 160 ms. The reference point for the UE initial transmit timing control requirement shall be the downlink timing of the reference cell minus . The downlink timing is defined as the time when the first detected path (in time) of the corresponding downlink frame is received from the reference cell. |
| vivo | Option 2.  Firstly, UE transmit timing requirements are clear. So, the reference point should be the ‘the first detected path (in time)’.  Then for the UL transmit timing error it is contributed by many factors, including downlink timing detection error, sampling quantization error and RF related errors etc. The downlink timing detection error is mainly due to resolution of DL timing estimation. So, downlink timing detection error is included in the initial uplink transmit timing error. |
| Intel | Option 2. Note that this topic mainly deals with weather/how we modify our spec instead of how we reply to RAN1.  In my understanding this wording has been used for a long time. It describes the UE behaviour upon applying TA and TA offset to the detected DL timing. Since there is no way for the UE to know the true timing so specifying that the UE needs to follow true timing is not correct for this part of the requirements.  As for the Te value requirement, we agree that the true timing is the baseline for defining it: in fact most part of Te is due to this detection error.  For the reply to RAN1, we can discuss upon the draftLS thread from Li. I think the group is willing to achieve a solid version. |

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| Reply LS on UE transmit timing error | Huawei | To: RAN\_1 |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

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** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

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