**3GPP TSG-RAN WG4 Meeting # 102-e R4-22XXXXX**

**Electronic Meeting, 21 February – 03 March 2022**

**Agenda item:** 10.23

**Source:** Moderator (Nokia)

**Title:** Email discussion summary for [102-e][233] NR\_IIOT\_URLLC\_enh

**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.*

This email discussion cover following agenda items:

* 1. Enhanced IIoT and URLLC support [NR\_IIOT\_URLLC\_enh]
     1. General [NR\_IIOT\_URLLC\_enh-Core]
     2. RRM core requirements [NR\_IIOT\_URLLC\_enh-Core]
        1. Propagation delay compensation enhancements [NR\_IIOT\_URLLC\_enh-Core]
        2. Reference point for Te requirements [NR\_IIOT\_URLLC\_enh-Core]
        3. Others [NR\_IIOT\_URLLC\_enh-Core]

3 Main topics have been identified for discussion:

* Propagation Delay Compensation Enhancements
* timing reference point for UE UL timing
* UE features for enhanced IIoT and URLLC

Additionally, a number of companies have contributed with simulation results. They will be collected separately.

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

* 1st round: all 3 topics are open for discussion
* 2nd round: TBA

**Earlier agreed documents**

RAN4#101-bis

* R4-2202783, WF on NR\_IIOT\_URLLC\_enh\_RRM

RAN4#101:

* R4-2120335, WF on NR\_IIOT\_URLLC\_enh\_RRM

RAN4#100bis:

* R4-2115371, WF on NR\_IIOT\_URLLC\_enh\_RRM

RAN4#99:

* R4-2108368, WF on RRM for NR IIoT and URLLC,

# Topic #1: Propagation Delay Compensation Enhancements

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2203655 | Nokia, Nokia Shanghai Bell | 1. RAN1 evaluate the PDC RTT error budget with PRS measurement accuracy under fading channel condition. 2. At least include the AWGN channel and the fading channel condition defined in 10.1.25.2-2 in TS 38.133 v17.3.0 for PDC RTT with PRS. 3. Rel-17 ePos 1 sample PRS measurement accuracy is based on the BW condition “PRS BW (RBs) ≥ 48”. 4. Reuse the PRS measurement accuracy requirement based on 4 samples defined in 10.1.25 in TS 38.133 v17.3.0 for Rel-17 PDC RTT with PRS. 5. The PRS measurement period requirement for PDC RTT is   where   1. The TRS measurement period requirement for PDC RTT is   where  is the number of TRS measurement samples for PDC RTT.  is the periodicity of the TRS specific for PDC RTT UE Rx-Tx time difference measurement.   1. The TRS resource number has minor effect on the TUE-RX error. 2. The TRS measurement sample number has minor effect on the TUE-RX error. 3. The TRS TUE-RX error changes significantly between AWGN and TDL-A. 4. Define UE Rx-Tx time difference measurement accuracy for TRS with both AWGN and TDL-A channels. 5. RAN4 should define test cases for PDC RTT UE Rx-Tx time difference measurement accuracy requirement with TRS/PRS and SRS.   [Moderator: Simulation results will be collected separately] |
| R4-2204306 | OPPO | Observation 1: The goal for low latency positioning enhancement in Rel-17 is to keep the existing Rel-16 accuracy requirements.  Proposal 1: For PRS-based UE Rx-Tx time difference measurement, accuracy requirements from Rel-16 spec could be reused as baseline for RTT-based PDC.  Proposal 2: Not discuss the number of PRS samples, if only accuracy requirements will be specified.  Proposal 3: 60kHz and FR2 should be excluded for gNB Rx-Tx time difference accuracy requirements. |
| R4-2204472 | Qualcomm Incorporated | Observation 1: Simulation results for UE Rx-Tx time difference using TRS are shown in Table 1. The results do not include any margin to account for UE Rx/Tx group delay calibration error.  Observation 2: The physical reference points for RTT measurements are at the antenna or antenna connector, while the reference point for ReferenceTimeInfo is an unspecified point at the network. ReferenceTimeInfo may not account for “RF propagation delay” at the gNB. If the two reference points are different and the delay between them is not compensated, PDC accuracy may be degraded.  [Moderator: Simulation results will be collected separately] |
| R4-2204647 | vivo | Proposal 1: Accuracy requirements for RTT-based PDC with PRS are based on measurements with one sample.  Proposal 2: Accuracy requirements for RTT-based PDC with TRS are based on measurements with one sample.  Proposal 3: No measurement period requirements are specified for RTT-based PDC.  Proposal 4: AWGN channel is assumed for defining accuracy requirements for PDC measurement. Additional LOS channel may be considered.  Proposal 5: Test cases are discussed after completion of accuracy requirements.  Observation 1: 60kHz and 120kHz SCS for FR2 are not excluded explicitly for PDC use cases. |
| R4-2204648 | vivo | Observation 1: Measurement accuracy with 4 samples and 1 sample are almost the same under AWGN channel.  Observation 2: Measurement accuracy can be improved with 4 samples compared to 1 sample measurement under TDL-A fading channel.  [Moderator: Simulation results will be collected separately] |
| R4-2205389 | Huawei, HiSilicon | Proposal 1: Measurement requirements for UE Rx-Tx are defined based on single-shot measurement.  Proposal 2: Measurement requirements for UE Rx-Tx are defined based on AWGN.  Proposal 3: Measurement requirements for TRS based UE Rx-Tx are defined based on 2-slot TRS configuration for FR1 at least.  Proposal 4: Inform RAN2 about the RAN4 agreements on report mapping for UE and gNB Rx-Tx. |
| R4-2205390 | Huawei, HiSilicon | CR on requirements for UE Rx-Tx measurement for PDC |
| R4-2205418 | Ericsson | Observation 1: The 15 and 30 kHz SCS from RAN1 LS were for evaluation using control-to-control and smart grid set of requirements. The final LS states no SCS limitations.  Proposal 1: Requirements for PDC shall be stated for all SCS.  Observation 2: The control-to-control and smart grid set of evaluation requirements can be fulfilled with rel-16 TS 38.133 section 10.1.25 Ue Rx-Tx Time Difference Measurements requirements.  Proposal 2: Reuse rel-16 TS 38.133 section 10.1.25 Ue Rx-Tx Time Difference Measurements requirements, for UE Rx-Tx time difference measurement accuracy based on PRS.  Proposal 3: In order to facilitate reuse of rel-16 TS 38.133 section 10.1.25 Ue Rx-Tx Time Difference Measurements requirements, for UE Rx-Tx time difference measurement accuracy based on PRS we can base PDC requirements on 4 samples.  Observation 3: Observation 3: Our simulation results are reported in R4-2205419, Simulation results for Propagation Delay Compensation [5].  [Moderator: Simulation results will be collected separately] |
| R4-2205419 | Ericsson | [Moderator: Simulation results will be collected separately] |
| R4-2205815 | Nokia, Nokia Shanghai Bell | draftCR on requirements for UE Rx-Tx measurement for propagation delay compensation |

## Open issues summary

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

Based on the submitted papers from the companies and the WF agreed in last meeting following 4 sub-topics have been identified for propagation delay compensation enhancements for discussion:

1. UE Rx-Tx time difference measurement requirement for PRS.
   * Issue 1-1: PRS measurement period requirement for PDC RTT
   * Issue 1-2: Define UE Rx-Tx time difference measurement requirement for PRS requirements for FR2
   * Issue 1-3: Define UE Rx-Tx time difference measurement requirement for PRS requirements for 60KHz
   * Issue 1-4: Shall RAN4 define requirements based on Rel-16 or Rel-17, or for Rel-16 and Rel-17 PRS
   * Issue 1-5: Are simulations needed for defining accuracy requirements
   * Issue 1-6: Number of samples assumed for deriving the accuracy requirements
2. UE Rx-Tx time difference measurement requirement for TRS.
   * Issue 1-7: TRS measurement period requirement for PDC RTT
   * Issue 1-8: Channel conditions for which RAN4 will develop requirements
   * Issue 1-9: Define UE Rx-Tx time difference measurement requirement for TRS requirements for FR2
   * Issue 1-10: Define UE Rx-Tx time difference measurement requirement for TRS requirements for 60KHz
   * Issue 1-11: TRS resource number used for developing UE requirements
   * Issue 1-12: Number of samples assumed for deriving the accuracy requirements
3. Inform RAN2 about the RAN4 agreements on report mapping for UE and gNB Rx-Tx.
   * Issue 1-13: LS to RAN2 group for Rel-17 enhanced IIOT/URLLC
4. RAN4 to start test case work for PDC RTT UE Rx-Tx time difference measurement accuracy requirement with TRS/PRS and SRS.
   * Issue 1-14: Test case work for PDC RTT UE Rx-Tx time difference measurement accuracy requirement with TRS/PRS and SRS

Some issues identified for each sub-topic needs to be resolved in this meeting to progress the further work in RAN4 related to performance and simulations.

### Sub-topic 1-1

*Sub-topic description:* UE Rx-Tx time difference measurement requirement for PRS

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

**Issue 1-1: PRS measurement period requirement for PDC RTT**

* Proposals
  + Option 1: (Nokia Proposal 3)

where

* + Option 2: Other
* Recommended WF
  + More discussion needed

**Issue 1-2: Define UE Rx-Tx time difference measurement requirement for PRS requirements for FR2**

(decision needed because of possible simulations)

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

**Issue 1-3: Define UE Rx-Tx time difference measurement requirement for PRS requirements for 60KHz**

(decision needed because of possible simulations)

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

**Issue 1-4: Shall RAN4 define requirements based on Rel-16 or Rel-17, or for Rel-16 and Rel-17 PRS**

(decision needed because of possible simulations)

* Proposals
  + Option 1: Rel-16 only
  + Option 2: Rel-17 only
  + Option 3: Rel-16 and Rel-17
* Recommended WF
  + More discussion needed

**Issue 1-5: Are simulations needed for defining accuracy requirements**

(decision needed because of possible simulations)

* Proposals
  + Option 1: No, RAN4 reuse PDC RTT accuracy from R16 defined in TR 38.133-10.1.25.2 for Rel-17 PDC RTT-based method
  + Option 2: Yes
* Recommended WF
  + More discussion needed

**Issue 1-6: Number of samples assumed for deriving the accuracy requirements**

(open but will be decided based on simulation results)

* Proposals
  + Option 1: 1 sample
  + Option 2: 4 samples
  + Option 3: other
* Recommended WF
  + More discussion needed

### Sub-topic 1-2

*Sub-topic description:* UE Rx-Tx time difference measurement requirement for TRS

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

**Issue 1-7: TRS measurement period requirement for PDC RTT**

* Proposals
  + Option 1: No measurement period requirements are specified for RTT-based PDC
  + Option 2: Nokia proposal 4
* The TRS measurement period requirement for PDC RTT is

where

is the number of TRS measurement samples for PDC RTT.

is the periodicity of the TRS specific for PDC RTT UE Rx-Tx time difference measurement.

* + Option 3: Huawei proposal in CR
    - The UE shall be able to measure UE Rx-Tx time difference on PCell after receving [TBD, command from network that triggers the UE Rx-Tx measurement] within TUERx-Tx\_PDC, where
    - TUERx-Tx\_PDC = TBD
* Recommended WF
  + More discussion needed

**Issue 1-8: Channel conditions for which RAN4 will develop requirements**

* Proposals
  + Option 1: AWGN only
  + Option 2: AWGN and fading (TDL-A)
* Recommended WF
  + More discussion needed

**Issue 1-9: Define UE Rx-Tx time difference measurement requirement for TRS requirements for FR2**

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

**Issue 1-10: Define UE Rx-Tx time difference measurement requirement for TRS requirements for 60KHz**

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

**Issue 1-11: TRS resource number used for developing UE requirements**

* Proposals
  + Option 1: 4 (2-slot TRS configuration)
  + Option 2: 2 (2-slot TRS configuration)
* Recommended WF
  + More discussion needed

**Issue 1-12: Number of samples** **assumed for deriving the accuracy requirements**

(open but will be decided based on simulation results)

* Proposals
  + Option 1: 1 sample
  + Option 2: 4 samples
  + Option 3: other
* Recommended WF
  + More discussion needed

### Sub-topic 1-3

*Sub-topic description:* Inform RAN2 about the RAN4 agreements on report mapping for UE and gNB Rx-Tx

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

**Issue 1-13: LS to RAN2 group for Rel-17 enhanced IIOT/URLLC**

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

### Sub-topic 1-4

*Sub-topic description:* RAN4 to start test case work for PDC RTT UE Rx-Tx time difference measurement accuracy requirement with TRS/PRS and SRS

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

**Issue 1-14: Test case work for PDC RTT UE Rx-Tx time difference measurement accuracy requirement with TRS/PRS and SRS**

* Proposals
  + Option 1: Yes
  + Option 2: No
* Recommended WF
  + RAN4 should discuss an initial list of test cases.

## Companies views’ collection for 1st round

### Open issues

Sub-topic 1-1: Sub-topic description: UE Rx-Tx time difference measurement requirement for PRS

**Issue 1-1: PRS measurement period requirement for PDC RTT**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| Huawei | Fine to use option 1 as the starting point.   * Some scaling factor is for UE processing capability, and RAN4 may need to revisit if there is conflict with RAN1 capability discussion. * CSSF should be FFS, as we agreed last meeting that PDC measurement does not require MG. |
| Ericsson | Option 1. |
| Nokia | Support option 1. |
| Qualcomm | The proposal in option 1 aims to leverage the measurement period requirement for NR positioning measurements. While it may be reasonable to use the existing requirements as a starting point, our view is that the PDC use case is quite different from positioning use cases and in the end we may not be able to leverage much of the requirements. The main differences are:   * Only PRS transmitted by the serving cell is measured/processed * Small PRS timing uncertainty (since DL timing is known) * No MG is needed for PRS contained within active BWP and with the same SCS   Given these differences, we understand that RAN1 may specify a different processing capability for PRS in the context of PDC.  In addition, TRS can be used as the DL reference signal for the UE Rx-Tx measurement, instead of PRS. Ideally, there would be some commonality between the requirements for RTT-based PDC when TRS and PRS are used as the DL reference signal. |

**Issue 1-2: Define UE Rx-Tx time difference measurement requirement for PRS requirements for FR2**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| Huawei | Either option is fine for us. |
| Ericsson | Option 1. Define UE Rx-Tx time difference measurement requirement for PRS requirements for FR2.   Industrial IIoT WID does not exclude any SCS.   Existing positioning requirements exist for all SCS in FR1 and FR2. |
| Nokia | We can support option 1. |
| Qualcomm | We can support option 1. |

**Issue 1-3: Define UE Rx-Tx time difference measurement requirement for PRS requirements for 60KHz**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| Huawei | Either option is fine for us. |
| Ericsson | Option 1. Define UE Rx-Tx time difference measurement requirement for PRS requirements for SCS = 60 kHz.   Industrial IIoT WID makes no exclusion.   Existing positioning requirements exist for all SCS in FR1 and FR2. |
| Nokia | We can support option 1. |
| Qualcomm | OK with option 1. |

**Issue 1-4: Shall RAN4 define requirements based on Rel-16 or Rel-17, or for Rel-16 and Rel-17 PRS**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| Huawei | The issue is not very clear to us. Does Rel-17 PRS refer to the PRS measurement requirements for reduced sample number that are defined in Rel-17?  If so we support to consider Rel-17 PRS. We are open to consider REl-16 PRS if there is clear justification, but we see no point to consider both. |
| Ericsson | Our initial position into meeting is that rel-16 and rel-16 number of samples are fine as a baseline. Rel-17 will work as well. |
| Nokia | Option 1.  In *R4-2202776 WF on NR Positioning Enhancements (Part 1),* it shows the agreed conditions for Rel-17 ePos 1 sample PRS measurement   |  |  | | --- | --- | | **Parameters** | **Value** | | **No of samples w/o AGC (M1)** | 1 | | **PRS Ês/Iot (dB)** | ≥ -6 | | **Propagation conditions** | LOS | | **PRS BW (RBs)** | ≥ [48] | | **Accuracy** | R16 | | **Repetition** | R16 |   We understand that if Rel-17 ePos PRS with 1 sample measurement is adopted, then the accuracy for BW 24 PRB will be missing for PDC RTT. If this is a correct understanding, we then think the simulation for 24 PRB PRS with 1 sample measurement will be needed. But at the end, the simulation accuracy result for 24 PRB 1 sample PRS may or may not satisfy the PDC error budget.  For the purpose of reducing workload, and also because 4 sample PRS (Rel-16 PRS) has already been verified by RAN1, we still prefer to reuse the measurement accuracy with 4 sample PRS (Rel-16 PRS), and we don’t see any strong reason against it.  Also, we would like to check whether it is a common understanding that reusing Rel-16 requirements means reusing PRS measurement accuracy with both AWGN and fading channels for PDC? |
| Qualcomm | Same question as Huawei. We assume Rel-16/17 refers to different number of PRS samples and side conditions. Note that for reduced number of samples, the performance requirements have not been finalized.  PDC applications may not need low-latency measurements so Rel-16 assumptions would be sufficient. |

**Issue 1-5: Are simulations needed for defining accuracy requirements**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| Huawei | Option 1. |
| Ericsson | Option 1. |
| Nokia | Option 1.  We support reusing the Rel-16 PRS requirements so no more stimulation is needed for PRS. |
| Qualcomm | We understand this question is for PRS. Option 1 is fine. However, let’s clarify that this means we also reuse the corresponding side conditions and assumptions (e.g. number of samples, etc.). |

**Issue 1-6: Number of samples assumed for deriving the accuracy requirements**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| Huawei | Option 1.  The benefits in assuming 1-sample is that gNB Rx-Tx requirements are defined based on 1-sample. It is well known that for RTT based PDC the proximity between UE Rx-Tx and gNB Rx-Tx measurements are important, and using 1-sample also for UE measurements can help to ensure UE and gNB measurements are taken close in time. |
| Ericsson | We propose to reuse PDC RTT accuracy from R16 defined in TR 38.133-10.1.25.2 for PRS (Issue 1-5), then we accept to inherit the number of samples form TR 38.133-10.1.25.2.  For TRS we are open to discuss the number of samples needed 1 or 4. |
| Nokia | We prefer option 2. See our comments in 1-4.  We understand that for 1 sample PRS measurement accuracy, the extra simulation will be needed since Rel-17 ePos did not define the measurement accuracy for 1 sample PRS with small BW (>=24PRB). |
| Qualcomm | See answer to issue 1-5. |

Sub-topic 1-2: Sub-topic description: UE Rx-Tx time difference measurement requirement for TRS

**Issue 1-7: TRS measurement period requirement for PDC RTT**

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| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| Huawei | Fine to use option 2 as the starting point. |
| Ericsson | Option 2. |
| Nokia | Option 2 |
| Qualcomm | We understand measurement period requirements are within scope. FFS the detailed requirement. See answer to issue 1-1. |

**Issue 1-8: Channel conditions for which RAN4 will develop requirements**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| Huawei | Option 1.  We understand AWGN is more relevant for URLLC/IIOT scenarios.  Accuracy is clearly better with AWGN than with TDL-A. It is noted that in RAN1 evaluation the group delay calibration margin was not considered, so we believe RAN4 should target better accuracy for PDC.  gNB Rx-Tx measurement requirements are defined based on 1-sample and AWGN, and we prefer to align the assumption for UE and gNB as much as possible |
| Ericsson | Option 2, both. Existing SRS/PRS requirements exist for both AWGN and TDL-A. Even in IIoT there is a sufficiently rich set of scenarios to merit both channels. My reference:  [https://www.3gpp.org/ftp/tsg\_ran/WG2\_RL2/TSGR2\_112-e/Inbox/Chairmans\_Notes/RAN2-112-e\_NR-U\_PowSav\_2sRA%20-Rel-17%20Sdata\_IioT%20Notes%20(Diana)\_Nov9\_17-00.docx](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_112-e/Inbox/Chairmans_Notes/RAN2-112-e_NR-U_PowSav_2sRA%20-Rel-17%20Sdata_IIoT%20Notes%20(Diana)_Nov9_17-00.docx)  •     Scenario 1: In the control-to-control communication use case, where TSC devices behind a target UE are synchronized to any TD, from a GM behind the CN. The 5GS introduced error is caused by the relative time-stamping inaccuracy at the NW-TT and the DS-TTs.  •     Scenario 2: In the control-to-control communication use case, where TSC devices behind a target UE are synchronized to any TD, from a GM behind the UE. The 5GS introduced error is caused by the relative time-stamping inaccuracies at the involved DS-TTs.  •     Scenario 3: In the smart grid use case, where the TSC devices behind a target UE are synchronized to the 5G GM TD. The 5GS introduced error is caused by the synchronization of the 5G clock to the DS-TT. |
| Nokia | Option 2.  We agree with Ericsson that both AWGN and TDL-A should be considered for IIOT, and we think the condition for TRS should be consistent with the conditions for PRS. |
| Qualcomm | Option 1. It makes sense to prioritize AWGN. |

**Issue 1-9: Define UE Rx-Tx time difference measurement requirement for TRS requirements for FR2**

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| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| Huawei | Either option is fine for us. |
| Ericsson | Option 1. Define UE Rx-Tx time difference measurement requirement for TRS requirements for FR2.   Industrial IIoT WID makes no exclusion.   Existing positioning requirements (PRS, SRS) exist for all SCS in FR1 and FR2. |
| Nokia | We can support option 1. |
| Qualcomm | Option 1 is fine. |

**Issue 1-10: Define UE Rx-Tx time difference measurement requirement for PRS requirements for 60KHz**

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| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| Huawei | Either option is fine for us. |
| Ericsson | Option 1. Define UE Rx-Tx time difference measurement requirement for TRS requirements for SCS = 60 kHz.   Industrial IIoT WID makes no exclusion.   Existing positioning requirements (PRS,SRS) exist for all SCS in FR1 and FR2. |
| Nokia | We can support option 1. |
| Qualcomm | Option 1 is fine. |

**Issue 1-11: TRS resource number used for developing UE requirements**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| Huawei | Option 1 for FR1, and option 2 for FR2. |
| Ericsson | We agree with Nokia’s conclusion from R4-R4-2203655 that Observation he TRS resource number has minor effect on the TUE-RX error. |
| Nokia | In our simulation results, we observe that there is not too much variance between using 2 resources of TRS and 4 resources of TRS. Considering 4 TRS resources with 2 consecutive slots will be configured in FR1 and it is available in FR2 (38.214), we support option 1. |
| Qualcomm | Our preference is option 1. |

**Issue 1-12: Number of samples**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| Huawei | Option 1, and same comment as Issue 1-6 for PRS. |
| Ericsson | 1 or 4 samples impact depend on channel.  One (1) sample works fine if we select AWGN as channel. Our results show no significant improvement for AWGN with 4 samples.  For TDL-A we see improvement with 4 samples. |
| Qualcomm | For UE Rx-Tx accuracy requirements it would be good to be consistent in the assumptions for PRS and TRS. We prefer option 2. |

Sub-topic 1-3: Sub-topic description: Inform RAN2 about the RAN4 agreements on report mapping for UE and gNB Rx-Tx

**Issue 1-13: LS to RAN2 group for Rel-17 enhanced IIOT/URLLC**

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| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| Huawei | Option 1.  The following is included in the incoming LS from RAN1 R1-2112834, so RAN4 should inform the related agreement to other WGs.  ***Conclusion***  *The reporting range of Rx-Tx time difference measurement for RTT-based PDC is up to RAN4.* |
| Ericsson | We agree with Huawei. |
| Nokia | Same view with Huawei |
| Qualcomm | Option 1 |

Sub-topic 1-4: Sub-topic description: RAN4 should define test cases for PDC RTT UE Rx-Tx time difference measurement accuracy requirement with TRS/PRS and SRS

**Issue 1-14: Test case work for PDC RTT UE Rx-Tx time difference measurement accuracy requirement with TRS/PRS and SRS**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| Huawei | This should be the work for the perf part? |
| Ericsson | We do this in performance part of WI. |
| Nokia | Option 1. |
| Qualcomm | Yes, during the performance part. |

### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2205390, Huawei, HiSilicon | Title: CR on requirements for UE Rx-Tx measurement for PDC |
| Qualcomm:  Fix typo in section numbering: 9.12.2 instead of 9.11.2.  Should there be separate sections for the measurement period using PRS and TRS? |
|  |
| R4-2205815,  Nokia, Nokia Shanghai Bell | Title: draftCR on requirements for UE Rx-Tx measurement for propagation delay compensation |
| Qualcomm:  9.12.3 Measurement Capability  We’re not sure the multi-RTT capability will be reused. Delete the text or put it in [].  Numbering typo: 9.12.3 repeated  Our understanding is that RAN2 is still discussing the procedures for RTT-based PDC. For PDC at the UE side, the UE will not report the UE Rx-Tx measurements. For now, it may be better to remove section 9.12.3 Measurement Reporting Requirements.  Also in 9.12.3.1 Measurement Reporting Requirements for PRS: PDC procedure should not rely on LPP. |
|  |

## 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** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### 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** |
| R4-2205390, Huawei, HiSilicon | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |
| R4-2205815,  Nokia, Nokia Shanghai Bell | Ericsson: “If UE Rx-Tx time difference measurement is based on PRS, the capability is as indicated by the UE in NR-Multi-RTT-ProvideCapabilities, according to TS 37.355 [34].”  RAN2 will follow the RAN1 capabilities below:  RAN1 has agreed the following propagation delay compensation related capabilities in [R1-2112902](http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_107-e/Docs/R1-2112902.zip" \o "http://www.3gpp.org/ftp/tsg_ran/wg1_rl1/tsgr1_107-e/docs/r1-2112902.zip" \t "_blank):   * FG 25-19: Propagation delay compensation based on CSI-RS for tracking and SRS, per FS * FG 25-19a: Propagation delay compensation based on DL PRS and SRS, per FS * FG 25-20: Propagation delay compensation based on legacy TA procedure, per UE   *NR-Multi-RTT-ProvideCapabilities* is provided to the LMF (i assume). But RAN2 agreed that LMF is not part of the PDC procedure.  IIoT is not multi RTT. |

## Discussion on 2nd round (if applicable)

# Topic #2: Timing reference point for UE UL timing

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2203656 | Nokia, Nokia Shanghai Bell | Proposal 1: TP for Rel-15/16/17 38.133 7.1.2  “The downlink timing is defined as the time when the first detected path in time of the corresponding downlink frame from the reference cell is received at the UE antenna”  Proposal 2: If Option #1 is not agreeable, then Option # 3 can be compromised. |
| R4-2204423 | Intel | draftCR to clarify timing reference point for UE UL timing test cases |
| R4-2204649 | vivo | Proposal 1: 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 at the UE antenna. |
| R4-2205391 | Huawei, HiSilicon | Proposal 1a: Do not mention ‘detected’ nor ‘detectable’ in the definition of the “reference point” for Te requirements in clause 7.1.2 of 38.133.  Proposal 1b: Add a note in the requirements that the requirements may not apply in all conditions but shall apply under conditions used in the test cases.  Proposal 2: Update the definition of the “reference point” in clause 7.1.2 of 38.133 from Rel-15:  “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 arrives at the UE antenna.”  Proposal 3: Send LS to inform RAN1 about the updated definition of the “reference point”. |
| R4-2206021 | Ericsson | • Observation 1: The term first “detected path” (in time) in the definition of the reference point for timing error control requirement in section 7.1.2 in TS 38.133 would mean that the reference point is inside the UE i.e. at the UE baseband.  • Observation 2: The purpose of the reference point is for interpretation, derivation, verification or testing of the core requirements. But the reference point inside the UE (i.e. at baseband) means that the reference point cannot be determined/estimated by the test system  • Observation 3: It is agreed to include “UE antenna” will in the reference point definition. But UE antenna does not ‘detect’ rather receive signal,  • Observation 4: Testing of Te is done under AWGN which has one path. Therefore, the path arriving at the UE antenna and detectected by the UE is the same. That’s why the problem has not been observed or will not be observed in the test.  • Observation 5: In principle use of first “detected” path in the reference point definition creates ambiguity and in principle such definition (with detected path) also leaves core requirements “untestable”.  • Proposal #1: The term “detected” is not included in the reference point definition.  • Proposal #2: Clarify reference point definition according to Option # 2 [2]:  o The downlink timing is defined as the time when the first path (in time) of the corresponding downlink frame from the reference cell arrives at the UE antenna.  • Proposal #3: If Option #2 is not agreeable then clarify reference point definition according to Option # 3 [2]: |
| R4-2206022 | Ericsson, Intel, Huawei, HiSilicon, Qualcomm | Correction to reference point defintion for UE timing in TS 38.133 |

## Open issues summary

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

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.

TP Option 1:

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 at the UE antenna

TP Option 2:

The downlink timing is defined as the time when the first path (in time) of the corresponding downlink frame from the reference cell arrives at the UE antenna

TP Option 3:

The downlink timing is defined as the time when the first ~~detected~~ path (in time) of the corresponding downlink frame used by the UE to determine downlink timing is received from the reference cell at the UE antenna

WF:

Next meeting is last meeting to reach agreement. All 3 options are open for discussion.

### Sub-topic 2-1

*Sub-topic description:* TP for downlink timing definition

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

**Issue 2-1: Preference for TP for downlink timing definition**

* Proposals
  + Option 1: Prefer TP option 1
  + Option 2: Prefer TP option 2
  + Option 3: Prefer TP option 3
  + Option 4: can compromise to TP option 3.
* Recommended WF
  + More discussion needed

## Companies views’ collection for 1st round

### Open issues

**Issue 2-1: Preference for TP for downlink timing definition**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | **Issue 2-1: Preference for TP for downlink timing definition** |
| Intel | **We support option 2.**  **We are also willing to look at the possibility to go with option 3. One note is that no impact on RAN5 conformance test cases is expected.** |
| Huawei | **Support option 2 but we can also compromise to option 3.** |
| Ericsson | **We support Option 2. But we can also compromise to Option 3 for the sake of progress.** |
| Nokia | **We prefer Option 1, but we can compromise to Option 4 to move forward.** |
| Qualcomm | We support option 2. The wording in Option 3 sounds a bit circular and in our view it does not address the concern about testability.  At the very least RAN4 should add “at the UE antenna” to the text in the specification. |
| Apple | Support option 1. Can compromise to option ¾. |

### 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.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2204423, Intel | Title: draftCR to clarify timing reference point for UE UL timing test cases |
| Company A |
|  |
| R4-2206022, Ericsson, Intel, Huawei, HiSilicon, Qualcomm | Title: Correction to reference point defintion for UE timing in TS 38.133 |
| Company A |
|  |

## 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** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

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

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| R4-2204423, Intel | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |
| R4-2206022, Ericsson, Intel, Huawei, HiSilicon, Qualcomm |  |

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Topic #3: UE features for enhanced IIoT and URLLC

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2206015 | Nokia, Nokia Shanghai Bell | Proposal: RAN4 does not introduce additional UE feature group for Rel-17 enhanced IIOT/URLLC. |
| R4-2204472 | Qualcomm Incorporated | Proposal 1: The UE capability for RTT-based PDC should be defined per feature set. |

## 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 3-1

*Sub-topic description:*

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

**Issue 3-1: Is there a need for RAN4 input to the feature** **group for Rel-17 enhanced IIOT/URLLC**

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| Huawei | Option 2.  Technically, we support Proposal 1 from R4-2204472, but we assume it is more proper to be discussed in RAN1. |
| Ericsson | Option 2. There is no need for any RAN4 feature. |
| Nokia | Option 2. |
| Qualcomm | The UE capability should be defined per feature set. We need to check the status in RAN1. |

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-22xxxxx | 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** |
| R4-22xxxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-22xxxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-22xxxxx | 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

# Annex

Contact information

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email address** |
| Intel | Meng | [Meng.zhang@intel.com](mailto:Meng.zhang@intel.com) |
| Huawei | Li Zhang | zhangli164@huawei.com |

Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)