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

**Electronic Meeting, 21st February – 3rd March, 2022**

**Agenda item:** 5.1.3

**Source:** Moderator (Intel Corporation)

**Title:** Email discussion summary for [102-e][205] Maintenance\_NR\_pos

**Document for:** Information

# Introduction

This email discussion handles the contributions submitted to agenda item 5.1.3.1 and 5.1.3.2 (additional papers of R4-2205441/42/43 are moved from AI 5.1.5.3 to this thread). The scope of this email discussion covers Rel-16 positioning enhancement maintenance, which specifies the UE and BS positioning measurement requirements for both Core and Perf. parts. There are 2 topics (Maintenance to RRM core requirements and maintenance to RRM perf. requirements) in this email discussion and multiple sub-topics within each of them. Note that since this discussion is mainly maintenance work, we will start to agree on CRs and mirror CRs in the first round. In the second round, only the projected contentious issues are discussed. There is no GTW time slot planned so far for this email discussion.

# Topic #1: Maintenance to RRM Core requirements

Topic #1 handles the issue identified to maintain RRM Core requirements for Rel-16 positioning. The previously approved WF related to this topic is in ***R4-2120266***.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2203869 | CATT | Discussion on R16 NR positioning core requirement maintenance:**Proposal 1: If the PRS/SRS proximity condition is not met, UE can still measure and report the UE Rx-Tx time difference measurement, but the measurement requirements are not applicable.****Proposal 2: If the PRS/SRS proximity condition is not met, the accuracy requirements still apply.** **Proposal 3: When SRS is reconfigured without cell change during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration on the target cell is complete.** |
| R4-2203870 | CATT | Draft CR on R16 NR positioning measurement requirements (R16) |
| R4-2203871 | CATT | Mirror CR to R4-2203870 |
| R4-2204461 | Qualcomm Incorporated | Remaining issues in NR positioning core requirements:**Proposal 1: When the PRS/SRS proximity condition is not met, UE Rx-Tx time difference measurement requirements do not apply and UE behavior is left to implementation.** |
| R4-2204652 | vivo | Remaining issues on measurement requirements for Rel-16 NR positioning:**Proposal 1: UE still measures and reports UE Rx-Tx measurement if PRS/SRS proximity condition is not met.****Proposal 2: Both UE Rx-Tx measurement period and measurement accuracy requirements apply if PRS/SRS proximity condition is not met.****Proposal 3: When SRS is reconfigured without cell change during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration on the target cell is complete.** |
| R4-2204654 | vivo | Draft CR to 38.133 correction to NR positioning measurement requirements (R16) |
| R4-2204655 | vivo | Mirror CR to R4-2204654 |
| R4-2205351 | Huawei, HiSilicon | Discussion on remaining issues for positioning measurement requirements:**Proposal 1: UE Rx-Tx measurement requirements, including measurement period requirements and measurement accuracy requirements, do not apply when PRS/SRS proximity condition is not met.****Proposal 2: When SRS is reconfigured without cell change during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration on the target cell is complete.** |
| R4-2205352 | Huawei, HiSilicon | CR on positioning measurement requirements R16 (R16) |
| R4-2205353 | Huawei, HiSilicon | Mirror CR to R4-2205352 |
| R4-2206031 | Ericsson | On UE positioning measurement requirements:Observation 1: When PRS/SRS proximity condition is not met then the UE not meeting measurement requirement may lead to worse positioning accuracy.Observation 2: When PRS/SRS proximity condition is not met some UE implementation may still meet the measurement and accuracy requirements.**Proposal for UE behaviour:****Proposal 1: If SRS and PRS proximity condition is not met then it is up to the UE whether to transmit the UE Rx-Tx measurement results to LMF.****Proposals for requirements:****Proposal 2: If the SRS and PRS proximity condition is not met then the UE is not expected to meet the UE Rx-Tx time difference measurement requirements.****Proposal 3: If the SRS and PRS proximity condition is not met then the UE is not expected to meet the UE Rx-Tx time difference accuracy requirements.** |
| R4-2206032 | Ericsson | Updates to measurement requirements for UE positioning measurements in TS 38.133 (R16) |
| R4-2206033 | Ericsson | Mirror CR to R4-2206032 |

## Open issues summary

### Sub-topic 1-1

In previous meeting, the SRS/PRS proximity condition was agreed, and the proximity condition was described as below:

|  |
| --- |
| Agreements in RAN4#98bis-e (R4-2105851): * The measurement requirements is applicable only if any SRS transmission is within [-X, X] msec of at least one DL PRS resource of each of the TRPs in the assistance data.
	+ Accuracy requirements are independent of PRS and SRS separation
	+ X = FFS between 160ms or 80ms
	+ FFS if UE still measures and reports UE Rx-Tx measurement or not if PRS/SRS proximity condition is not met
 |

**Issue 1-1-1: If the SRS and PRS proximity condition is not met, how does RAN4 specify the UE measurement and report requirements (Core)?**

* Option 1: UE Rx-Tx measurement requirements, including measurement period requirements **do not apply.**
	+ It is UE implementation whether the UE transmit the UE Rx-Tx measurement results to LMF or not
* Option 2: UE Rx-Tx measurement requirements still **apply,** and the UE still measures and reports UE Rx-Tx measurement
* Option 3: UE Rx-Tx measurement requirements **do not** **apply,** but the UE still measures and reports UE Rx-Tx measurement
* Recommended WF
	+ Discuss between option 1 and option 2
	+ Agree on option 1

Companies are encouraged to provide comments per sub-topic directly below the summary.

|  |  |
| --- | --- |
| **Company** | **Comments**  |
| Ericsson | We support Option 1 |
| Huawei | Support option 1. |
| Intel | Support Option1 |
| Qualcomm | We support option 1. Again, the motivation is to avoid configurations that violate the proximity condition between SRS and PRS. |
| CATT | Fine with option 1.  |
| Nokia  | We support option 1. |
| vivo | Based on agreements in RAN4#98bis as list by moderator, accuracy requirements are independent of PRS and SRS separation.So, we propose option 1a instead.* Option 1a: UE Rx-Tx measurement reporting and measurement period requirements **do not apply** but measurement accuracy requirements **still apply.**
	+ It is up to UE implementation whether the UE transmits the UE Rx-Tx measurement results to LMF or not
 |

**Issue 1-1-2: If the SRS and PRS proximity condition is not met, what about accuracy requirements (Perf.)?**

* Option 1: UE Rx-Tx measurement accuracy requirements **do not apply.**
* Option 2: UE Rx-Tx measurement accuracy requirements still **apply**
* Recommended WF
	+ Discuss between option 1 and option 2
	+ Agree on option 1

Companies are encouraged to provide comments per sub-topic directly below the summary.

|  |  |
| --- | --- |
| **Company** | **Comments**  |
| Ericsson | Support Option 1 |
| Huawei | Support option 1. |
| Intel | Support option 1. |
| Qualcomm | Option 1. Same motivation as for issue 1-1-1. |
| CATT | Fine with option 1.  |
| Nokia  | We support option 1. |
| vivo | Comments provided for Issue 1-1-2. |

### Sub-topic 1-2

In RAN4#101-e, it was agreed that if serving cell change, i.e. PSCell or SCell addition or release, causes SRS reconfiguration, UE shall re-start the Rx-Tx measurement. The scenario is that SRS was configured on old Scell, and then cell change occurs where the old Scell is released and new Scell is added. UE should re-start the measurement after SRS is configured on the new Scell.

|  |
| --- |
| Issue 1-2-2: Measurement period requirements with cell change impacting SRSWhen PSCell or Scell addition or release causes SRS reconfiguration during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration on the target cell is complete.FFS: When SRS is reconfigured without cell change during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration on the target cell is complete. |

**Issue 1-2-1: When SRS is reconfigured without cell change during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration on the target cell is complete.**

* Recommended WF
	+ Agree on the below statement
		- When SRS is reconfigured without cell change during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration on the target cell is complete.

Companies are encouraged to provide comments per sub-topic directly below the summary.

|  |  |
| --- | --- |
| **Company** | **Comments**  |
| Ericsson | Our understanding is that this is related to SRS reconfiguration in the existing serving cell. So the use of target cell is very confusing. In principle we are fine with the WF. But the wording needs to be updated as follows:* *When SRS is reconfigured on the serving cell without serving cell change during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration on the serving cell is complete*
 |
| Huawei | We support the Recommended WF. We can also see the point raised up by Ericsson, but we understand scenario includes both SRS reconfiguration in the existing serving cell and SRS reconfiguration from one serving cell to another serving cell, so we suggest following update based on the version from Ericsson:* + - *When SRS is reconfigured on the serving cell or from one serving cell to another serving cell without serving cell change during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration ~~on the serving cell~~ is complete*
 |
| Intel | We support the recommended WF. There is similar discussion in Rel17 ePos. It is better we can conclude this for Rel16. |
| Qualcomm | Support the recommended WF with one correction:When SRS is reconfigured without cell change during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration ~~on the target cell~~ is completeThe wording in CR R4-2206034 can be used. |
| CATT | Fine with the recommended WF and QC’s wording.  |
| Ericsson2 | QC suggested wording leaves some ambiguity whether the SRS is reconfigured on the current serving cell or between serving cells.We are fine either to limit the case for SRS reconfiguration on the serving cell or between serving cells. But the UE behavour should be clear. We prefer following wording:1. If we only consider SRS reconfiguration on the serving cell

*When SRS is reconfigured on the serving cell without serving cell change during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration is complete.*1. If we consider SRS reconfiguration on the serving cell, as well as between serving cells.

OK with HW wording. |
| Nokia  | We support the recommended WF. |
| vivo | Agree with the recommended WF. QC’s wording seems clearer. |

## Companies views’ collection for 1st round

### Open issues

 ***Companies are encouraged to provide comments to each of the sub-topics in the above section.***

### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2203870R4-2203871CATT | E///: Wording needs update. Please see our comments on: **Issue 1-2-1** |
| Huawei: pending on open issue conclusion |
| Qualcomm: The first change is OK in principle but we suggest refining the wording as follows:"the UE transmits SRS within [-160, 160] msec of at least one DL PRS resource of each of the TRPs in the assistance data.”For the second change, use the wording in R4-2206032.CATT: fine with QC’s suggestion on the first change. The second change can follow the conclusion of issue 1-2-1.  |
| R4-2204654R4-2204655vivo | E///: Wording needs update. Please see our comments on: **Issue 1-2-1** |
| Huawei: pending on open issue conclusion |
| Qualcomm: Use the wording in R4-2206032. |
| R4-2205352R4-2205353Huawei | E///: Wording needs update. Please see our comments on: **Issue 1-2-1** |
| Huawei: pending on open issue conclusion |
| Qualcomm: Use the wording in R4-2206032. |
| R4-2206032R4-2206033Ericsson | Huawei: pending on open issue conclusion |
| Qualcomm: OK |
|  |

## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic#1-1-1** | *Tentative agreements:** If the SRS and PRS proximity condition is not met, UE Rx-Tx measurement and reporting requirements **do not apply.**
	+ It is UE implementation whether the UE transmit the UE Rx-Tx measurement results to LMF or not

*Recommendations for 2nd round: Agree on the above tentative agreements.* |
| **Sub-topic#1-1-2** | *Background clarification:* *7 companies provided comments in the 1st round and all of which supported option 1 except one company supported option 2. The moderator suggests agreeing on option 1 and if it is not objected, he thanks to companies for the great efforts and fair compromise.**Tentative agreements:** If the SRS and PRS proximity condition is not met, UE Rx-Tx measurement accuracy requirements **do not apply.**

*Recommendations for 2nd round: Agree on the above tentative agreements.* |
| **Sub-topic#1-2-1** | *Background clarification:**Thanks to the good discussion in the 1st round, companies clarified that the idea of the proposal from moderator is accepted in general. Detailed updates are further proposed and discussed by companies. The moderator suggests agreeing on a further polished version (applies to all scenarios).**Tentative agreements:** When SRS is reconfigured without serving cell change during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration is complete.

*Recommendations for 2nd round: Agree on the above tentative agreements.* |
|  |  |

### CRs/TPs

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| R4-2203870R4-2203871CATT | Revised to address Qualcomm comments and capture conclusion of discussion issue 1-2-1. |
| R4-2204654R4-2204655vivo | *Merged into R4-2203870/3871;**R16 Not pursued;**R17 withdrawn* |
| R4-2205352R4-2205353Huawei | *Merged into R4-2203870/3871;**R16 Not pursued;**R17 withdrawn* |
| R4-2206032R4-2206033Ericsson | *Merged into R4-2203870/3871;**R16 Not pursued;**R17 withdrawn* |

## 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*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
|  |  |
|  |  |

# Topic #2: Maintenance to RRM Perf. Requirements

Performance part maintenance of the R16 positioning requirements corrections is covered in Topic #2. Please see the below details. The previously approved WF related to this topic is in ***R4-2120270***.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2203872 | CATT | Discussion on R16 NR positioning performance maintenance:**Proposal 1: The PRS RSRP accuracy requirements in extreme condition are X dB larger than that in normal condition, and X is:** * + - **3dB for absolute accuracy for FR1.**
		- **3dB for absolute accuracy for FR2.**
		- **1dB for relative accuracy for FR1.**
		- **3dB for relative accuracy for FR2.**

**Proposal 2: For the PRS RSRP accuracy requirements in extreme condition, define a single value for each SINR side condition independent of PRS configuration.** **Proposal 3: UE Rx-Tx measurement accuracy requirements shall apply if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.****Proposal 4: No need to define additional test cases for UE based positioning.** |
| R4-2203873 | CATT | Draft CR on R16 NR positioning accuracy requirements (R16) |
| R4-2203874 | CATT | Mirror CR to R4-2203873 |
| R4-2203875 | CATT | Draft CR on SRS configuration for R16 positioning test case (R16) |
| R4-2203876 | CATT | Mirror CR to R4-2203875 |
| R4-2204407 | Intel Corporation | Discussion on Rel-16 NR positioning measurement accuracy requirements:**Proposal 1: The maximum frequency drift between the measured TRPs can be dependent the maximum time offsets among the measured TRPs/cells (e.g. 2\* expectedRSTD).****Proposal 2: Applicability of accuracy requirements under TA adjustment if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment can be:*** + - **UE Rx-Tx measurement accuracy requirements shall apply for a serving cell even if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.**
		- **the UE Rx-Tx measurement accuracy requirements shall not apply for a eighbour cell if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.**
 |
| R4-2204462 | Qualcomm Incorporated | On UE measurement accuracy requirements for NR positioning:**Proposal 1: For UE Rx-Tx measurement accuracy requirements in FR1, add group delay calibration margins listed in the table below.**

|  |  |
| --- | --- |
| **Min(PRS BW, SRS BW) (MHz)** | **Margin (Tc)** |
| ≥ 5 | 160 |
| ≥ 10 | 80 |
| ≥ 20 | 40 |
| ≥ 50 | 16 |
| ≥ 100 | 8 |

**Proposal 2: For UE Rx-Tx measurement accuracy requirements in FR2, add group delay calibration margins listed in the table below.**

|  |  |
| --- | --- |
| **Min(PRS BW, SRS BW) (MHz)** | **Margin (Tc)** |
| ≥ 20 | 80 |
| ≥ 50 | 32 |
| ≥ 100 | 16 |
| ≥ 200 | 8 |

**Proposal 3: For RSTD measurement accuracy requirements in FR1 when the reference and target PRS resources are in the same PFL (single PFL case), add group delay calibration margins listed in the table below.**

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 5 | 160 |
| ≥ 10 | 80 |
| ≥ 20 | 40 |
| ≥ 50 | 16 |
| ≥ 100 | 8 |

**Proposal 4: For RSTD measurement accuracy requirements in FR2 when the reference and target PRS resources are in the same PFL (single PFL case), add group delay calibration margins listed in the table below.**

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 20 | 80 |
| ≥ 50 | 32 |
| ≥ 100 | 16 |
| ≥ 200 | 8 |

**Proposal 5: For PRS-RSTD measurements in FR1 with neighbor and reference PRS resources in different PFLs, the value of the group delay calibration margin is FFS.****Proposal 6: For PRS-RSTD measurements in FR2 with neighbor and reference PRS resources in different PFLs, the value of the group delay calibration margin is FFS.****Proposal 7a: Add a frequency margin of 32 Tc for RSTD that applies for a maximum time offset of 160 msec between the PRS resource instances used to calculate the RSTD measurement for the case of a single PFL.****Proposal 7b: Add a frequency margin of 50 Tc for RSTD that applies for a maximum time offset of 1 second between the PRS resource instances used to calculate the RSTD measurement for the case of multiple PFLs.****Proposal 8: No need to define PRS-RSRP accuracy requirements for extreme conditions.****Proposal 9: UE Rx-Tx measurement accuracy requirements shall apply if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.** |
| R4-2204653 | vivo | Remaining issues on measurement accuracy requirements for Rel-16 NR positioning:**Proposal 1: Frequency drift margin for the RSTD accuracy requirements is 0.5Ts (32Tc) in both FR1 and FR2.** **Proposal 2: The margin for PRS-RSRP accuracy requirements under extreme conditions are:*** + - **3dB for absolute accuracy for FR1.**
		- **3dB for absolute accuracy for FR2.**
		- **1.5dB for relative accuracy for FR1.**
		- **3dB for relative accuracy for FR2.**

**Proposal 3: UE Rx-Tx measurement accuracy requirements shall apply if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.** |
| R4-2204656 | vivo | Draft CR to 38.133 correction to NR positioning accuracy requirements |
| R4-2204657 | vivo | Mirror CR to R4-2204656 |
| R4-2205354 | Huawei, HiSilicon | Discussion on accuracy requirements for positioning measurement:**Proposal 1: Add the following group delay calibration margin for RSTD accuracy for single PFL case.****Table 1: Calibration margin for RSTD FR1 single PFL case**

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 5 | [40] |
| ≥ 10 | [32] |
| ≥ 20 | [32] |
| ≥ 50 | [16] |
| ≥ 100 | [16] |

**Table 2: Calibration margin for RSTD FR2 single PFL case**

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 20 | [32] |
| ≥ 50 | [32] |
| ≥ 100 | [16] |
| ≥ 200 | [16] |

**Proposal 2: For RSTD accuracy requirements, define the frequency drift margin as +/-32Tc based on maximum offset of 160ms. FFS whether and how to handle larger time offset.** **Proposal 3: RAN4 does not define PRS-RSRP accuracy requirements for extreme condition in Rel-16.****Proposal 4: Add the following group delay calibration margin for UE Rx-Tx accuracy.****Table 3: Calibration margin for UE Rx-Tx FR1**

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 5 | [96] |
| ≥ 10 | [80] |
| ≥ 20 | [72] |
| ≥ 50 | [32] |
| ≥ 100 | [24] |

**Table 4: Calibration margin for UE Rx-Tx FR2**

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 20 | [72] |
| ≥ 50 | [32] |
| ≥ 100 | [24] |
| ≥ 200 | [24] |

**Proposal 5: Applicability of Rx-Tx accuracy requirements with autonomous timing adjustment is defined as:*** + - **UE Rx-Tx measurement accuracy requirements shall apply for a cell, which is also the downlink reference cell (defined in section 7.1.1) for SRS transmission even if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.**
		- **UE Rx-Tx measurement accuracy requirements shall not apply for a cell, which is not the downlink reference cell (defined in section 7.1.1) for SRS transmission, if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.**
 |
| R4-2205355 | Huawei, HiSilicon | CR on accuracy requirements for positioning measurement R16 (R16) |
| R4-2205356 | Huawei, HiSilicon | Mirror CR to R4-2205355 |
| R4-2205357 | Huawei, HiSilicon | CR to introduce posSRS RMC for positioning test cases R16 (R16) |
| R4-2205358 | Huawei, HiSilicon | Mirror CR to R4-2205358 |
| R4-2206034 | Ericsson | On UE positioning accuracy measurements:Observation 1: It may not be uncommon that the UE operates in extreme conditions e.g. at 14C or 36C.Observation 2: PRS-RSRP may significantly drift or vary in the extreme conditions.**Proposal 1: Specify PRS-RSRP accuracies in extreme conditions.****Proposal 2: Support PRS-RSRP accuracies in extreme conditions as in the WF i.e.: PRS RSRP measurement requirements in extreme condition are X dB larger than that in normal condition, and X is:*** + - **3dB for absolute accuracy for FR1.**
		- **3dB for absolute accuracy for FR2.**
		- **1.5 dB for relative accuracy for FR1.**
		- **3dB for relative accuracy for FR2.**

Observation 3: The UL autonomous timing adjustment, which is based on the DL timing, follows the DL timing change in the reference cell, resulting in the UE transmit timing changes in the same direction in which the DL timing changes in the reference cell.Observation 4: The UE can be configured to perform UE Rx-Tx measurements on multiple cells (multi-RTT).Observation 5: In one multi-RTT measurement scenario, the UE may transmit SRS on reference cell (e.g. Pcell) while perform PRS also on the reference cell (e.g. Pcell). In this case the changes in SRS timing due to autonomous timing adjustment follows the PRS timing change in the reference cell.Observation 6: In another multi-RTT measurement scenario, the UE may transmit SRS on reference cell (e.g. Pcell) while perform PRS on another serving cell (e.g. Scell). In this case the changes in SRS timing due to autonomous timing adjustment is not related to PRS timing in the Scell.Observation 7: In another multi-RTT measurement scenario, the UE may transmit SRS on reference cell (e.g. Pcell) while perform PRS on a neighbor cell (non-serving cell). In this case as well the changes in SRS timing due to autonomous timing adjustment is not related to PRS timing in the neighbor cell.**Proposal 3: Applicability of accuracy requirements under TA adjustment if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment is specified to cover all supported single RTT and multi-RTT measurement scenarios.****Proposal 4: Applicability of accuracy requirements under TA adjustment if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment is specified based on Option 2 in the WF [1] i.e:*** + - **UE Rx-Tx measurement accuracy requirements shall apply for a cell, which is also the downlink reference cell (defined in section 7.1.1) for SRS transmission even if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.**
		- **the UE Rx-Tx measurement accuracy requirements shall not apply for a cell, which is not the downlink reference cell (defined in section 7.1.1) for SRS transmission, if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.**
 |
| R4-2206035 | Ericsson | Updates to accuracy requirements for UE positioning measurements in TS 38.133 (R16) |
| R4-2206036 | Ericsson | Mirror CR to R4-2206035 |
| R4-2205441 | Rohde & Schwarz | On UE-based DL-TDOA support:Observation 1: Measurement delay requirements are agnostic of UE-assisted or UE-based positioning method.Observation 2: The UE needs the base station antenna location and the RTD value for a UE-based location fix.**Proposal 1: To enable measurement delay testing for UE-based DL-TDOA, add to the test case a table containing a model of the base station locations and the RTD value between them compliant to the current test configurations. For UE-based the UE location fix reporting delay is evaluated.** The UE location in the table below is based on the time offset between PRS signals defined for the test case in A.6.6.12.1/2 in [4]. It is just shown for information purposed and it will not be provided to the UE.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **East [m]** | **North [m]** | **Up [m]** | **RTD** |
| **NR Cell 1** | 0 | 0 | 20 | 0 (Ref) |
| **NR Cell 2** | 3000 | 0 | 15 | 0 |
| **NR Cell 3** | 1500 | 2598 | 25 | 0 |
| **UENote 1** | 1500 | 399 | 0 | N/A |
| Note 1: The UE coordinates are derived from the time delays between PRS signals. They are for information and are not part of the assistance data.Note 2: The HDOP of the proposed model is 1.03. |

Observation 3: The accuracy of the RSTD measurements cannot be evaluated directly from the UE-based reports.**Proposal 2: To enable measurement accuracy testing for UE-based DL-TDOA, infer RSTD measurement accuracy from location fix reporting accuracy using the equation** $E\_{fix}=E\_{RSTD}⋅HDOP$**Proposal 3: Add a third cell to RSTD measurement accuracy test cases to enable RSTD accuracy testing for UE-based DL-TDOA.****Proposal 4: For the measurement accuracy test case, re-use the same positioning scenario as for measurement delay test case (Proposal 1).**Submitted to AI 5.1.5.3 |
| R4-2205442 | Rohde & Schwarz | Draft CR to TS 38.133: Additions to RSTD test cases for UE-based DL-TDOA support (R16)Submitted to AI 5.1.5.3 |
| R4-2205443 | Rohde & Schwarz | Mirror CR to R4-2205441Submitted to AI 5.1.5.3 |

## Open issues summary

### Sub-topic 2-1 RSTD measurements

For RSTD, if reference cell and neighbour cell are measured with different Rx paths or at different times, the measurements will experience different calibration errors which cannot be cancelled out. As a result, a margin to account for the ‘relative’ calibration error is needed.

**Issue 2-1-1: Group delay calibration margin for RSTD measurement accuracy in FR1**

* Proposals for single PFL
	+ Option 1:

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 5 | 160 |
| ≥ 10 | 80 |
| ≥ 20 | 40 |
| ≥ 50 | 16 |
| ≥ 100 | 8 |

* + Option 2:

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 5 | [40] |
| ≥ 10 | [32] |
| ≥ 20 | [32] |
| ≥ 50 | [16] |
| ≥ 100 | [16] |

* Recommended WF
	+ Compromised values are needed so moderator proposes the below values with brackets

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 5 | [100] |
| ≥ 10 | [56] |
| ≥ 20 | [36] |
| ≥ 50 | [16] |
| ≥ 100 | [12] |

Companies are encouraged to provide comments per sub-topic directly below the summary.

|  |  |
| --- | --- |
| **Company** | **Comments**  |
| E/// | We are fine with the recommended WF |
| Huawei | We are fine with the recommended WF |
| Intel | Support the recommended WF |
| Qualcomm | The recommended WF is mostly OK. For the first two bins, options 1 and 2 are quite far apart so the average is not attractive as a compromise with such a large spread. The rest are OK to us.We suggest to leave the fist two bins as TBD for now. For the next meeting, we check if we can revise our proposals for those two bins and come up with lower margins. However, we would also like to ask Huawei for an explanation of the dependence of the margin vs. BW in their proposal. In our proposal it’s clear that the margin scales inversely with BW but not so in Huawei’s proposal. What is the rationale behind Huawei’s proposal?

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 5 | TBD |
| ≥ 10 | TBD |
| ≥ 20 | [36] |
| ≥ 50 | [16] |
| ≥ 100 | [12] |

 |

**Issue 2-1-2: Group delay calibration margin for RSTD measurement accuracy in FR2**

* Proposals for single PFL
	+ Option 1:

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 20 | 80 |
| ≥ 50 | 32 |
| ≥ 100 | 16 |
| ≥ 200 | 8 |

* + Option 2:

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 20 | [32] |
| ≥ 50 | [32] |
| ≥ 100 | [16] |
| ≥ 200 | [16] |

* Recommended WF
	+ Compromised values are needed so moderator proposes the below value with brackets

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 10 | [56] |
| ≥ 20 | [32] |
| ≥ 100 | [16] |
| ≥ 200 | [12] |

Companies are encouraged to provide comments per sub-topic directly below the summary.

|  |  |
| --- | --- |
| **Company** | **Comments**  |
| E/// | We are fine with the recommended WF.  |
| Huawei | We are fine with the recommended WF |
| Intel | Support the recommended WF |
| Qualcomm | Similar comment as for issue 2-1-2. For now, we can compromise to the table below.

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 10 | TBD |
| ≥ 20 | [32] |
| ≥ 100 | [16] |
| ≥ 200 | [12] |

 |

**Issue 2-1-3: Frequency drift margin for RSTD measurement accuracy requirements**

|  |
| --- |
| **Frequency drift margin for RSTD** * RAN4 will define a single value for the frequency drift margin based on a single value of the maximum time offset
* FFS on the exact value
 |

* Proposals
	+ Option 1: The maximum frequency drift between the measured TRPs can be dependent the maximum time offsets among the measured TRPs/cells (e.g. 2\* expectedRSTD)
	+ Option 2:
		- Add a frequency margin of 32 Tc for RSTD that applies for a maximum time offset of 160 msec between the PRS resource instances used to calculate the RSTD measurement for the case of a single PFL.
		- Add a frequency margin of 50 Tc for RSTD that applies for a maximum time offset of 1 second between the PRS resource instances used to calculate the RSTD measurement for the case of multiple PFLs.
	+ Option 3: Frequency drift margin for the RSTD accuracy requirements is 0.5Ts (32Tc) in both FR1 and FR2.
	+ Option 4: For RSTD accuracy requirements, define the frequency drift margin as +/-32Tc based on maximum offset of 160ms. FFS whether and how to handle larger time offset
* Recommended WF
	+ Option 5: Specify frequency drift margin for RSTD accuracy requirements assuming one single maximum timing offset, which is [160ms] across FR1 and FR2: [32Tc].

Companies are encouraged to provide comments per sub-topic directly below the summary.

|  |  |
| --- | --- |
| **Company** | **Comments**  |
| Huawei | We are fine with the recommended WFWe are also open to consider a larger margin value based on a larger time offset, but the value proposed in option 2 is too aggressive. We suggest to assume 0.1ppm as in the UE RF requirements if additional {margin, time offset} is to be introduced.  |
| Intel | The recommended WF is fine for us.  |
| Qualcomm | We support option 2, which provides some flexibility to address single PFL and multiple PFL scenarios. The first bullet point under option 2 aligns with option 3 and the recommended WF.For the second bullet point under option 2, we are open to discussing the margin and time offset values.As a compromise, we propose the following:* Specify a frequency drift margin of 32 Tc for RSTD that applies for a maximum time offset of 160 msec between the PRS resource instances used to calculate the RSTD measurement for the case of a single PFL in FR1 and FR2.
* FFS the frequency drift margin and the maximum time offset for the case of multiple PFLs

Option 1: Add a frequency margin of [50 Tc] for RSTD that applies for a maximum time offset of [1 second] between the PRS resource instances used to calculate the RSTD measurement for the case of multiple PFLs. |
| vivo | Support the recommended WF. |

### Sub-topic 2-2 Rx – Tx measurements

For UE Rx-Tx, one of the differences is that the group delay of both Rx path and Tx path need to be compensated, so the calibration error from both paths need to be accounted. For both Rx – Tx and RSTD, group delay is dependent on BW and frequency range.

**Issue 2-2-1: Group delay calibration margin for Rx-Tx measurement accuracy in FR1**

* Proposals for single PFL
	+ Option 1:

|  |  |
| --- | --- |
| **Min(PRS BW, SRS BW) (MHz)** | **Margin (Tc)** |
| ≥ 5 | 160 |
| ≥ 10 | 80 |
| ≥ 20 | 40 |
| ≥ 50 | 16 |
| ≥ 100 | 8 |

* + Option 2:

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 5 | [96] |
| ≥ 10 | [80] |
| ≥ 20 | [72] |
| ≥ 50 | [32] |
| ≥ 100 | [24] |

* Recommended WF
	+ Compromised values are needed so moderator proposes the below values with brackets

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 5 | [128] |
| ≥ 10 | [80] |
| ≥ 20 | [56] |
| ≥ 50 | [24] |
| ≥ 100 | [16] |

Companies are encouraged to provide comments per sub-topic directly below the summary.

|  |  |
| --- | --- |
| **Company** | **Comments**  |
| E/// | We are fine with the recommended WF |
| Huawei | We are fine with the recommended WF except for the largest BW (100MHz). We suggest to use the value in option 2, i.e. 24Tc. We were proposing 48Tc in previous meetings, and we can compromise to 24Tc as in option 2. We think it is challenging to achieve smaller value than that because unlike RSTD, for UE Rx-Tx both UL and DL errors need to be considered.  |
| Intel | We agree on Huawei’s view. UE Rx-Tx performance can be impacted on both DL and UL error(SRS). And in order to make progress, we can compromise the value below. And companies can further confirm in future meeting.

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 5 | [128] |
| ≥ 10 | [80] |
| ≥ 20 | [56] |
| ≥ 50 | [24] |
| ≥ 100 | [24] |

 |
| Qualcomm | We have similar concerns here as for the RSTD group delay margins (sub-topic 2-1).We propose the following as a compromise in this meeting.

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 5 | TBD |
| ≥ 10 | [80] |
| ≥ 20 | [56] |
| ≥ 50 | [24] |
| ≥ 100 | [24] |

 |

**Issue 2-2-2: Group delay calibration margin for Rx – Tx measurement accuracy in FR2**

* Proposals for single PFL
	+ Option 1:

|  |  |
| --- | --- |
| **Min(PRS BW, SRS BW) (MHz)** | **Margin (Tc)** |
| ≥ 20 | 80 |
| ≥ 50 | 32 |
| ≥ 100 | 16 |
| ≥ 200 | 8 |

* + Option 2:

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 20 | [72] |
| ≥ 50 | [32] |
| ≥ 100 | [24] |
| ≥ 200 | [24] |

* Recommended WF
	+ Compromised values are needed so moderator proposes the below value with brackets

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 10 | [76] |
| ≥ 20 | [32] |
| ≥ 100 | [20] |
| ≥ 200 | [16] |

Companies are encouraged to provide comments per sub-topic directly below the summary.

|  |  |
| --- | --- |
| **Company** | **Comments**  |
| E/// | We are fine with the recommended WF |
| Huawei | We are fine with the recommended WF except for the two largest BW (100MHz and 200MHz). We suggest to use 24Tc for 100MHz and 20Tc for 200MHz for the same reason mentioned in Issue 2-2-1.  |
| Intel | The compromised values can be updated as below. Companies can further confirm these bracketed values in the future meetings.

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 10 | [76] |
| ≥ 20 | [32] |
| ≥ 100 | [24] |
| ≥ 200 | [20] |

 |
| Qualcomm | We can compromise to the revised margins proposed by Intel but note that there was a typo the PRS BW in the first two rows. It should be as shown below

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 20 | [76] |
| ≥ 50 | [32] |
| ≥ 100 | [24] |
| ≥ 200 | [20] |

 |

**Issue 2-2-3: Applicability of Rx-Tx accuracy requirements with autonomous timing adjustment**

* Proposals
	+ Option 1: UE Rx-Tx measurement accuracy requirements shall apply if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.
	+ Option 2: Applicability of accuracy requirements under TA adjustment if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment can be:
		- UE Rx-Tx measurement accuracy requirements shall apply for a serving cell even if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.
		- the UE Rx-Tx measurement accuracy requirements shall not apply for a neighbor cell if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.
	+ Option 3: Applicability of Rx-Tx accuracy requirements with autonomous timing adjustment is defined as:
		- UE Rx-Tx measurement accuracy requirements shall apply for a cell, which is also the downlink reference cell (defined in section 7.1.1) for SRS transmission even if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.
		- UE Rx-Tx measurement accuracy requirements shall not apply for a cell, which is not the downlink reference cell (defined in section 7.1.1) for SRS transmission, if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.
* Recommended WF
	+ Agree on Option 3

Companies are encouraged to provide comments per sub-topic directly below the summary.

|  |  |
| --- | --- |
| **Company** | **Comments**  |
| E/// | We support the recommended WF. Option 3 is generic enough to cover all multi-RTT measurement scenarios.  |
| Huawei | We support the recommended WF. |
| Intel | support the recommended WF. |
| Qualcomm | We support option 1.Our understanding is that options 2 and 3 would limit applicability of requirements to only one cell. Multi-RTT would not be viable. Is that the intention? |
| CATT | Prefer option 1. Generally multiple-RTT is based on the measurement of multiple cell, it is strange that some cells meet the requirements while others not. And we think the PRS measurement does not differentiate whether the cell is downlink reference cell, suggest defining a unified applicability.  |
| Ericsson2 | To QC/CATT.* The issue is not about limiting the multi-RTT measurement to single cell or certain cells. we have to ensure that the multi-RTT measurement does not add any additional error/uncertainty beyond the specified accuracy.
* The problem with Option 1 is that multi-RTT measurements done on cells other than reference cell (assuming both PRS and SRS are transmitted on the reference cell) will be incorrect/unreliable.
 |
| Nokia  | We support the recommended WF. |
| vivo | We support option 1. |

### Sub-topic 2-3 RSRP measurements

**Issue 2-3-1: PRS-RSRP accuracy under extreme condition**

* Proposals
	+ Option 1: The PRS RSRP accuracy requirements in extreme condition are X dB larger than that in normal condition, and X is one single value for each SNR side condition across different PRS configurations:
		- 3dB for absolute accuracy for FR1.
		- 3dB for absolute accuracy for FR2.
		- 1dB for relative accuracy for FR1.
		- 3dB for relative accuracy for FR2.
	+ Option 2: The margin for PRS-RSRP accuracy requirements under extreme conditions are:
		- 3dB for absolute accuracy for FR1.
		- 3dB for absolute accuracy for FR2.
		- 1.5dB for relative accuracy for FR1.
		- 3dB for relative accuracy for FR2.
	+ Option 3: No need to define PRS-RSRP accuracy requirements for extreme conditions in Rel-16.
* Recommended WF
	+ Agree on Option 2

Companies are encouraged to provide comments per sub-topic directly below the summary.

|  |  |
| --- | --- |
| **Company** | **Comments**  |
| E/// | We are fine with the recommended WF. There is no reason to exclude PRS RSRP accuracy requirements in extreme condition. |
| Huawei | Support option 3 but we can compromise to option 2 (recommended WF). |
| Intel | Support the recommended WF |
| Qualcomm | Our preference is option 3. The reason is that we don’t see a strong need for such requirements. As Huawei points out in their paper, RAN4 has not specified accuracy requirements for other NR positioning measurements under extreme conditions. |
| CATT | Fine with both option 1 and option 2. Agree with Ericsson that there is no reason to preclude PRS measurement.  |
| Nokia  | We support the recommended WF. |
| vivo | Fine with the recommended WF. |

### Sub-topic 2-4 UE based DL-TDOA test cases

There are two positioning modes, UE-assisted and UE-based. Current test requirement definition assumes UE-assisted support. However, UE-assisted and UE-based are both optional features. A UE could decide to support only UE-based DL-TDOA and not support UE-assisted. In such a scenario, DL-TDOA requirements would remain untested for this UE. Previous agreements are copied below.

|  |  |
| --- | --- |
| **Sub-topic#3-1** | **Test cases for the UE-based positioning measurement delay reporting*** + FFS on test case for UE based positioning measurement delay reporting : RAN4 to add UE-based DL-TDOA reporting delay test case requirements based on the existing RSTD reporting delay test cases, but adding the needed pre-requisites.
 |
| **Sub-topic #3-2** | **Test cases for the UE-based positioning measurement accuracy requirements*** + FFS on test case for UE based positioning measurement accuracy requirements : RAN4 to consider the definition of DL-TDOA accuracy test case requirements for UEs supporting UE-based DL-TDOA based on one of the following alternatives:
		- Alternative 1: considering the worst case RSTD absolute accuracy from TS 38.133 section 10.1.23 (e.g. Expected RSTD – K for the serving cell, Expected RSTD + K for all neighbor cells, where K is the accuracy limit for the corresponding PRS configuration), calculate the total positioning error that results based on multilateration algorithm.
		- Alternative 2: consider the E911 requirements as basis and define a positioning accuracy error of +-50m
 |
| **Sub-topic#3-3** | **TC of RSTD accuracy with dual PFLs*** FFS: Option 1 (Huawei):
* RAN4 to remove the test cases for RSTD accuracy with dual PFLs
 |

**Issue 2-4-1: Measurement delay test cases**

* Proposals
	+ Option 1: To enable measurement delay testing for UE-based DL-TDOA,add to the test case a table containing a model of the base station locations and the RTD value between them compliant to the current test configurations. For UE-based the UE location fix reporting delay is evaluated.
	+ Option 2: No need to define additional test cases for UE based positioning.
* Recommended WF
	+ Discuss upon Option 1.

Companies are encouraged to provide comments per sub-topic directly below the summary.

|  |  |
| --- | --- |
| **Company** | **Comments**  |
| E/// | We support Option 2. There are no core requirements for UE-based DL-TDOA. Therefore, test case should not contain any aspect related to UE-based DL-TDOA. In the beginning of R16 positioning WI, the UE-based DL-TDOA was down prioritized.  |
| Huawei | Option 2.Same comment as Ericsson. |
| Intel | Option 2 |
| Qualcomm | A new test for UE-based DL-TDOA reporting delay can be added with limited additional effort, leveraging the existing test case setup for UE-assisted. The details of the test configuration may need to be discussed further. Sufficient time should be given to companies to evaluate/check the proposal. It would be reasonable to aim to finalize the test case by the next RAN4 meeting. |
| CATT | Support option 2.  |
| R&S | As previously discusses, the main concern is that UE supporting only UE-based, will remain untested, although the underlying RSTD measurements are the same and fulfil the same requirement as UE assisted (as confirmed also by R4-2203872, CATT), but they are simply not accessed due to lack of respective reports. Thus, we support Option 1, which proposes a way how to adapt the UE assisted test case setup to cover also the UE based testing, by evaluating the same RSTD requirements by indirectly assessing the UE based location fix reports. This is also aligned with the comment of Qualcomm, which we support.  |
| Ericsson2 | To R&S: there are many different capabilities and features but they lack requirements. It is normal that such capabilities cannot be tested for requirements – because there are no requirements. We do not see the need for defining requirements for the sake of testing. It is the other way around i.e. tests are defined to verify requirements. Requirements cannot be defined as TEI17. This is significant work. RAN4 deliberately down prioritized this work in R16.  |
| Nokia  | We support option 2. |

**Issue 2-4-2: Measurement accuracy test cases**

* Proposals
	+ Option 1: specify UE-based DL-TDOA measurement accuracy test cases
		- To enable measurement accuracy testing for UE-based DL-TDOA, infer RSTD measurement accuracy from location fix reporting accuracy using the equation E\_fix=E\_RSTD⋅HDOP
		- Add a third cell to RSTD measurement accuracy test cases to enable RSTD accuracy testing for UE-based DL-TDOA
		- Re-use the same positioning scenario as for measurement delay test case mentioned in issue 2-4-1
	+ Option 2: No need to define additional test cases for UE based positioning.
* Recommended WF
	+ Discuss upon Option 1.

Companies are encouraged to provide comments per sub-topic directly below the summary.

|  |  |
| --- | --- |
| **Company** | **Comments**  |
| E/// | We support Option 2. There are no performance/accuracy requirements for UE-based DL-TDOA. Therefore, test case should not contain any aspect related to UE-based DL-TDOA. In the beginning of R16 positioning WI, the UE-based DL-TDOA was down prioritized.  |
| Huawei | Option 2.Same comment as Ericsson. |
| Intel | Option 2 |
| Qualcomm | Regarding the positioning accuracy test, our view is that this amounts to specifying new requirements. We would support the proposal but it should be done properly, with a new simulation campaign in RAN4 (leveraging existing simulation assumptions). We think this could be done under Rel-16 TEI or Rel-17 TEI (and back-ported to Rel-16). |
| CATT | Support option 2.  |
| R&S | As previously discusses, the main concern is that UE supporting only UE-based, will remain untested. We support Option 1 and the comment of Qualcomm.  |
| Ericsson2 | Same view as for measurement delay tests:We should not define accuracy requirements for the sake of testing accuracy. Tests are defined to verify accuracy requirements.  |
| Nokia  | We support option 2. |

## Companies views’ collection for 1st round

### Open issues

 ***Companies are encouraged to provide comments to each of the sub-topics in the above section.***

### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2203873R4-2203874CATT | E///: Might need update based on the agreements on related issues (sub-topic 2-2) |
| Qualcomm:Change 1 depends on issue 2-3-1.Change 2 depends on issue 2-2-3.Change 3 is OK |
|  |
| R4-2203875R4-2203876CATT | E///: seems some overlap with CR in 5357 (HW) |
| Qualcomm: Merge with R4-2205357. |
|  |
| R4-2204656R4-2204657vivo | E///: Might need update based on the agreements on related issues (sub-topic 2-2) |
| Qualcomm* Defined PRS-RSRP accuracy requirements under extreme conditions. -> Depends on issue 2-3-1.
* UE Rx-Tx time difference accuracy requirements shall apply under TA autonomous adjustment -> Depends on issue 2-2-3.
 |
|  |
| R4-2205355R4-2205356Huawei | E///: Might need update based on the agreements on related issues (sub-topics 2-1, 2-2) |
| Qualcomm:Changes 1 and 2: Depend on issues 2-1-1, 2-1-2, 2-1-3Change 3 depends on issues 2-2-1, 2-2-2.Change 4 depends on issue 2-2-3. |
|  |
| R4-2205357R4-2205358Huawei | Qualcomm: OK |
|  |
|  |
| R4-2206035R4-2206036Ericsson | Huawei: OK |
| Qualcomm: Depends on issue 2-2-3. |
|  |
| R4-2205442R4-2205443R&S | E///: We do not support the proposed changes. Please see our comments under issues 2-4-1 and 2-4-2. |
| Qualcomm: See our comments under issues 2-4-1 and 2-4-2. |
|  |

## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic#2-1-1** | *Tentative agreements:**Group delay calibration margin for RSTD measurement accuracy in FR1:*

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 5 | TBD |
| ≥ 10 | TBD |
| ≥ 20 | [36] |
| ≥ 50 | [16] |
| ≥ 100 | [12] |

*Recommendations for 2nd round: agree on the tentative agreement.*. |
| **Sub-topic#2-1-2** | *Tentative agreements:**Group delay calibration margin for RSTD measurement accuracy in FR2*

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 20 | TBD |
| ≥ 50 | [32] |
| ≥ 100 | [16] |
| ≥ 200 | [12] |

*Recommendations for 2nd round: agree on the tentative agreement.*. |
| **Sub-topic#2-1-3** | *Background clarification:* *4 companies provided comments on this matter in the 1st round. One company proposed compromised proposal and suggest further discussion on whether to add a frequency margin for a time offset which is other than 160ms. The moderator suggests discussing this issue further in the 2nd round.**Tentative agreements:** Specify a frequency drift margin of 32 Tc for RSTD that applies for a maximum time offset of 160 msec between the PRS resource instances used to calculate the RSTD measurement for the case of a single PFL in FR1 and FR2.
* FFS the frequency drift margin and the maximum time offset for the case of multiple PFLs

*Candidate options:** + Option 1: Add a frequency margin of [50 Tc] for RSTD that applies for a maximum time offset of [1 second] between the PRS resource instances used to calculate the RSTD measurement for the case of multiple PFLs.

*Recommendations for 2nd round: further discuss on candidate options.*. |
| **Sub-topic#2-2-1** | *Tentative agreements:**Candidate options:**Group delay calibration margin for Rx-Tx measurement accuracy in FR1*

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 5 | TBD |
| ≥ 10 | [80] |
| ≥ 20 | [56] |
| ≥ 50 | [24] |
| ≥ 100 | [24] |

*Recommendations for 2nd round: Agree on the tentative agreement.* |
| **Sub-topic#2-2-2** | *Tentative agreements:**Group delay calibration margin for Rx -– Tx measurement accuracy in FR2*

|  |  |
| --- | --- |
| **PRS BW (MHz)** | **Margin (Tc)** |
| ≥ 20 | [76] |
| ≥ 50 | [32] |
| ≥ 100 | [24] |
| ≥ 200 | [20] |

*Recommendations for 2nd round: agree on the tentative agreement.*. |
| **Sub-topic#2-2-3** | *Background clarification:* *Companies are divided into two camps between option 1 (3 companies) and option 3 (4 companies). We will have another round of discussions on this issue.**Tentative agreements:**None.**Candidate options:** Option 1: UE Rx-Tx measurement accuracy requirements shall apply if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.
* Option 3: Applicability of Rx-Tx accuracy requirements with autonomous timing adjustment is defined as:
	+ UE Rx-Tx measurement accuracy requirements shall apply for a cell, which is also the downlink reference cell (defined in section 7.1.1) for SRS transmission even if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.
	+ UE Rx-Tx measurement accuracy requirements shall not apply for a cell, which is not the downlink reference cell (defined in section 7.1.1) for SRS transmission, if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.

*Recommendations for 2nd round: Further discuss this issue in the email thread in 2nd round*. |
| **Sub-topic#2-3-1** | *Background clarification:* *7 companies provided comments in the 1st round and all the companies are willing to agree on recommended WF except for one company who supported option 3. The moderator suggests agreeing on option 2 and if it is not objected, he thanks to companies for the great efforts and fair compromise.**Tentative agreements:** Introduce PRS-RSRP accuracy requirements for extreme conditions in Rel-16
* The margin for PRS-RSRP accuracy requirements under extreme conditions are:
	+ [3]dB for absolute accuracy for FR1.
	+ [3]dB for absolute accuracy for FR2.
	+ [1.5]dB for relative accuracy for FR1.
	+ [3]dB for relative accuracy for FR2.

*Recommendations for 2nd round: Agree on introducing PRS-RSRP accuracy requirements for extreme conditions in Rel-16 and discuss the margins.* |
| **Sub-topic#2-4-1** | *Background clarification:* *The moderator read the discussions in #2-4-1 and #2-4-2 and suggest discussing them together in the 2nd round. The suggested new issue 2-4-3 is whether to specify new UE based DL-TDOA test cases.** Specify new test case for UE-based DL-TDOA measurements:
	+ New test case for UE-based DL-TDOA reporting delay is added with limited additional effort, leveraging the existing test case setup for UE-assisted
		- Detailed test configuration is FFS
	+ New test case for UE-based DL-TDOA measurement accuracy is added
		- Detailed test configuration is FFS

*Tentative agreements: None.**Candidate options:** Option 1: both of the above tests are added
* Option 2: none of the above test is added

*Recommendations for 2nd round: Further discuss the issue in clarification above in the 2nd round*. |
| **Sub-topic#2-4-2** | *See summary for sub-topic #2-4-1.* |

### CRs/TPs

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| R4-2203873R4-2203874CATT | *Merged into R4-2204656/4657;**R16 Not pursued;**R17 Withdrawn.* |
| R4-2203875R4-2203876CATT | *Revised to take into account changes in R4-2205357:*‘SRS transmission periodicity ~~is 40ms~~’ |
| R4-2204656R4-2204657vivo | *Revised to capture only 10.1.24 changes;*  |
| R4-2205355R4-2205356Huawei | *Revised to capture only 10.1.23 changes;* |
| R4-2205357R4-2205358Huawei | *Merged into R4-2203875/3876;**R16 Not pursued;**R17 Withdrawn.* |
| R4-2206035R4-2206036Ericsson | *Revised to capture 10.1.25 changes; take into account editorial changes in R4-2205355.* |
| R4-2205442R4-2205443R&S | *Return to in the 2nd round.* |

## Discussion on 2nd round (if applicable)

### Sub-topic 2-1-3

**Issue 2-1-3: Frequency drift margin for RSTD measurement accuracy requirements**

* Specify a frequency drift margin of 32 Tc for RSTD that applies for a maximum time offset of 160 msec between the PRS resource instances used to calculate the RSTD measurement for the case of a single PFL in FR1 and FR2.
* FFS the frequency drift margin and the maximum time offset for the case of multiple PFLs
	+ Option 1: Add a frequency margin of [50 Tc] for RSTD that applies for a maximum time offset of [1 second] between the PRS resource instances used to calculate the RSTD measurement for the case of multiple PFLs.

*Recommendations for 2nd round: further discuss on candidate options.*

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| **Company** | **Comments**  |
| Qualcomm | We support the first bullet point for single PFL. The motivation for introducing a different margin for the case of multiple PFLs is that, typically, the time offset between resources in different PFL will be larger and, therefore, a larger margin would be needed to account for frequency drift**.**For time offset between resources, if we assume Tprs = 160 ms and 4 samples, then resources in the next PFL would be measured >= 640 ms later. So in option 1 we proposed max. time offset of 1 second. For the corresponding margin, if it is agreed to have a separate margin for single PFL, we propose to reuse the same assumption of 0.1 ppm, i.e. 100 ns ~ 200 Tc. WSo we can support option 1a:Add a frequency margin of [200 Tc] for RSTD that applies for a maximum time offset of [1 second] between the PRS resource instances used to calculate the RSTD measurement for the case of multiple PFLs.We can consider other proposals as well. |
| Huawei | We are fine to introduce a separate margin based on larger time offset to address the multiple PFL case as QC mentioned above, provided that it is based on the existing RF requirement on frequency error, i.e. 0.1ppm.On the exact values, we have a slightly different proposal from QC considering the typical PRS resource periodicity is a power of 2.Option 1b:Add a frequency margin of [256 Tc] for RSTD that applies for a maximum time offset of [1.28 second] between the PRS resource instances used to calculate the RSTD measurement for the case of multiple PFLs. |
| Qualcomm2 | We’re OK with Huawei’s proposal. |

### Sub-topic 2-2-3

**Issue 2-2-3: Applicability of Rx-Tx accuracy requirements with autonomous timing adjustment**

* Option 1: UE Rx-Tx measurement accuracy requirements shall apply if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.
* Option 3: Applicability of Rx-Tx accuracy requirements with autonomous timing adjustment is defined as:
	+ UE Rx-Tx measurement accuracy requirements shall apply for a cell, which is also the downlink reference cell (defined in section 7.1.1) for SRS transmission even if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.
	+ UE Rx-Tx measurement accuracy requirements shall not apply for a cell, which is not the downlink reference cell (defined in section 7.1.1) for SRS transmission, if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.

*Recommendations for 2nd round: Further discuss this issue in the email thread in 2nd round*

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| **Company** | **Comments**  |
| E/// | We support Option 3.Option 1 has the following problem:As explained earlier the autonomous adjustment means: UE transmit timing changes in the same direction as that of the DL reference cell i.e. UE Tx timing follows the DL timing change of the DL reference cell. This has the following consequence:* If UE Rx-Tx measurement is done on a cell which is also the DL reference cell for SRS transmission timing then no error is introduced in the measurement due to autonomous timing adjustment.
* But if UE Rx-Tx measurement is done on a cell which is NOT the DL reference cell for SRS transmission timing then additional error is introduced in the measurement due to autonomous timing adjustment. This is because the UL (SRS) timing is changed by following DL reference cell timing e.g. by ΔT. Therefore UE Rx-Tx measurement, which is measured on PRS of another DL cell, will have an additional error of ΔT. In FR1 the max adjustment can be 352 Tc over 200 m. This is very large error – in fact several times the accuracy. Clearly the UE cannot meet the accuracy. UE Rx-Tx measurement period is much longer than 200 ms. This means in reality the error can be much larger. Therefore, Option 1 is not feasible.
 |
| Qualcomm | Our concern with option 3 is that it limits applicability of UE Rx-Tx measurements to only the serving cell used for reference timing. Then multi-RTT is left without requirements.We continue to support option 1. |
| Huawei | support option 3.On option 1, the problem to apply the accuracy requirements for non-serving cell is how to define the ideal value. With UE autonomous timing adjustment, UE could have more than one UL timing during the measurement period, and it’s unclear which one should be used to determine the ideal Rx-Tx. For serving cell, UL is following the DL with UE autonomous timing adjustment, so the ideal UE Rx-Tx does not change, so the requirements can apply. |
| Qualcomm2 | For UE Rx-Tx time difference, the UE should report the measurement using the actual transmission time, not some ideal transmission time. In practice, the UE Rx-Tx and the gNB Rx-Tx are combined to measure RTT. Additional delay in the UE transmission will be observed by the TRPs, both serving and non-serving, when they measure gNB Rx-Tx. And ideally, any additional delay is cancelled when UE Rx-Tx and gNB Rx-Tx are combined. Now, it is true that if UE Rx-Tx is combined with a gNB Rx-Tx where there is a difference in UL transmission time between the two measurements there would be degradation in RTT accuracy. But that doesn’t mean that UE Rx-Tx accuracy is degraded. This degradation in RTT is not addressed directly by accuracy requirements in RAN4, which only apply individually to the UE and gNB measurements. To try to avoid degradation in RTT, RAN4 introduced a proximity condition between SRS and PRS. It’s not perfect but it is one mechanism to try to mitigate degradation in RTT accuracy. Rel-17 can improve even further by using TEGs. |

### New Sub-topic 2-4-3

**Issue 2-4-3: whether to specify new UE based DL-TDOA test cases**

*Background clarification:*

*The moderator read the discussions in #2-4-1 and #2-4-2 and suggest discussing them together in the 2nd round. The suggested new issue 2-4-3 is whether to specify new UE based DL-TDOA test cases.*

* Specify new test case for UE-based DL-TDOA measurements:
	+ New test case for UE-based DL-TDOA reporting delay is added with limited additional effort, leveraging the existing test case setup for UE-assisted
		- Detailed test configuration is FFS
	+ New test case for UE-based DL-TDOA measurement accuracy is added
		- Detailed test configuration is FFS

*Candidate options:*

* Option 1: both of the above tests are added
* Option 2: none of the above test is added

*Recommendations for 2nd round: Further discuss the issue in clarification above in the 2nd round*

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| **Company** | **Comments**  |
| Ericsson | We support Option 2.We do not support the idea of defining UE based DL-TDOA test cases because, “UE supporting only UE-based, will remain untested,”. There are many features in the specs which do not have corresponding requirements. Therefore their performance cannot be tested. The motivation of requirements should be strong commercial need. They should not be introduced just for the sake of testing.  |
| R&S | We basically support Option 1Our motivation is not to test devices just for sake of testing. As a testing company, we feel responsible to address the topic and trigger the discussion. We see a lack of test coverage for UE based only devices, especially with respect of emergency caller location and other safety critical applications (e.g. E911 in USA), which will be then deployed untested. However, it is certainly up to the chipset / device / infrastructure vendors and network operators to decide on the final need of such tests, as well as agree on the requirements.  |
| Qualcomm | As we expressed in the first round, in general we’re supportive of introducing tests for UE-based DL-TDOA. However, RAN4 would need to run simulations to derive new accuracy requirements for UE based DL-TDOA. This effort could be carried out under Rel-16 TEI or Rel-17 TEI.We would support option 1 if the work is done under TEI. |
| Huawei | support option 2.RAN4 has discussed the requirements for UE based positioning in the beginning of Rel-16 and there was no consensus to introduce the requirements. In this case, we do not think RAN4 should introduce test cases for UE based positioning (because there is no requirement). |

### Sub-topic 2-3-1

**Issue 2-3-1: PRS-RSRP accuracy under extreme condition**

*Background clarification:*

*7 companies provided comments in the 1st round and all the companies are willing to agree on recommended WF except for one company who supported option 3. The moderator suggests agreeing on option 2 and if it is not objected, he thanks to companies for the great efforts and fair compromise.*

*Tentative agreements:*

* Introduce PRS-RSRP accuracy requirements for extreme conditions in Rel-16
* The margin for PRS-RSRP accuracy requirements under extreme conditions are:
	+ [3] dB for absolute accuracy for FR1.
	+ [3] dB for absolute accuracy for FR2.
	+ [1.5] dB for relative accuracy for FR1.
	+ [3] dB for relative accuracy for FR2.

*Recommendations for 2nd round: Agree on introducing PRS-RSRP accuracy requirements for extreme conditions in Rel-16 and discuss the margins.*

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| **Company** | **Comments**  |
| E/// | We support the tentative agreement. We are also fine with the proposed margins. |
| Qualcomm | We can compromise to adding requirements for extreme conditions but we would like to understand better the proposed margin values.E.g. in 38.133 we see that for FR1 SS-RSRP absolute accuracy, a degradation of 4.5 dB is allowed under extreme conditions. Why is the proposed value lower for PRS-RSRP? |
| Huawei | to QC, we assume the current proposals are based on the margin for high Io cases (up to -50dBm), but maybe other proponents can help to clarify. We note that for absolute SS-RSRP, there is a margin when going from medium Io  (-70) to high Io (-50), but this has not been accounted for PRS-RSRP. Therefore, we are open to consider a larger margin e.g. 4.5dB for absolute accuracy. |
| Qualcomm2 | We would be OK with [4.5] dB for absolute accuracy for FR1. |

## Summary on 2nd round (if applicable)

All the agreements reached in the 2nd round discussion of this thread are captured in the WF R4-2206821.

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# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| Way forward on maintenance to R16 POS requirements | Intel Corporation |  |
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**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-2203870 | Draft CR on R16 NR positioning measurement requirements (R16) | CATT | Revised  |  |
| R4-2203871 | Mirror CR to R4-2203870 | CATT | Return to |  |
| R4-2204654 | Draft CR to 38.133 correction to NR positioning measurement requirements (R16) | vivo | Not pursued |  |
| R4-2204655 | Mirror CR to R4-2204654 | vivo | Withdrawn  |  |
| R4-2205352 | CR on positioning measurement requirements R16 (R16) | Huawei, HiSilicon | Not pursued |  |
| R4-2205353 | Mirror CR to R4-2205352 | Huawei, HiSilicon | Withdrawn  |  |
| R4-2206032 | Updates to measurement requirements for UE positioning measurements in TS 38.133 (R16) | Ericsson | Not pursued |  |
| R4-2206033 | Mirror CR to R4-2206032 | Ericsson | Withdrawn  |  |
| R4-2203873 | Draft CR on R16 NR positioning accuracy requirements (R16) | CATT | Not pursued |  |
| R4-2203874 | Mirror CR to R4-2203873 | CATT | Withdrawn  |  |
| R4-2203875 | Draft CR on SRS configuration for R16 positioning test case (R16) | CATT | Revised  |  |
| R4-2203876 | Mirror CR to R4-2203875 | CATT | Return to |  |
| R4-2204656 | Draft CR to 38.133 correction to NR positioning accuracy requirements | vivo | Revised  |  |
| R4-2204657 | Mirror CR to R4-2204656 | vivo | Return to |  |
| R4-2205355 | CR on accuracy requirements for positioning measurement R16 (R16) | Huawei, HiSilicon | Revised  |  |
| R4-2205356 | Mirror CR to R4-2205355 | Huawei, HiSilicon | Return to |  |
| R4-2205357 | CR to introduce posSRS RMC for positioning test cases R16 (R16) | Huawei, HiSilicon | Not pursued |  |
| R4-2205358 | Mirror CR to R4-2205358 | Huawei, HiSilicon | Withdrawn  |  |
| R4-2206035 | Updates to accuracy requirements for UE positioning measurements in TS 38.133 (R16) | Ericsson | Revised  |  |
| R4-2206036 | Mirror CR to R4-2206035 | Ericsson | Return to |  |
| R4-2205442 | Draft CR to TS 38.133: Additions to RSTD test cases for UE-based DL-TDOA support (R16)Submitted to AI 5.1.5.3 | Rohde & Schwarz | Return to |  |
| R4-2205443 | Mirror CR to R4-2205441Submitted to AI 5.1.5.3 | Rohde & Schwarz | Return to |  |

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

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| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
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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

|  |  |  |
| --- | --- | --- |
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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)