3GPP TSG RAN WG1 Meeting #108e R1-2202497

**e-meeting, February 21st – March 3rd,, 2022**

**Source: Moderator (CATT)**

**Title: FL Summary for accuracy improvements by mitigating UE Rx/Tx and/or gNB Rx/Tx timing delays**

**Agenda item: 8.5.1**

**Document for: Discussion and Decision**

# Introduction

This document provides a summary of the following email discussion for AI 8.5.1:

[108-e-R17-ePos-01] Email discussion for maintenance on accuracy improvements by mitigating UE Rx/Tx and/or gNB Rx/Tx timing delays – Ren Da (CATT)

* 1st check point: February 25
* Final check point: March 3

One of the RAN1 objectives of this work item is to:

* *Specify* ***methods****,* ***measurements****,* ***signalling, and procedures*** *for improving positioning accuracy of the Rel-16 NR positioning methods by mitigating UE Rx/Tx and/or gNB Rx/Tx timing delays, including [RAN1]*
	+ DL, UL and DL+UL positioning methods
	+ UE-based and UE-assisted positioning solutions

The WI was closed in RAN#94e from RAN1’s perspective. The document covers the remaining issues related to related to the accuracy improvements by mitigating UE Rx/Tx and/or gNB Rx/Tx timing delays based on the contributions [1-16]:

**Notes:**

* The following highlights will be used in this summary:
	+ “Pink highlights” are used for proposals with high priority
	+ “Turquoise highlights” are used for offline consensus/conclusion
	+ “Grey highlights” are used for proposals resolved in this meeting.

Note: The above priority highlights are used mainly as a suggestion of the priority for *online* discussion. The priority indications may be changed based on the received comments. During the email discussion, interested companies are encouraged to provide comments to all proposals regardless of the priority indications.

* When providing the comments, it would be helpful to indicate explicitly whether to“*support*”, or “*not support*”, or provide a suggestion of modification. A comment of “*high/low priority*” is only interpreted as a suggestion for the priority for email/online discussions. For a proposal with multiple options, it would be helpful to indicate which of the option(s) are “*supported*” and/or “*preferred*”.
* For a proposed enhancement, if we cannot reach a consensus, we may conclude that “*a consensus cannot be reached for the proposed enhancement*” for this email discussion in this meeting. It does not necessarily mean the proposed enhancement will not be further discussed in future meetings.

# Methods for mitigating UE/TRP Tx/Rx timing errors

## Reporting of SRS port IDs with the RTOA measurements

Submitted Proposals

* ***(Huawei, R1-2200920[1]) Proposal 1:*** *It is up to RAN3 to decide whether to support SRS port ID reporting associated with RTOA measurement.*

FL Comments

The proposal to support gNB to report the associated SRS port ID for improving the positioning performance was discussed in the previous meetings, but only a few companies provided the comments during the email discussions [17]. In [1], it suggests leaving the reporting of the SRS ports with RTOA measurement for RAN3. In FL’s understanding, the support of SRS port ID reporting has no impact on UE side.

### Question 2.1

*Companies are invited to provide their views on whether the following proposals should be discussed (or not discussed) in this meeting, and if yes, please provide the additional comments (e.g., the priority, whether you support the proposal).*

* + *(Huawei, R1-2200920[1]) Proposal 1*

Comments

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **yes** | **NO** | **Additional comments** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

## Reporting of UE Tx TEGs

Submitted Proposals

* ***(Huawei, R1-2200920[1]) Proposal 4****: For static SRS-TEG association, UE may report the association before positioning SRS transmission.*

FL: Suggest focusing on whether to support the reporting of Tx TEG association before SRS transmission w/o defining the static/dynamic SRS-TEG association, since it is up to UE to determine the change of the TEG association based on RAN4’s LS. Further discussion in Proposal 3.2-1.

* ***(Huawei, R1-2200920[1]) Proposal 5****: For dynamic SRS-TEG association, UE shall only report the association for the previously transmitted SRS.*

FL: Suggest focusing on whether to support the reporting of Tx TEG association before SRS transmission w/o defining the static/dynamic SRS-TEG association, since it is up to UE to determine the change of the TEG association based on RAN4’s LS. Further discussion in Proposal 3.2-1.

* ***(Huawei, R1-2200920[1]) Proposal 6****: For triggered SRS-TEG association reporting, it is up to RAN2 to consider whether to support it.*

FL: Further discussion in Proposal 3.2-1.

* ***(Nokia, R1-2201634[7]) Proposal 3****: Allow UE to respond to a request for Tx TEG associations with an indication that it will report, or has already reported, directly to LMF (if responding to gNB) or to gNB (if responding to LMF).*

FL: Similar proposal was discussed in the previous meeting but it was lack of the support. It seems the issue is not critical. Suggest checking with all companies to see if we want to have further discussion in this meeting.

* ***(InterDigital, R1-2201824[9]) Proposal 1:*** *Support the UE to report the association information between UE Tx TEG and SRS resource for UL-TDOA at periodically configured reporting occasion only if there is a change in the Tx TEG association compared to the last reporting.*

FL: Similar proposal was discussed intensively in the previous meeting. Given that RAN1 has made the decision of supporting periodic reporting, and RAN4 to decide the UE determines the previous association information is no longer valid, Suggest checking with all companies to see if we want to have further discussion in this meeting.

* ***(InterDigital, R1-2201824[9]) Proposal 2:*** *Support the UE to report the association information between UE Tx TEG and SRS resource whenever the UE determines the previous association information is no longer valid.*

FL: Similar proposal was discussed intensively in the previous meeting. Given that RAN1 has made the decision of supporting periodic reporting, and RAN4 to decide the UE determines the previous association information is no longer valid. Suggest no further discussion in this meeting.

* ***(InterDigital, R1-2201824[9]) Proposal 3:*** *Support validity time for TEG, i.e., within the validity time, the UE may not report the TEG association information.*

FL: Similar proposal was discussed in the previous meeting but it was lack of the support. Suggest no further discussion in this meeting.

* ***(Qualcomm, R1-2202140[12]) Proposal 1****: For M-RTT, support a UE to report, within the UE Rx-Tx measurement report, the UE Tx TEG association for the SRS resources for positioning that have already been transmitted, together with the associated timestamp(s) for which a particular association is valid.*
	+ *Send an LS to RAN2 to continue the signaling design*

FL: Further discussion in Proposal 3.2-1.

* ***(LGE, R1-2202291[13]) Proposal 1:*** *Regarding measurement with different Rx TEGs at both UE and gNB, RAN1 should support that related information needs to be transmitted through location measurement request message (e.g. RequestLocationInformation for LPP and MEASUREMENT REQUEST for NRPPA)*

FL: High-layer message for Rx TEG reporting can be decided by RAN2/RAN3. Suggest no further discussion in this meeting.

FL comments

The time when LMF/gNB request UE to report UE TxTEG association and the time when UE transmits positioning SRS resources and the time when the gNB receives the SRS resources could all be different. For periodic reporting of UE TxTEG for UL-TDOA, the issue may not be critical since the LMF will obtain all of the updates of UE TxTEG association through the reportings, although it may cause positioning latency. For non-periodic reporting of UE TxTEG, than there may be a need to specify the time or time duration for the reporting of the UE TxTEG association.

### Question 2.2

*Please indicate whether any of the following proposals should be discussed (or not discussed) in this meeting, and if yes, please provide the additional comments (e.g., the priority, whether you support the proposal).*

* + ***P1:*** *(Nokia, R1-2201634[7]) Proposal 3: Allow UE to respond to a request for Tx TEG associations with an indication that it will report, or has already reported, directly to LMF (if responding to gNB) or to gNB (if responding to LMF).*
	+ ***P2:*** *(InterDigital, R1-2201824[9]) Proposal 1: Support the UE to report the association information between UE Tx TEG and SRS resource for UL-TDOA at periodically configured reporting occasion only if there is a change in the Tx TEG association compared to the last reporting.*
	+ ***P3:*** *(InterDigital, R1-2201824[9]) Proposal 2: Support the UE to report the association information between UE Tx TEG and SRS resource whenever the UE determines the previous association information is no longer valid.*
	+ ***P4:*** *(InterDigital, R1-2201824[9]) Proposal 3: Support validity time for TEG, i.e., within the validity time, the UE may not report the TEG association information.*
	+ ***P5:*** *(LGE, R1-2202291[13]) Proposal 1****:*** *Regarding measurement with different Rx TEGs at both UE and gNB, RAN1 should support that related information needs to be transmitted through location measurement request message (e.g. RequestLocationInformation for LPP and MEASUREMENT REQUEST for NRPPA)*

Comments

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **yes** | **NO** | **Additional comments** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

### Proposal 2.2

* *For M-RTT, subject to UE capability, support the LMF to request a UE to report the UE Tx TEG association for the SRS resources for positioning together with the associated timestamp(s) within a configured time window:*
	+ *The starting time of the time window can be earlier than the time when the UE reports the UE Tx TEG association*
	+ *The end time of the time window can be later than the time when the UE reports the UE Tx TEG association*
	+ *It is up to UE’s capability and implementation on whether and how to provide the UE Tx TEG association according to the request from the LMF.*
	+ *It is up to RAN2 to define the starting and the end time*
	+ *Send an LS to RAN2 to continue the signaling design*

Comments

*Companies are invited to provide their views on whether the issue covered by the above proposal should be discussed in this meeting, and if yes, please provide the additional comments (e.g., the priority, whether you support the proposal).*

|  |  |  |
| --- | --- | --- |
| **Company** | **yes/no** | **Additional comments**  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

## Reporting of UE Tx TEGs

Background

|  |
| --- |
| Agreement:Make the following modification of the previous agreement:For mitigating UE Tx/Rx timing errors for DL+UL positioning, a UE ~~may~~ should support, up to UE capability, either one or both of the following options:* Option 1: Reporting of UE RxTx TEG ID ~~is supported by the UE~~
	+ FFS: Further details on how the UE RxTx TEG IDs are related/associated to UE Tx TEG IDs and/or UE Rx TEG IDs and to the UE Rx-Tx measurements.
* Option 2: Reporting of ~~UE RxTx TEG ID is not supported by the UE; reporting of~~ UE Rx TEG ID and UE Tx TEG ID ~~is supported~~.
* In either option, a UE Tx TEG ID is associated with (downselection needed)
	+ Alt. 1: an UL SRS resource for positioning corresponding to the Tx timing of the UE Rx-Tx measurement
	+ Alt. 2: the Tx timing of the UE Rx-Tx measurement
	+ Alt. 3: one or more UL SRS resources for positioning
* Note: An UE Rx TEG ID is associated with one DL PRS resource (or more DL PRS resources) corresponding to the Rx time of the measurement
* FFS: How to resolve potential mismatch between UE and gNB Rx-Tx time difference measurements (e.g. UE provides the UE Rx-Tx measurements associated with a Tx TEG with SRS1, while gNB provides the gNB Rx-Tx measurements with a Rx TEG associated with SRS2).
* FFS: The potential impact and modification on the definition of Rx-Tx time difference measurements

Agreement:* If a Tx TEG ID is reported with a UE Rx-Tx time difference measurement, the UE should also report the association of the Tx TEG ID to the UL SRS resource(s)
	+ FFS: how the association of the Tx TEG ID to the UL SRS resource(s) is determined by UE.
	+ FFS: details of the signalling

Agreement:If a RxTx TEG ID is reported with a UE Rx-Tx time difference measurement, the UE may optionally also report a Tx TEG ID.  |

Submitted Proposal

* ***(vivo, R1-2201093[2]) Proposal 1:*** *For mitigating UE Rx/Tx timing errors for DL+UL positioning, up to the UE capability, the following should be supported:*
	+ *The UE provides the association information of UE Tx TEG(s) with all UL Positioning SRS resources to LMF.*
	+ *For a Rx-Tx time difference measurement for a PRS resource, the UE may report one or more pairs of {RxTx TEG, Tx TEG}, which are used to represent the mapping relationship with all Tx TEGs of all SRS resources.*
		- *wherein, the maximum number of Tx TEGs here is N, N={1,2,3,4,6,8}, subjective to UE capability.*
* ***(Ericsson , R1-2202389[16]) Proposal 4:*** *The UE can be configured by the gNB with a list of SRS resource sets and SRS resources for which UE TX TEG association reporting should be performed. In case an SRS resource set is listed rather than an SRS resource then the UE should report the UE TX TEG association for all SRS resources in the SRS resource set.*

FL comments

Based on the previous agreement, if a UE supports Option 1, UE may (or may not) report TRP Tx TEG ID with a UE Rx-Tx time difference measurement. For a UE supporting Option 2, FL shares the similar view with vivo in that it is highly desirable for UE to report UE Tx TEG(s) of all UL Positioning SRS resources to LMF. However, further discussion is needed on whether the UE can be forced to report the mapping of *all SRS respurces to TEGs.* In UE feature, it says “lf the UE does not include TxTEG-ID associated with a measurement, no assumption can be made on the [mitigation of] UE Tx timing errors for this SRS resource for positioning.” Thus, it is still up to UE implementation to decide how the UE to provide the mapping of *the SRS respurces to TEGs.*

### Question 3.3

*Companies are invited to provide their views on whether the following proposal should be discussed (or not discussed) in this meeting, and if yes, please provide the additional comments (e.g., the priority, whether you support the proposal).*

* + *(vivo, R1-2201093[2]) Proposal 1*
	+ *(Ericsson , R1-2202389[16]) Proposal 4*

Comments

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **yes** | **NO** | **Additional comments** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

## Periodict Reporting of UE Tx TEG for Multi-RTT

Background

|  |
| --- |
| **Agreement (RAN1#107e)*** For UL-TDOA, supporting the following for the serving gNB to request a UE to report the Tx TEG association information between UE Tx TEG IDs and SRS resources for positioning, subject to UE capability of supporting UE Tx TEG:
	+ Based on a configured periodicity, a UE may report the UE Tx TEG association for the SRS resources for positioning that have already been transmitted during the configured period
		- It is up to RAN2 to decide how to indicate the change of the Tx TEG association during the configured period (e.g., using the timestamps)
		- It is up to RAN4 to decide when the Tx TEG association is changed
	+ The values of the configurable periodicities are up to RAN2
	+ Note: Tx TEG association information reporting by single request/response mode is assumed already supported with the previous agreement.
* Send an LS to RAN2/RAN4 (cc: RAN3)
	+ to RAN2, including the following RAN1’s agreement related to the reporting of the UE Tx TEG, for RAN2 to work on the signaling
	+ to RAN4 for checking the agreement and work on how to decide when the Tx TEG association is changed
 |

|  |
| --- |
| RAN4 LS (R1-2200902)“The UE Tx TEG association between UE Tx TEG IDs and SRS resources for positioning is up to UE implementation, so it is not necessary nor practical to define the condition when the TEG association is changed.” |

Submitted Proposal

* ***(vivo, R1-2201093[2]) Proposal 2:******Support UE Tx TEG updating in Multi-RTT as the following:***
	+ For ~~UL-TDOA~~ Multi-RTT, supporting the following for the ~~serving gNB~~ LMF to request a UE to report the Tx TEG association information between UE Tx TEG IDs and SRS resources for positioning, subject to UE capability of supporting UE Tx TEG:
		- Based on a configured periodicity, a UE may report the UE Tx TEG association for the SRS resources for positioning that have already been transmitted during the configured period
			* It is up to RAN2 to decide how to indicate the change of the Tx TEG association during the configured period (e.g., using the timestamps)
			* ~~It is up to RAN4 to decide when the Tx TEG association is changed~~
		- The values of the configurable periodicities are up to RAN2
		- It is up to RAN2 to decide whether to include UE Tx TEG association information request/report in Rx-Tx measurement request/report or in a separate IE
		- Note: Tx TEG association information reporting by single request/response mode is assumed already supported with the previous agreement.
	+ Send an LS to RAN2~~/RAN4~~ (cc: RAN3)
	+ ~~to RAN2,~~ including the following RAN1’s agreement related to the reporting of the UE Tx TEG, for RAN2 to work on the signalling

FL: Further discussion in Proposal 3.4-1 for Multi-RTT.

* ***(Sony, R1-2201582[6])******Proposal 1:*** *Support UE to provide periodic reporting of TEG association*

FL: Periodic reporting of UE Tx TEG is supported for UL-TDOA. See Proposal 3.4-1 for Multi-RTT.

* ***(Sony, R1-2201582[6])******Proposal 2:*** *Periodic TEG association report and aperiodic TEG association report can be both supported. LMF can configure the UE on the selected reporting type.*

FL: Periodic and aperiodic reporting of UE Tx TEG is supported for UL-TDOA. See Proposal 3.4-1 for Multi-RTT.

FL comments

Periodic reporting of UE Tx TEG associationfor UL-TDOA was agreed in the previous meeting. However, Periodic reporting of UE Tx TEG associationfor Multi-RTT was not agreed. There were different views on whether there is a need to support, Periodic reporting of UE Tx TEG associationfor Multi-RTT with the consideration that the UE may report UE Tx TEG associationfor Multi-RTT together with the measurement reports of the UE Rx-Tx measurements.

### Proposal 2.4

* + *For Multi-RTT, supporting the following for the LMF to request a UE to report the Tx TEG association information between UE Tx TEG IDs and SRS resources for positioning, subject to UE capability of supporting UE Tx TEG:*
		- *Based on a configured periodicity, a UE may report the UE Tx TEG association for the SRS resources for positioning that have already been transmitted during the configured period*
			* *It is up to RAN2 to decide how to indicate the change of the Tx TEG association during the configured period (e.g., using the timestamps)*
		- *The values of the configurable periodicities are up to RAN2*
		- *It is up to RAN2 to decide whether to include UE Tx TEG association information request/report in Rx-Tx measurement request/report or in a separate IE*
		- *Note: Tx TEG association information reporting by single request/response mode is assumed already supported with the previous agreement.*
	+ *Send an LS to RAN2 to continue the signaling design*

Comments

*Companies are invited to provide their views on whether the above proposal should be discussed (or not discussed) in this meeting, and if yes, please provide the additional comments (e.g., the priority, whether you support the proposal).*

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **yes** | **NO** | **Additional comments** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

## Reception of the DL PRS with different UE/TRP Rx TEGs

Submitted proposals

* **(Huawei, R1-2200920[1]) Proposal 7:** *UE is not required to measure the same DL PRS resource with the exactly the same number of Rx TEGs as requested by LMF or indicated in the capability signaling*.

FL Comments

In FL’s understanding, similar to other positioning measurements, it is up to RAN4 to decide the conditions under which the UE is required (or not required) to *measure the same DL PRS resource* with the number of different Rx TEGS as requested by LMF or indicated in the capability signaling. There is no need for RAN1 to make an agreement on that.

### Question 2.5

*Companies are invited to provide their views on whether the following proposal should be discussed (or not discussed) in this meeting, and if yes, please provide the additional comments (e.g., the priority, whether you support the proposal).*

* + *(Huawei, R1-2200920[1]) Proposal 7*

Comments

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **yes** | **NO** | **Additional comments** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

##  UE TX/RX temporal timing error index

Submttted proposals

* ***(Ericsson , R1-2202389[16]) Proposal 11****: Support UE to maintain a UE RX temporal timing error index (TTEI). The state of the UE RX TTEI at the instance of DL PRS reception for an RSTD or UE Rx-Tx time difference measurement should be reported together with UE RX TEG association, timestamp and RSTD/UE Rx-Tx time difference measurement in the DL-TDOA/multi-RTT measurement report.*
* ***(Ericsson , R1-2202389[16]) Proposal 12:*** *Support UE to maintain a UE TX temporal timing error index (TTEI). The state of the UE TX TTEI at the instance of UL SRS transmission should be reported together with UE TX TEG association and timestamp.*

FL Comments

The timing errors of UE Rx/Tx/RxTx TEGs may changes over time for various reasons. In previous meetings, different options regarding the reporting/updating of Tx TEG association with positioning SRS/PRS resources were discussed, including the use of a temporal timing error index (TTEI) as proposed in [16]. For Tx TEG changes, RAN1 made an agreement in RAN1#107e that “It is up to RAN4 to decide when the Tx TEG association is changed” and “It is up to RAN2 to decide how to indicate the change of the Tx TEG association during the configured period (e.g., using the timestamps)”.

### Question 2.6

*Companies are invited to provide their views on whether the following proposal should be discussed (or not discussed) in this meeting, and if yes, please provide the additional comments (e.g., the priority, whether you support the proposal).*

* + ***P1****: (Ericsson , R1-2202389[16]) Proposal 11*
	+ ***P2****: (Ericsson , R1-2202389[16]) Proposal 12*

Comments

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **yes** | **NO** | **Additional comments** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

##  UE Tx TEG sweeping

Submttted proposals

* ***(InterDigital, R1-2201824[9]) Proposal 4:*** *Support the LMF to request the TRP to fix TRP Rx TEG, configure the UE to use N different UE Tx TEGs and report respective RTOA, if the TRP and UE support more than one Rx TEGs and Tx TEGs, respectively.*

FL: The condition of more than one TRP Rx TEG may not be needed.

* ***(CMCC, R1-2201856[10]) Proposal 1****: Support UE Tx TEG sweeping as an optional UE capability:*
	+ *Introduce a new indication for UE sending N SRS pos resources by using N different UE Tx TEGs in turn*
* ***(Ericsson , R1-2202389[16]) Proposal 5****. Support UE TX TEG sweeping over SRS resources for positioning in a SRS resource set configuration.*
* ***(Ericsson , R1-2202389[16]) Proposal 6****. The UE shall report the number of UE TX TEGs as part of UE capabilities.*

FL: This seems already covered in UE feature session.

* ***(Ericsson , R1-2202389[16]) Proposal 7****. It shall be possible to configure a UE with an SRS resource with a restriction for the UE to utilize a certain UE TX TEG when transmitting the SRS.*
* ***(Ericsson , R1-2202389[16]) Proposal 8****. The total number of UE beams needed to sweep all UE TX TEGs and all directions should be reported as part of UE capabilities.*

FL: It is unclear how to define the total number of UE beams for all directions.

FL Comments

The approach of configuring a UE to use different UE Tx TEGs for UL transmission of SRS positioning resources or UE TX TEG sweeping over SRS resources for positioning was proposed by multiple companies [9][10][16]. The simulation results in [16] also shows the significant performance improvement under certain conditions. Similar proposals were discussed in the previous meeting [17], but only few companies provided the comments, and some companies did not support UE TX TEG sweeping. One potential issue related to UE TX TEG sweepingmay be the overhead on the UL resource usage and also increase of the UL interferences. We would need more inputs from interested companies to above proposals to decide whether to support UE TX TEG sweeping in Rel-17, and if yes, which of the options to support.

### Proposal 2.7

* *Support UE Tx TEG sweeping, in which*
	+ *LMF configures the UE to use N different UE Tx TEGs for the transmission of the SRS resources for positioning,*
		- *FFS: N, which is subject to UE capability*
	+ *LMF requests the TRP to use the same Rx Tx TEGs to receive the SRS resources for positioning transmitted from different UE Tx TEGs*

Comments

*Companies are invited to provide their views on whether the UE TX TEG sweeping over SRS resources for positioning should be supported (or not supported) in Rel-17, and if yes, whether it is the high priority in this meeting and any additional comments on above proposal.*

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **yes** | **NO** | **Additional comments** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

## Options of multiple RSTD measurements of the same DL PRS resource

Submitted Proposals

* ***(ZTE, R1-2201193[3]) Proposal 1:*** *When multiple reference signals are used to determine the same Rx timing, support the followings,*
	+ *For DL RSTD measurement, if multiple DL PRS resources are used to determine a start of one subframe from a TP, the multiple DL PRS resources should be associated with a same UE Rx TEG ID.*
	+ *For UE Rx-Tx time difference measurement, if multiple DL PRS resources are used to determine a start of one subframe of the first arrival path of the TP, the multiple DL PRS resources should be associated with a same UE Rx TEG ID.*
	+ *For UL RTOA measurement, if multiple SRS resources are used to determine a beginning of one subframe containing SRS received at a RP, the multiple SRS resources for positioning should be associated with a same TRP Rx TEG ID.*
	+ *For gNB Rx-Tx time difference measurement, if multiple SRS resources for positioning are used to determine a start of one subframe containing SRS, the multiple SRS resources for positioning should be associated with a same TRP Rx TEG ID.*

FL: The similar proposal was discussed in the previous meeting without conclusion. Some companies supported, while some companies commented that the proposals were not needed. In FL’s view, if the Rx TEG ID is reported together with the measurement, it implies the measurement is associated with the Rx TEG ID.

* ***(Ericsson , R1-2202389[16]) Proposal 1:*** *Downselect which among the following options apply to UE feature row 27-1-4:*
	+ *UE performs multiple RSTD measurements towards the same TRP based on different repetitions of the same DL PRS resource,*
	+ *UE performs multiple RSTD measurements towards the same TRP based on different symbols of the same DL PRS resource,*
	+ *UE performs multiple RSTD measurements towards the same TRP based on different occasions of the same DL PRS resource.*

FL: These options presented above are related to UE measures the same DL PRS resources at different times. How to support the perform multiple RSTD measurements towards the same TRP may be up to UE. It seems there is no need to further define how the UE made the measurement. Further discussion is needed on whether to specify these options directions in UE feature row 27-1-4.

### Question 2.8-1

*Companies are invited to provide their views on whether the following proposal should be discussed (or not discussed) in this meeting, and if yes, please provide the additional comments (e.g., the priority, whether you support the proposal).*

* + *ZTE, R1-2201193[3]) Proposal 1*

Comments

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **yes** | **NO** | **Additional comments** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

### Question 2.8-2

*Companies are invited to provide their views on whether the following proposal should be discussed (or not discussed) in this meeting, and if yes, please provide the additional comments (e.g., the priority, whether you support the proposal).*

* + *(Ericsson , R1-2202389[16]) Proposal 1*

Comments

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **yes** | **NO** | **Additional comments** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

## Timing error margins of TEGs

Submitted Proposals

* ***(Sony, R1-2201582[6]) Proposal 3:*** *Support to associate TEG ID with the timing error margin value (e.g., the smallest TEG ID represent the TEG with the smallest timing error margin.*
* ***(Sony, R1-2201582[6]) Proposal 4:*** *Define the certain margin of a TEG. This aspect can be investigated by RAN4.*
* ***(Fraunhofer, R1-2202366[14]) Proposal 1:*** *From RAN1 perspective, the timing error margin(s) will be defined by RAN4 and the definition takes the aspects Rx timing errors/Tx timing errors defined by RAN1 into account.*
	+ *Send an LS to RAN4*

FL comments

There were intensive discussion and multiple round of discussion of different proposals on how to define the *timing error margins* and *UE capability of timing error margins* w/o conclusion. Given that RAN4 is working on the issues related to *timing error margins,* the suggestion from FL is no further discussion unless RAN4 wants RAN1 to be involved in the discussion.

### Question 2.9

*Companies are invited to provide their views on whether there is a need for RAN1 to discuss (or not discuss) the timing error margins in this meeting, and if yes, please provide the additional comments (e.g., the priority, whether you support the proposal) for the following proposals:*

* + *(Sony, R1-2201582[6]) Proposal 3*
	+ *(Sony, R1-2201582[6]) Proposal 4*
	+ *(Fraunhofer, R1-2202366[14]) Proposal*

Comments

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **yes** | **NO** | **Additional comments** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

## Reporting of self-calibration of a TEG

Submitted Proposals

* ***(Nokia, R1-2201634[7]) Proposal 4:*** *Allow UE to report an indicator to LMF to inform if a positioning measurement has been calibrated for a specific TEG.*

FL comments

In FL’s view, UE/TRP will have always to perform a certain levels of calibration of the Rx timing delays for the positioning measurements in order to support meeting the measurement performance defined by RAN4, and the UE will determine whether the measurements in the same Rx TEG based on the UE implementation. Thus, it seems not meaningful for UE to indicate if a positioning measurement has been calibrated for a specific TEG unless there is a specific margin or value is defined to the calibration.

### Question 2.10

*Companies are invited to provide their views on whether the following proposal should be discussed (or not discussed) in this meeting, and if yes, please provide the additional comments (e.g., the priority, whether you support the proposal).*

* + *(Nokia, R1-2201634[7]) Proposal 4*

Comments

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **yes** | **NO** | **Additional comments** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

## RSRP/RSRPP diversity

Submitted Proposals

* ***(Huawei, R1-2200920[1]) Proposal 8:*** *For PRS-RSRPP, the reported value for a target DL-PRS resource can be Rx branch specific.*

FL comments

In [1], there was an observation that if the reported PRS-RSRP (and potentially PRS-RSRPP) is not lower than the PRS-RSRP (and potentially PRS-RSRPP) of any individual Rx branches, some TOA measurement associated with a Rx TEG ID may not have PRS-RSRP (and potentially PRS-RSRPP) value. Thus, the proposal is to support *Rx branch specific PRS-RSRPP* in order to have TOA measurement and *PRS-RSRPP* from the same Rx branch.

### Question 2.11

*Companies are invited to provide their views on whether the following proposal should be discussed (or not discussed) in this meeting, and if yes, please provide the additional comments (e.g., the priority, whether you support the proposal).*

* + *(Huawei, R1-2200920[1]) Proposal 8*

Comments

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **yes** | **NO** | **Additional comments** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

## Performance requirements for RSTD measurements of the same DL PRS resource

Submitted Proposals

* ***(Ericsson , R1-2202389[16]) Proposal 2:*** *Inform RAN4 with an LS that RAN4 requirements should capture that, subject to UE capability, a UE configured to perform and report multiple RSTD measurements towards the same TRP, utilizing different UE RX TEGs, shall report one RSTD measurement for each UE RX TEG association for which the DL PRS is received with an appropriate configuration and with high enough SINR..*

FL comments

In FL’s view, RAN4 will work the performance requirements for all features introduced in Rel-17 ePOS. It seems no need to specifically send LS to RAN4, asking them to define the performance requirements for RSTD measurements of the same DL PRS resource.

### Question 2.12

*Companies are invited to provide their views on whether the following proposal should be discussed (or not discussed) in this meeting, and if yes, please provide the additional comments (e.g., the priority, whether you support the proposal).*

* + *• (Ericsson , R1-2202389[16]) Proposal 2*

Comments

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **yes** | **NO** | **Additional comments** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

## Association of UE Tx TEGs with the MIMO SRS

Submitted Proposals

* ***(Ericsson , R1-2202389[16]) Proposal 3:*** *The UE can be configured by the gNB to send UE TX TEG association reports for all SRS types including SRS for MIMO.*

FL comments

In previous meetings, there were intensive discussions related to whether to support a UE to provide the association information of UL SRS resources for MIMO with Tx TEGs without conclusion. Given that the WI was closed from RAN1 pespective, FL would suggest “no further discussion on the association of UE Tx TEG with MIMO SRS in Rel-17”.

### Question 2.13

*Companies are invited to provide their views on whether the following proposal should be discussed (or not discussed) in this meeting, and if yes, please provide the additional comments (e.g., the priority, whether you support the proposal).*

* + *• (Ericsson , R1-2202389[16]) Proposal 3*

Comments

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **yes** | **NO** | **Additional comments** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

## Impact of TA on UE Rx-Tx time difference

Submitted Proposals

* ***(Ericsson , R1-2202389[16]) Proposal 9:*** *To mitigate transmission timing changes for multi-RTT measurements:*
	+ *Support the LMF to configure a UE (with required capabilities) with a list of SRS resource sets and SRS resources for each TRP for reporting of transmission timing compensation.*
		- *In case, an SRS resource set is listed, then that should be interpreted as including all SRS resources in the SRS resource set.*
	+ *Given a UE Rx-Tx time difference measurement reported in a multi RTT report, the UE should also report a transmission timing compensation for each SRS resource indicated for transmission timing compensation.*
		- *The transmission timing compensation is signaled together with two timestamps:*
			* *A first timestamp for the UL subframe #j closest in time to the DL subframe #i in which the DL PRS used for the UE Rx-Tx time difference measurement is received*
			* *A second timestamp for the subframe #k where the TX instance of the SRS resource occurs which is closest in time to the reception time of the DL PRS used for the UE Rx-Tx time difference measurement.*
		- *Transmission timing compensation is defined as the difference in transmission timing between the subframe #k and subframe #j.*
		- *Transmission timing is defined as the time between the transmission of UL subframe #i and the first detected path (in time) of the corresponding downlink subframe #i from the reference cell.*
		- *A transmission timing compensation in a multi-RTT report is only coupled to the two timestamps and is thus in the report not tied to a specific SRS resource or UE Rx-Tx time difference measurement.*
* ***(Ericsson , R1-2202389[16]) Proposal 10:*** *The transmission timing compensation should be reported by the UE to the LMF together with a quality estimate, giving a measure of the deviation of the transmission timing compensation from the true difference in transmission timing between UL subframe #k of UL SRS transmission and UL subframe #j closest in time to DL PRS reception.*

FL comments

Significant efforts have been spent on the impact of TA on multi-RTT in the previous meetings on the issue [17]. Based on various considerations and the resolutions of the impact of the timing adjustment on the UE Rx-Tx time difference measurement is not explicitly included in the WI objectives, the FL had suggested no further discussion of this topic in Rel-17, which was supported by majority companies. Given that the WI was closed from RAN1’s perspective, and only one company proposes to revisit the issue, and there are many other more issues need to be resolved in this meeting, the FL would suggest no further discussion on the issue in this meeting.

### Question 2.14

*Companies are invited to provide their views on whether the following proposal should be discussed (or not discussed) in this meeting, and if yes, please provide the additional comments (e.g., the priority, whether you support the proposal).*

* + *(Ericsson , R1-2202389[16]) Proposal 9*
	+ *(Ericsson , R1-2202389[16]) Proposal 10*

Comments

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **yes** | **NO** | **Additional comments** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

## Multiple reference timings

Submitted Proposals

* ***(LGE, R1-2202291[13]) Proposal 2:*** *RAN1 should consider/adopt configuring multiple reference timing to UE.*

FL comments

In FL’s understanding, LMF does not know UE channel condition and does not need to use the channel condition to configure the timing referencetoUE. The main purpose of configured *reference timing* with the uncertainty range is for the UE to search the DL PRS signals. In UE side, it is up to UE implementation on whether to use the LMF configured timing reference or define another DL PRS as the timing reference when reporting the RSTD measurements. Thus, it seems no need to consider the configuration of multiple reference timings. A similar proposal was presented in previous meetings w/o a conclusion since only few companies provided the comments.

### Question 2.15

*Companies are invited to provide their views on whether the following proposal should be discussed (or not discussed) in this meeting, and if yes, please provide the additional comments (e.g., the priority, whether you support the proposal).*

* + *(LGE, R1-2202291[13]) Proposal 2*

Comments

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **yes** | **NO** | **Additional comments** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

# Measurement enhancements for mitigating UE/gNB Tx/Rx timing errors

Background

|  |
| --- |
| Agreement (RAN1#104e)Support enabling* A UE to report one or more measurement instances (of RSTD, DL RSRP, and/or UE Rx-Tx time difference measurements) in a single measurement report to LMF for UE-assisted positioning, and
* A TRP to report one or more measurement instances (of RTOA, UL RSRP, and/or gNB Rx-Tx time difference measurements) in a single measurement report to LMF, and
* Each measurement instance is reported with its own timestamp
	+ FFS: The measurement instances are within a [configured] measurement time window
* FFS: Each UE measurement instance can be configured with N instances of the DL-PRS Resource Set
	+ FFS: N (including N=1)
* FFS: Each TRP measurement instance can be configured with M SRS measurement time occasions
	+ FFS: M (including M=1)
* FFS: details of behavior, procedures, and UE capability if any
* FFS: whether and how to consider the additional enhancement related to measurement reporting of multi-paths and quality metric
* Note 1: A measurement instance refers to one or more measurements, which can either be the same or different types, which are obtained from the same DL PRS resource(s), or the same UL SRS resource(s).
* Note 2: This enhancement has no intention to change the mapping of measurement types to Rel-16 positioning techniques and no intention to introduce new positioning techniques either.

Agreement (RAN1#106e)Consider the following options (both could be selected) until RAN1#106b-e* Option 1: Support LMF to optionally indicate the measurement time window (MTW) for a UE for the measurement instances included in a measurement report.
* Option 2: Support LMF to optionally indicate the measurement time window for a gNB for the measurement instances included in a measurement report.
* FFS: the details of the MTW configuration.

Any requirements can be discussed by RAN4 after decision on the options is made. |

## Measurement time window

Background

|  |
| --- |
| Agreement (RAN1#106e)Consider the following options (both could be selected) until RAN1#106b-e* Option 1: Support LMF to optionally indicate the measurement time window (MTW) for a UE for the measurement instances included in a measurement report.
* Option 2: Support LMF to optionally indicate the measurement time window for a gNB for the measurement instances included in a measurement report.
* FFS: the details of the MTW configuration.
* Any requirements can be discussed by RAN4 after decision on the options is made.
 |

Submitted Proposals

* ***(Huawei, R1-2200920[1]) Proposal 2:*** *The following procedures for the MTW indication from LMF is supported:*
	+ *LMF to optionally recommend the measurement time window (MTW) for a UE for the measurement instances included in a measurement report.*
		- *A new UE capability to receive the indication of MTW is defined*
	+ *LMF to optionally recommend the measurement time window for a gNB for the measurement instances included in a measurement report.*
	+ *For both cases, UE and gNB are not required to follow the recommendation.*
	+ *Send an LS to RAN2 and RAN3.*
* ***(Huawei, R1-2200920[1]) Proposal 3:*** *MTW configuration to UE/gNB should include*
	+ *MTW starting/offset SFN*
	+ *MTW length in the unit of 10msec*
	+ *MTW periodicity for the cases of periodic reporting in the unit of 10msec*
	+ *The UE/gNB expects MTW periodicity to be configured to a number close to the periodic reporting interval, which is a multiple of PRS/SRS periodicity and can divide or can be divided by 10.24s SFN period.*
	+ *Include the parameters in the higher layer parameter spread sheet.*
* *(ZTE, R1-2201193[3])* ***Proposal 2:*** *There is no need to introduce measurement time window in Rel-17 NR positioning*
* *(CATT, R1-2201361[5])* ***Proposal 1:*** *The configurable measurement time windows should be supported, in which the UE or TRP measurement instances are obtained.*
* *(CATT, R1-2201361[5])* ***Proposal 2****: Support LMF to indicate a preferred measurement starting time to the UE/TRP for the measurement instances included in a single measurement report.*
* ***(CATT, R1-2201361[5]) Proposal 3****: UE/TRP measurement time window can be configured with the following parameters by LMF:*
	+ *For UE measurement time window (via LPP signalling):*
	+ *P1: The periodicity of UE measurement time window (for periodic UE MTW).*
	+ *T1: The start time of UE measurement time window.*
	+ *L1: The length of UE measurement time window.*
	+ *For TRP measurement time window (via NRPPa signalling):*
	+ *P2: The periodicity of TRP measurement time window (for periodic TRP MTW).*
	+ *T2: The start time of TRP measurement time window.*
	+ *L2: The length of TRP measurement time window.*
* ***(InterDigital, R1-2201824[9]) Proposal 5****: Support Option 1 (“Support LMF to optionally indicate the measurement time window for a UE”) and Option 2 (“Support LMF to optionally indicate the measurement time window for a gNB”) of the measurement time window.*
* ***(CMCC, R1-2201856[10])*** *Proposal 2: Support both of the following options:*
	+ *Option 1: Support LMF to optionally indicate the measurement time window (MTW) for a UE for the measurement instances included in a measurement report.*
	+ *Option 2: Support LMF to optionally indicate the measurement time window for a gNB for the measurement instances included in a measurement report.*

FL Comments

Whether to introduce the measurement time windows (MTW) for UE and gNB have been discussed very intensively in the previous meetings (e.g., [17]). While majority companies were supportive, some companies did not think it is necessary to do so. For this meeting, multiple companies (e.g., [1][5][9][10]) propose again to introduce the MTW, while one company considers it is not needed to introduce MTW. Given than the WI was closed from RAN1’s perspective, FL would like first check companies’ views on the priority of the issue, and the views on the latest proposal discussion discussed in the previous meeting, and then to decide whether we should have a further discussion on this issue in this meeting.

### Proposal 3.1

* *The measurement time window (MTW) configuration for a UE/gNB should include*
	+ *MTW starting time (e.g., the offset of SFN)*
	+ *MTW length, which may be configured with one of the following options*
		- * + *Option 1: (explicitly) configured in the unit of 10msec;*
				+ *Option 2: (implicitly) decided based on the configuration of UE/gNB measurement instances for the MTW, and the number of consecutive samples (PRS/SRS instances) for each UE/gNB measurement instance*

Comments

*Companies are invited to provide their views on whether the issue covered by the above proposal should be discussed in this meeting, and if yes, please provide the additional comments (e.g., the priority, whether you support the proposal).*

|  |  |  |
| --- | --- | --- |
| **Company** | **yes/no** | **Additional comments**  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

## Timestamp of measurement instance

Submitted proposals

* ***(vivo, R1-2201093[2]) Proposal 3:*** *Support to enable the UE to report PRS measurements derived from the most recent measurement instances before the measurement report.*
* ***(vivo, R1-2201093[2]) Proposal 4:*** *The timestamp of the UE (or TRP) measurement instance corresponds to the reception time of the last DL-PRS resource (or the last SRS resource for the positioning purpose) that are used to determine the measurement instance.*
* **(ZTE, R1-2201193[3])** ***Proposal 3*:** *Support of a UE to report multiple measurement instances in a measurement report,*
	+ *For PRS processing sample number=1, each measurement instance should be based on a single time instance of corresponding DL PRS resource. UE can report multiple measurement instances based on different time instances of the same DL PRS resource, where different time instances of the same DL PRS resource should be associated with the same UE Rx TEG.*
	+ *For PRS processing sample number=4, each measurement value in a measurement instance can be based on a filtered/averaged results from at least four time instances of the corresponding DL PRS resource. UE should report a time stamp to indicate the time duration over which the filtering or average is performed, where the time stamp includes,*
	+ *A starting time instance corresponds to the reception time of the first instance of the DL PRS resources to obtain the reported measurement instance, and*
	+ *An ending time instance corresponds to a reception time of the last instance of the DL PRS resources to obtain the reported measurement instance.*
	+ *Note: For both PRS processing sample number=1 and PRS processing sample number=4, UE should always follow the measurement period defined in Rel-16.*

FL Comments

Whether and how to define to the timestamp of measurement instances have been discussed very intensively in the previous meetings (e.g., [17]). Various options were discussed, while majority companies were supportive for RAN1 to provide the clear definition of the timestamp of measurement, some companies did not think it is necessary to do so. For this meeting, two companies (e.g., [2][3]) propose again the definition of the timestamp of measurement instances. Given than the WI was closed from RAN1’s perspective, FL would like first check companies’ views on the priority of the issue, and the views on the latest proposal discussion discussed in the previous meeting, and then to decide whether we should have a further discussion on this issue in this meeting.

### Proposal 3.2

*The timestamp for a measurement instance in a measurement report is defined by one of the following options:*

* *Option 1: The timestamp of the UE (or TRP) measurement instance corresponds to the reception time of the last DL-PRS resource (or the last SRS resource for the positioning purpose) that are used to determining the measurement instance.*
	+ *FFS: Whether to report an additional timestamp corresponding to the reception time of the first instance of the DL PRS (or UL SRS) resources, if multiple instances of the DL PRS (or UL SRS) resources are used to obtain the measurement instance.*
* *Option 2: Up to UE implementation.*
* *Option 3: Up to UE implementation but within the reception time of the first and last DL-PRS resource (or the first and last SRS resource for the positioning purpose) that are used to determining the measurement instance.*

Comments

*Companies are invited to provide their views on whether the issue covered by the above proposal should be discussed in this meeting, and if yes, please provide the additional comments (e.g., the priority, which options you want to support, etc.).*

|  |  |  |
| --- | --- | --- |
| **Company** | **yes/no** | **Additional comments**  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

## Timestamp of measurement instance

Submitted proposals

* **(ZTE, R1-2201193[3])** ***Proposal 4*:** *Further discuss the association between measurement instances and UE measurement report, at least consider one of the following alternatives,*
	+ *Alt.1: For each indicated DL PRS resource in a measurement report, multiple measurement instances are associated with the indicated DL PRS resource.*
	+ *Alt.2: For each indicated DL PRS resource set in a measurement report, multiple measurement instances are associated with the indicated DL PRS resource set.*
	+ *Alt.3: For each indicated measurement element (i.e. TRP) in a measurement report, multiple measurement instances are associated with the indicated measurement element.*
	+ *Alt.4: For each indicated positioning method in a measurement report, multiple measurement instances are associated with the indicated positioning method.*
	+ *Alt.5: Multiple measurement instances are directly associated with a measurement report.*
* ***(Qualcomm, R1-2202140[12])Proposal 4:*** *With regards to the association between measurement instances and UE measurement report, at least support the following option:*
	+ *Alt.4: For each indicated positioning method in a measurement report, multiple measurement instances are associated with the indicated positioning method.*
		- *That is, a UE should be able to report, in a single NR-XXX-ProvideLocationInformation, multiple NR-XXX-SignalMeasurementInformation elements for UE assisted positioning, and NR-XXX-LocationInformation for UE-based positioning.*

FL Comments

The proposal of the association between measurement instances and UE measurement report was discussed in the previous meeting w/o conclusion. Some companies considered that the issue should be discussed and decided in RAN1, but some other companies commented the issue should be discussed RAN2. Given than the WI was closed from RAN1’s perspective, FL would like first check companies’ views on the priority of the issue, and the views on the latest proposal discussion discussed in the previous meeting, and then to decide whether we should have a further discussion on this issue in this meeting.

### Proposal 3.3

* *The association between measurement instances and UE measurements should be defined with at least one of the following alternatives,*
	+ *Alt.1: For each indicated DL PRS resource in a measurement report, multiple measurement instances are associated with the indicated DL PRS resource.*
	+ *Alt.2: For each indicated DL PRS resource set in a measurement report, multiple measurement instances are associated with the indicated DL PRS resource set.*
	+ *Alt.3: For each indicated measurement element (i.e. TRP) in a measurement report, multiple measurement instances are associated with the indicated measurement element.*
	+ *Alt.4: For each indicated positioning method in a measurement report, multiple measurement instances are associated with the indicated positioning method.*
	+ *Alt.5: Multiple measurement instances are directly associated with a measurement report.*

Comments

*Companies are invited to provide their views on whether the issue covered by the above proposal should be discussed in this meeting, and if yes, please provide the additional comments (e.g., the priority, which alternative you want to support, etc.).*

|  |  |  |
| --- | --- | --- |
| **Company** | **yes/no** | **Additional comments**  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

# RAN2/SA2 Reply LSs on Positioning Reference Unit (PRUs)

Background

|  |
| --- |
| Agreement: (RAN1#105e)Send an LS to RAN2/RAN3 (cc SA2), including the following content:* RAN1 has evaluated the use of positioning reference units (PRUs) with known locations for positioning and observes improvements in using PRUs for enhancing the positioning performance. But, RAN1 has not identified specification enhancements needed in RAN1 specifications. RAN1 kindly requests RAN2/RAN3 (cc SA2) to determine if and what specification enhancements are adopted for PRUs for positioning.
* Notes:
	+ The term “positioning reference unit (PRU)” is only used as a terminology in this discussion. PRU does not necessarily mean an introduction of a new network node.
	+ PRU may support, at least, some of the Rel-16 positioning functionalities of UE, if agreed, which is up to RAN2. The positioning functionalities may include, but not limited to, the following:
		1. Provide the positioning measurements (e.g., RSTD, RSRP, Rx-Tx time differences)
		2. Transmit the UL SRS signals for positioning
	+ PRU may be requested by the LMF to provide its own known location coordinate information to the LMF. If the antenna orientation information of the PRU is known, the information may also be requested by the LMF.

[R1-2106265](file://Users/renda000/Downloads/2021_11_RAN1_107e/Docs/R1-2106265.doc) [DRAFT] LS on Positioning Reference Units (PRUs) for enhancing positioning performance Final LS endorsed in [R1-2106326](file://Users/renda000/Downloads/2021_11_RAN1_107e/Docs/R1-2106326.doc) (Email endorsement) |

SA2’s response to RAN1 LS [R1-2200862]

|  |
| --- |
| SA2 discussed the PRU and agreed to include the objective of how to support the ***PRU in Rel-18*** eLCS\_Ph3 Study Item, considering SA2 Rel-17 is already frozen and more time is needed to study how to support the PRU in SA2.SA2 also noticed that RAN2 is under discussion of how *to support PRUs in Rel-17* and is considering solutions which may or may not have impacts to SA2. SA2 does not have enough time in Rel-17 to comment on such solutions at the present time but expects that a solution or solutions preferable to SA2 should be possible in Release 18. |

RAN2’s response to RAN1 LS [R1-2200857]

|  |
| --- |
| RAN2 discussed support of PRUs as described in the RAN1 LS R2-2106920 (R1-2106326, S2-2105263). Based on the information provided by RAN1, RAN2's current understanding is that a PRU is a device with a priori known location (to some degree of accuracy at least) and which performs location measurements at this known location. In addition, the PRU can transmit SRS to enable TRPs to measure and report UL positioning measurements from PRUs at known location. The PRU or TRP measurements can then be compared by a location server with the measurements expected to determine "correction information" for other nearby target devices. The location measurements for other target devices may then be corrected based on the previously determined "correction information". Further, RAN2 discussed the modelling of PRUs and agreed that the PRU can be considered (at least) as a UE (from LMF perspective). However, since the PRU location measurements are needed by an LMF itself different views exist in RAN2 on how this can be enabled in the current LCS architecture.Some companies in RAN2 believe that PRU support has no impact on SA2 and CT specifications and think that the MT-LR procedures as currently specified in TS 23.273 can also be instigated by an LMF (e.g., an LMF may initiate a location request to a GMLC) or existing MO LR procedures as specified in TS 23.273 can be instigated by a PRU for enabling an LMF to obtain PRU location measurements or transmit UL-SRS.Other companies in RAN2 believe that an LMF needs to be enabled to instigate location procedures for a PRU (e.g., LPP, NRPPa procedures) without receiving a location request for the PRU from an AMF (i.e., in the absence of an MT-LR or MO-LR for the PRU). These companies also believe that this effectively means that the LMF should act as an "LCS Client" for PRUs. However, since the LCS procedures and overall architecture are in the realm of SA2, RAN2 would like to confirm with SA2 whether PRU support as described by RAN1 can be provided with the current LCS framework as specified by SA2 (e.g., TS 23.273) or whether any changes would be required.In addition, RAN2 discussed whether the LMF determined "correction information" obtained from PRU measurements needs to be provided to target UEs for UE-based mode of operation. As mentioned by RAN1 in the LS, a PRU may provide "antenna orientation information" to an LMF and RAN2 would like to ask RAN1 to provide further details of the "PRU antenna orientation information".2. Actions:To RAN1 group.ACTION: RAN2 kindly asks RAN1 whether the LMF determined "correction information" obtained from PRU measurements need to be ***provided to target UEs for UE-based mode of operation***, and if so, kindly asks RAN1 to ***provide further details on the specific "correction information"*** which need to be provided to target UEs.RAN2 also kindly asks RAN1 to provide further details on the "***PRU antenna orientation information***" which should be provided to an LMF. |

*Submitted Proposals*

* ***(Sony, R1-2201582[6]) Proposal 5:*** *Support to provide UE capability information to LMF, which can assist LMF to select the capable UE to become PRU.*
* ***(Sony, R1-2201582[6]) Proposal 6:*** *PRU with known location support the following reporting: Location uncertainty information, stationary status, positioning measurement and/or estimated Tx/Rx Timing error report.*
* ***(Nokia, R1-2201634[7]) Proposal 1:*** *Prioritize UE-assisted PRU in Rel-17 and send an LS to RAN2 informing them of this decision.*
* ***(Nokia, R1-2201634[7]) Proposal 2****: Include in the reply LS to RAN2 that the PRU antenna orientation is the 3D angle in the global coordinate system at which the PRU antenna is location*
* ***(Intel, R1-2201697[8])******Proposal 1:*** *For UE-based DL-TDOA positioning, support one of the following options for assistance information reporting from the LMF to the target UE to facilitate TRP TX timing errors mitigation:*
	+ *Option 1:*
		- *Support the LMF providing the DL RSTD measurement and the associated TX TEGs obtained with the Positioning Reference Unit (PRU) to the target UE*
		- *Support the LMF providing the PRU coordinates to the target UE*
	+ *Option 2:*
		- *Support the LMF providing the TRP TX timing errors difference (between the target and reference TRP) and the associated TX TEGs to the target UE*
* ***(Intel, R1-2201697[8])******Proposal 2:*** *Support PRU antenna orientation information reporting in GCS from PRU to the LMF reusing the LCS-GCS-Translation-Parameter-r16 defined in Rel.16*
	+ *where the PRU antenna array boresight direction in LCS is aligned with the x axis, and*
	+ *y and z axes in LCS are aligned with the row and column dimensions of the antenna array, respectively*
* ***(Intel, R1-2201697[8])******Proposal 3:*** *Introduce the following UE capability/feature groups for PRU support:*
	+ *FG x1: Support of the PRU functionality*
		- *UE may be requested by the LMF to provide its own known location coordinate information to the LMF to facilitate mitigation of UE/gNB TX/RX timing delay mitigation*
	+ *FG x2: Support of the PRU with antenna orientation information reporting*
		- *UE may be requested by the LMF to provide antenna orientation information*
	+ *FG x1 is a pre-requisite of the FG x2*
* ***(InterDigital, R1-2201824[9]) Proposal 5****: Support Option 1 (“Support LMF to optionally indicate the measurement time window for a UE”) and Option 2 (“Support LMF to optionally indicate the measurement time window for a gNB”) of the measurement time window.*
* ***(InterDigital, R1-2201824[9]) Proposal 6****: Integrity metrics associated with location information of the PRU is used to verify “known location” of the UE.*
* ***(InterDigital, R1-2201824[9]) Proposal 7****: Time validity conditions for PRU should be specified.*
* ***(Samsung, R1-2202014[11]) Proposal 1****: The "correction information" could at least include the time difference and the angle difference for PRU or between PRU and target UE, and each of them should be associated with two or more cell ID or reference signal ID for location measurement.*
* ***(Samsung, R1-2202014[11]) Proposal 2****: Correction state indicator should be configured to trigger the target UEs to receive "correction information".*
* ***(Samsung, R1-2202014[11]) Proposal 3****: The "correction information" can be requested by target UEs or provided by LMF directly according to the correction state indicator.*
* ***(Lenovo, R1-2202370[15])Proposal 1:*** *LMF may use current capability signalling procedures to differentiate and identify PRU and normal UEs.*
* ***(Lenovo, R1-2202370[15])Proposal 2:*** *LMF can manage and process PRU reference measurements in a similar manner to normal UE measurements.*
* ***(Lenovo, R1-2202370[15])Proposal 3****: RAN1 to confirm that PRU UE basic operations may be supported in Rel-17 with existing LPP procedures based on RAN2 and SA2 input.*
* ***(Lenovo, R1-2202370[15])Proposal 4:*** *RAN1 to confirm that the PRU UE can report its known available location information to the LMF via:*
	+ *LPP signalling;*
	+ *RRC signalling (e.g. using CommonLocationInfo message) via gNB.*
	+ *Offline/pre-configured location calibration*
	+ *Note: It is up to RAN2 decide, which messages may be used to transfer the known location information.*
* ***(Lenovo, R1-2202370[15])Proposal 5:*** *RAN1 to support provision of double differential correction information for UEs performing UE-based positioning.*
* ***(Lenovo, R1-2202370[15])Proposal 6:*** *RAN1 to at least support the following differential correction information provided to the UE:*
	+ *Pseudorange error corrections of associated TRPs including DL-PRS resource information of the measured TRPs;*
	+ *Pseudorange error correction validity time;*
	+ *Source type of the double differential correction information (e.g., PRU UE).*
* *(vivo, R1-2201046) And at least RSTD correction information should be included for UE-based DL TDOA.*
* *(ZTE, R1-2201205) RAN1 thinks LMF can obtain time/synchronization difference between a TEG i of a first TRP and TEG j of a second TRP based on the PRU/TRP measurements and the PRU location. Hence, the correct information refers to the time/synchronization difference between a TEG i of a first TRP and TEG j of a second TRP where a first TRP can be the same as the second TRP. It is like to extend NR-RTD-Info-r16 from TRP basis to TEG basis.*
* *(OPPO, R1-2201246) correction information” can be Tx timing error for PRS resource(s) / PRS resource set(s) to facilitate UE to compensate the timing-based measurement result.*
* *(CATT) Proposal 1: The support of providing "correction information" obtained from PRU measurements from LMF to target UEs for UE-based mode of operation will be considered in a future release, but not in Rel-17.*
* *(***InterDigital***, R1-2201822) Proposal 1: Correction information can be provided by the LMF to the target UE for UE-based positioning*
* *(***InterDigital***, R1-2201822) Proposal 2: As correction information, estimated timing offset associated with TRP Tx TEG is provided by the LMF to the target UE for UE-based positioning*
* *(CMCC, R1-2201838) Proposal 1: Support LMF to provide correction information of timing errors to a target UE using UE-based positioning.*
* *(CMCC, R1-2201838) Proposal 2: The correction information should include the positioning method or positioning measurement used at the LMF to obtain the timing errors, and the specific timing error values*
* *(Qualcomm, R1-2202108) no new assistance data, or correction information has been identified in this release beyond the assistance data enhancements that has already been agreed.*
* *(LGE, R1-2202296) it would be a details about the value of estimated Tx/Rx/TxRx TEGs at gNB obtained by PRU measurements.*
* *(Ericsson, R1-2202323)* *During Rel-17 enhanced positioning normative phase, RAN1 agreed that there is no RAN1 specification impact with respect to PRUs. As such, details of “correction information” were not discussed nor agreed during Rel-17 enhanced positioning normative phase. From RAN1 perspective, such detailed discussion needs to be deferred to a future release.*
* *(Huawei, R1-2202454)* *Proposal 1: RAN1 confirm that PRU functionality as a UE can be specified in RAN in Rel-17 time frame.*
* *(Huawei, R1-2202454) Proposal 2: RAN1 to reply to RAN2 with the question of correction information for UE-based mode:*
	+ *It is RAN1 understanding that the correction information for UE-based DL-TDOA can be provided via NR-RTD-Info in Rel-16 without change of specification, and that the correction information for UE-based DL-AoD can be provided via the Rel-17 TRP beam/antenna information already agreed.*
* ***(vivo, R1-2201046)*** ***the boresight direction information of PRU, and the contents are similar to (the boresight direction of a beam in AoD positioning(ie. DL-PRS-BeamInfoElement-r16))***
* *(ZTE, R1-2201205) a boresight direction where a PRU is used for receiving/transmitting reference signals, which can be expressed by azimuth angle information and/or elevation angle information.*
* *(OPPO, R1-2201246) For the type of PRU regarded as UE, the PRU antenna orientation information cannot be obtained.*
* *(CATT, R1-2201315)* *Proposal 2: If a PRU is a TRP, the TRP may provide its antenna orientation information, i.e., LCS to GCS Translation information, for the transmission of SRS resources for positioning to the LMF, which is similar to the case when TRP provides the antenna orientation information for the transmission of PRS resources to the LMF as supported in Rel-16. If a PRU is a UE, there is no need to support the UE to provide its antenna orientation information to the LMF in Rel-17.*
* *(***InterDigital***, R1-2201822)* Proposal 3: If requested by the network, the PRU can provide antenna orientation information where the antenna orientation information can include boresight angles of Tx and/or Rx panels
* *(Qualcomm, R1-2202108) RAN1 has not identified in this release, any further details on the "PRU antenna orientation information" which should be provided to an LMF*
* *(LGE, R1-2202296) Tx/Rx/TxRx TEGs (e.g. association information) and it may also include the coordination of antenna when the antennas are distributed.*
* *(Ericsson, R1-2202323)* PRU can be considered as a UE (from LMF perspective). As the UE’s orientation is likely to change, it doesn’t seem beneficial for a PRU UE to report “PRU antenna orientation information” to the LMF. Furthermore, details of “PRU antenna orientation information” were not discussed nor agreed during Rel-17 enhanced positioning normative phase.
* (Huawei, R1-2202454) Proposal 3: RAN1 to reply to RAN2 with the question of antenna orientation information:
	+ It is RAN1 understanding that a single LCS-GCS translation per UE is sufficient to convey the antenna orientation of a PRU.

FL comments

SA2 Reply LS has made clear that from SA2 Rel-17 is already frozen, and thus any PRU features that has impact on SA2 will be considered in Rel-18, but not in Rel-17. Thus, for Rel-17, RAN may only consider the support of the PRU features that do not have the impact on SA2, e.g., MO-LR.

In RAN2 replay LS asks RAN1 to provide the response on the following question,

* Q1: whether the LMF determined "correction information" obtained from PRU measurements need to be provided to target UEs for UE-based mode of operation, and if so, kindly asks RAN1 to provide further details on the specific "correction information" which need to be provided to target UEs.
* Q2: RAN2 also kindly asks RAN1 to provide further details on the "PRU antenna orientation information" which should be provided to an LMF.

For the 1st question of providing "correction information" obtained from PRU measurements from LMF to target UEs for UE-based mode of operation, many companies propose providing the timing related correction information, e.g., estimated TRP TX timing errors difference (Intel, Samsung, OPPO, InterDigital, CMCC, LGE, Huawei), differential correction (Lenovo), RSTD correction (vivo), TRP time/synchronization difference (ZTE). Some companies also propose providing the angle related correction information (Samsung, Huawei).

However, there are also multiple companies propose either prioritize UE-assisted PRU in Rel-17 (Nokia), or consider the support of providing "correction information" obtained from PRU measurements from LMF to target UEs for UE-based mode of operation in a future release, but not in Rel-17 (CATT, Qualcomm, Ericsson), mainly because RAN1 has so far not made the agreement on the correction information for UE-based positioning, and the WI was closed from RAN1’s perspective. In addition, Rel-16 already supports LMF to provide the RTD (real time difference) to UE. Thus, when LMF estimates the time synchronization errors between a reference TRP and a list of neighbour TRPs based on the information from PRU, the LMF can sent the *NR-RTD-Info* to UE to provide time synchronization information between a reference TRP and a list of neighbour TRPs.

For the 2nd question of “PRU antenna orientation information", most of companies consider the PRU antenna orientation information is the LCS-GCS transformation information of the PRU antenna (Nokia, Intel, CATT, InterDigital, LGE, Huawei) or the boresight direction of the signals (vivo, ZTE). However, some companies have pointed out that when a PRU is a UE, PRU antenna orientation information may not be available (OPPO, CATT, Ericsson). One company (Qualcomm) also proposes no further details on the "PRU antenna orientation information" should be provided to an LMF in Rel-17.

Based on the proposals from the companies, RAN1 will need to first discuss *whether the LMF determined new "correction information" obtained from PRU measurements need to be provided to target UEs for UE-based mode of operation* and whether and which "PRU antenna orientation information" can be provided to an LMF.

### Question 4-1

*Companies are invited to provide their views on whether RAN1 needs to define new "correction information" to be determined by the LMF from PRU measurements and provide the "correction information" for UE-based positioning in Rel-17.*

Comments

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **yes** | **NO** | **Additional comments** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

### Question 4-2

*If you consider RAN1 needs to define new "correction information" to be determined by the LMF from PRU measurements for UE-based positioning, please indicates which of the following can be the "correction information":*

* *TRP Tx timing error*
* *TRP Tx timing error difference between reference TRP and neighboring TRPs*
* *Correction of TOA measurement*
* *Correction of RSTD measurement between reference TRP and neighboring TRPs*
* *TRP synchronization information (in addition to the existing NR-RTD-Info)*
* *Differenial correction information*
* *…*

Comments

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **yes** | **NO** | **Additional comments** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

### Question 4-3

*Companies are invited to provide their views on following on whether PRU needs to provide “PRU antenna orientation information” to LMF when the PRU is a TRP, and if yes, provide your views on which of following defines the “PRU antenna orientation information”:*

* *Option 1: The translation information of a Local Coordinate System (LCS) of the PRU antenna to a Global Coordinate System (GCS) as defined in TR 38.901, including the angles α (bearing angle), β (downtilt angle) and γ (slant angle) (see e.g.,* LCS-GCS-TranslationParameter-r16 in 38.355)
* *Option 2: The boresight of direction information of the transmitted/received signals, including the azimuth and elevation angles in LCS or in GCS (see e.g., DL-PRS-BeamInfoElement in TS 37.355)*
* *Option 1 and Option 2 (LCS)*

Comments

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **yes** | **NO** | **Additional comments** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

### Question 4-4

*Companies are invited to provide their views on following on whether PRU needs to provide “PRU antenna orientation information” to LMF when the PRU is a UE, and if yes, provide your views on which of following defines the “PRU antenna orientation information”:*

* *Option 1: The translation information of a Local Coordinate System (LCS) of the PRU antenna to a Global Coordinate System (GCS) as defined in TR 38.901, including the angles α (bearing angle), β (downtilt angle) and γ (slant angle) (see e.g.,* LCS-GCS-TranslationParameter-r16 in 38.355)
* *Option 2: The boresight of direction information of the transmitted/received signals, including the azimuth and elevation angles in LCS or in GCS (see e.g., DL-PRS-BeamInfoElement in TS 37.355)*
* *Option 1 and Option 2 (LCS)*

Comments

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **yes** | **NO** | **Additional comments** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

# RAN4 LS on SRS for multi-RTT positioning

Background

|  |
| --- |
| RAN4 LS (R1-2200900):*RAN4 discussed whether Rel-15 SRS is applicable for multi-RTT positioning, i.e. whether it can be used in UE Rx-Tx time difference and gNB Rx-Tx time difference measurements.* *The UE Rx-Tx time difference measurement requirements in clause 9.9.4, TS 38.133 and gNB Rx-Tx time difference accuracy requirements in clause 10.1.25, TS 38.133 are applicable provided that the UE is configured with SRS.* *RAN4 has observed that some legacy gNB may not support Rel-16 positioning SRS. Furthermore, same gNB may be configured to perform gNB Rx-Tx time difference measurement and UL RTOA for the same UE.* *RAN4 kindly requests RAN1 to confirm whether Rel-15 SRS is applicable for UE Rx-Tx time difference measurement and gNB Rx-Tx time difference measurement, and if so, from which release.*  |

|  |
| --- |
| Agreement(RAN1#99):Support reuse of Rel-15 SRS resource set for NR UL RTOA, AoA and gNB RSRP measurements for positioning in NR.* Note: There is no impact to specifications managed by RAN1
* Note: There is no impact to specifications managed by RAN4 for UE requirements
* Note: No new UE behaviour is expected

Agreement (RAN1#98):* gNB Rx-Tx time difference is defined with respect to the subframe timing associated with the UE
* Multiple SRS resources for positioning purposes can be used to determine the received UL subframe timing of the first arrival path of the UE.
* FFS: The resource ID(s) or resource set ID(s) used for determining the timing of the UE and possibly the Rx beam used at the gNB in the gNB Rx-Tx time difference measurements can be requested for reporting in the measurement report.
 |

|  |
| --- |
| TS 38.214 Section 5.1.6.2The UE may be configured to measure and report, subject to UE capability, up to 4 UE Rx-Tx time difference measurements corresponding to a single configured SRS resource or resource set for positioning. Each measurement corresponds to a single received DL PRS resource or resource set which can be in different positioning frequency layers. |

|  |
| --- |
| Agreement (RAN1 #106-e):Reporting of one gNB Rx-Tx time difference and multiple UL-AOAs measurements for the first arrival path per SRS resource for positioning in a single gNB report to LMF is supported * The above measurements are associated with SRS resource ID which is also reported to LMF
* FFS: Reporting of RSRP for the first arrival path

Agreement:NR supports gNB reporting of the first arrival path UL-AOA/ZOA measurement per SRS for positioning resource and SRS for MIMO resourceNote: The use of SRS for MIMO resource is transparent to the UEAgreement:* For the first arrival path measurements ~~on SRS for positioning resource,~~
	+ gNB can report to LMF the following set of measurements {one SRS-RSRP, multiple UL-AOAs (AoA/ZoA pairs), one UL-RTOA}
	+ gNB can report to LMF the following set of measurements {one SRS-RSRP, multiple UL-AOAs (AoA/ZoA pairs), one-gNB Rx-Tx time difference}
	+ FFS additional option: gNB can report to LMF the following set of measurements {multiple SRS-RSRP, multiple UL-AOAs (AoA/ZoA pairs), one UL-RTOA, one-gNB Rx-Tx time difference}
	+ All gNB measurements above are associated with SRS resource ID and timestamp, which are also reported to LMF
* For the first arrival path measurements on SRS for MIMO resource,
	+ gNB can report to LMF the following set of measurements {one SRS-RSRP, multiple UL-AOAs (AoA/ZoA pairs), one UL-RTOA}
	+ FFS: gNB can report to LMF the following set of measurements {multiple SRS-RSRP, multiple UL-AOAs (AoA/ZoA pairs), one UL-RTOA}
	+ All gNB measurements above are associated with SRS resource ID and timestamp, which are also reported to LMF
	+ Note: The operation of SRS for MIMO is transparent to the UE
 |

**PDC agreements for URLLC:**

|  |
| --- |
| AgreementFor RTT-based PDC, existing definitions of UE Rx – Tx time difference (i.e. section 5.1.30 in TS 38.215) and gNB Rx – Tx time difference (i.e. section 5.2.3 in TS 38.215) are reused, with updates at least to reflect the single pair of TRS/PRS and SRS configured for RTT-based PDC. AgreementFor RTT-based propagation delay compensation, the Rx-Tx time difference is reported via RRC signalling. |

TS 38.215 V17.0.0 [6]

|  |  |
| --- | --- |
| **Definition** | The gNB Rx – Tx time difference is defined as TgNB-RX –TgNB-TXWhere:TgNB-RX is the Transmission and Reception Point (TRP) [18] received timing of uplink subframe #*i* containing SRS associated with UE, defined by the first detected path in time.TgNB-TX is the TRP transmit timing of downlink subframe #*j* that is closest in time to the subframe #*i* received from the UE.Multiple SRS resources can be used to determine the start of one subframe containing SRS.The reference point for TgNB-RX shall be:- for type 1-C base station TS 38.104 [9]: the Rx antenna connector,- for type 1-O or 2-O base station TS 38.104 [9]: the Rx antenna (i.e. the centre location of the radiating region of the Rx antenna),- for type 1-H base station TS 38.104 [9]: the Rx Transceiver Array Boundary connector.The reference point for TgNB-TX shall be:- for type 1-C base station TS 38.104 [9]: the Tx antenna connector,- for type 1-O or 2-O base station TS 38.104 [9]: the Tx antenna (i.e. the centre location of the radiating region of the Tx antenna),- for type 1-H base station TS 38.104 [9]: the Tx Transceiver Array Boundary connector. |

*Submitted Proposals*

* ***(Huawei, R1-2201010, R1-2202457):***
	+ *The use of MIMO SRS by the UE for UE Rx - Tx time difference measurement is not specified in Rel-16.*
	+ *The use of MIMO SRS by the UE for UE Rx - Tx time difference measurement is already supported in Rel-17.*
	+ *The use of MIMO SRS by the gNB for gNB Rx - Tx time difference measurement is up to gNB implementation.*
* ***(vivo, R1-2201053):***
	+ *RAN1 would like to confirm, in release 17 and previous releases, RAN1 has not supported the use of Rel-15 SRS for UE Rx-Tx time difference measurement.*
	+ *The use of SRS for MIMO resource is transparent to the UE*
	+ *RAN1 also concluded that Tx TEG enhancement is only for Rel-16 SRS and not applicable for Rel-16 SRS for UL TDOA positioning and Multi-RTT Positioning.*
	+ *RAN1 has finished Rel-17 work on NR\_pos\_enh, therefore, it may not be possible to study this topic, at leat in this release.*
* ***(ZTE, R1-2201210)***
	+ *From RAN1 perspective, only SRS configured for positioning (introduced from Rel-16) is applicable for UE Rx-Tx time difference measurement and gNB Rx-Tx time difference measurement. Hence, Rel-15 SRS is not applicable for multi-RTT positioning.*
* ***(OPPO, R1-2201248)***
	+ *According to RAN1 agreement made in RAN1#99, Rel-15 SRS is NOT applicable for UE Rx-Tx time difference measurement and gNB Rx-Tx time difference measurement.*
* ***(CATT, R1-2201309, R1-2201310)***
	+ *Rel-15 SRS is not applicable for both UE Rx-Tx time difference measurement and gNB Rx-Tx time difference measurement.*
* ***(Qualcomm, R1-2202104)***
	+ *Rel-15 SRS is not applicable for UE Rx-Tx time difference measurement and gNB Rx-Tx time difference measurement in neither NR Rel-16 release, nor NR Rel-17 release.*
* ***(Ericsson, R1-2202400)***
	+ *Support reuse of Rel-15 SRS resource set for gNB Rx-Tx and UE Rx-Tx measurements for rel16 NR positioning.*

*FL Comments*

Based on the contributions from the companies (Huawei, vivo, ZTE, OPPO, CATT, Qualcomm), it seems we have the following common understanding:

* *The use of MIMO SRS for UE/gNB Rx - Tx time difference measurements is not specified in Rel-16.*
* *The use of MIMO SRS for UE/gNB Rx - Tx time difference measurement for the purpose of positioning is not specified in Rel-17.*
* *MIMO SRS can be used for gNB Rx - Tx time difference measurement for RTT-based PDC in Rel-17.*

Then, it seems what we need is to discuss whether MIMO SRS can be used for both UE and gNB Rx-Tx time difference measurements for the purpose of positioning in Rel-17.

Another issue we may want to consider is that for *RTT-based PDC* the SRS is used to obtain the gNB Rx-Tx time difference from the serving cell only. For multi-RTT positioning, there is a need for the nighboring cells to measure the UE SRS in order to obtain the gNB Rx-Tx time differences from multiple TRPs.

By the way, it is unclear to me why RAN4 LS ask RAN1 to conform whether Rel-15 SRS is applicable for UE Rx-Tx time difference. In my understanding, UE Rx-Tx time difference is obtained by measuring the DL signals (e.g., PRS), but not the UL SRS signals.

### Question 5-1

*Companies are invited to provide their views on the following questions:*

*Q1: Do you agree that the use of Rel-15 SRS for Multi-RTT is not specified in Rel-16?*

*Q2: Do you agree that the use of Rel-15 SRS for Multi-RTT is not specified in Rel-17 for the purpose of positioning?*

*Q3: Do you agree that the use of Rel-15 SRS for Multi-RTT is already specified in Rel-17 for the purposes other than positioning?*

*Q4: Do you support the reuse of Rel-15 SRS for Multi-RTT for the purpose of positioning in Rel-17?*

Comments

|  |  |
| --- | --- |
| **Company** | **comments** |
|  |  |
|  |  |
|  |  |
|  |  |

# TPs

##  Multiple measurement instances

Background

|  |
| --- |
| Agreement (RAN1#104e)Support enabling* A UE to report one or more measurement instances (of RSTD, DL RSRP, and/or UE Rx-Tx time difference measurements) in a single measurement report to LMF for UE-assisted positioning, and
* A TRP to report one or more measurement instances (of RTOA, UL RSRP, and/or gNB Rx-Tx time difference measurements) in a single measurement report to LMF measurements) in a single measurement report to LMF, and
* Each measurement instance is reported with its own timestamp
 |

Submitted Proposals

* ***(OPPO, R1-2201239[4]) Proposal 1:*** *Adopt the following TP (TP1) to avoid the potential ambiguity on whether a report can contain different types of measurement results. (The modifications are highlighted by YELLOW).*

|  |
| --- |
| TP1 (based on Draft CR R1-2112953)The UE may be configured to report one or more measurement instances, each with its own timestamp, on DL RSTD~~,~~ and optionally DL PRS-RSRP~~, and/or UE Rx-Tx time difference~~ measurements, in a single measurement report. The UE may be configured to report one or more measurement instances, each with its own timestamp, on UE Rx-Tx time difference measurements, in a single measurement report. |

* ***(OPPO, R1-2201239[4]) Proposal 2:*** *In order to avoid additional definition of the association information and align RAN1 and RAN2 spec, adopt the following the change for draft CR.*
	+ *the association information of DL RSTD measurement(s) with UE Rx TEG(s) via higher layer parameter [ueRxTEG-ID] when the UE reports the DL RSTD measurement(s). -> the ~~association information of~~ DL RSTD measurement(s) with associated UE Rx TEG(s) via higher layer parameter [ueRxTEG-ID] ~~when the UE reports the DL RSTD measurement(s)~~.*
	+ *the association information of UE Rx-Tx time difference measurement(s) with UE RxTx TEG(s) via higher layer parameter [ueRxTxTEG-ID] -> the ~~association information of~~ UE Rx-Tx time difference measurement(s) with associated UE RxTx TEG(s) via higher layer parameter [ueRxTxTEG-ID].*
	+ *the association information of UE Rx-Tx time difference measurement(s) with the UE Rx TEG(s) and UE Tx TEG(s) via the higher layer parameters of [ueRxTEG-ID], and [ueTxTEG-ID] -> the ~~association information of~~ UE Rx-Tx time difference measurement(s) with ~~the~~ associated UE Rx TEG(s) and associated UE Tx TEG(s) via the higher layer parameters of [ueRxTEG-ID], and [ueTxTEG-ID]*
* ***(OPPO, R1-2201239[4]) Proposal 3:*** *In order to avoid additional definition of the association information and align RAN1 and RAN2 spec, adopt the following the change for draft CR*
	+ *where the DL RSTD can be DL RSTD measurement in NR-DL-TDOA-AdditionalMeasurementElement -> where the DL RSTD can be DL RSTD measurement in NR-DL-TDOA-MeasElement and/or NR-DL-TDOA-AdditionalMeasurementElement*
* ***(OPPO, R1-2201239[4]) Proposal 4:*** *Move the definition of “UE Tx TEG” to Section 5.1.6.5 of TS 38.214*
* ***(OPPO, R1-2201239[4]) Proposal 5****: Adopt the following TP (TP2) for the draft CR. (The modifications are highlighted by YELLOW)*

### Question 5.1-1

*Companies are invited to provide their views on the following proposal:*

* ***(OPPO, R1-2201239[4]) Proposal 1***

|  |  |  |
| --- | --- | --- |
| **Company** | **yes/no** | **Additional comments**  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

### Question 5.1-2

*Companies are invited to provide their views on the following proposal:*

* ***(OPPO, R1-2201239[4]) Proposal 2***

|  |  |  |
| --- | --- | --- |
| **Company** | **yes/no** | **Additional comments**  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

### Question 5.1-3

*Companies are invited to provide their views on the following proposal:*

* ***(OPPO, R1-2201239[4]) Proposal 3***

|  |  |  |
| --- | --- | --- |
| **Company** | **yes/no** | **Additional comments**  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

### Question 5.1-4

*Companies are invited to provide their views on the following proposal:*

* ***(OPPO, R1-2201239[4]) Proposal 4***

|  |  |  |
| --- | --- | --- |
| **Company** | **yes/no** | **Additional comments**  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

### Question 5.1-5

*Companies are invited to provide their views on the following proposal:*

* ***(OPPO, R1-2201239[4]) Proposal 5***

|  |  |  |
| --- | --- | --- |
| **Company** | **yes/no** | **Additional comments**  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

## Definitions of UE/TRP Rx/Tx timing errors and Timing Error Groups

Submitted Proposals

* ***(Fraunhofer, R1-2202366[14]) Proposal 2:*** *To avoid duplication, ueRxTxTEG and ueRxTEG definitions are removed from TS38.214 if captured in LPP****.***

FL comments

The above proposal may be discussed after *ueRxTxTEG and ueRxTEG definitions* are captured in LPP in RAN2. It has no impact on high-layer. Thus, FL suggests no further discussion of above proposal in this meeting.

### Question 5.2-1

*Companies are invited to provide their views on the following proposal in the following table*

* + *(Fraunhofer, R1-2202366[14]) Proposal 2*

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **yes** | **NO** | **Additional comments** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

# RRC Parameters

##  RAN2 LS (R2-2201776)

Submitted Proposals

* ***(CATT, R1-2201361[5]) Proposal 4:*** *The following two duplicated parameters should be deleted in the RAN1 parameter table*
	+ *numOfUERxTEG-PerPRSResource*
	+ *numOfTRPRxTEG-PerPRSResource\_RTOA*
* ***(CATT, R1-2201361[5]) Proposal 5****: The value range of maxNumOfUE-RxTEG should be 32, rather than as 8.*
* ***(CATT, R1-2201361[5]) Proposal 6****: There is no need to include the positioning SRS resource set ID in ueTxTEG and trpRxTEG association report.*
* ***(CATT, R1-2201361[5]) Proposal 7****: There is no need to introduce a triplet of UE {RxTx TEG ID, Rx TEG ID, Tx TEG ID} for ueRxTxTEG-ID-group or a triplet of TRP {RxTx TEG ID, Rx TEG ID, Tx TEG ID} for trpRxTxTEG-ID-group.*
* ***(Intel, R1-2201697[8])******Proposal 4****: Prepare reply to LS for RAN WG2 on the duplicated parameters issue (R1-2200878) clarifying the following:*
	+ *The parameters MeasPRSwithDiffRxTEGs\_Request\_RSTD and numOfUERxTEG-PerPRSResource do not duplicate each other, and both need to be captured in the higher layer parameter list*
	+ *The parameter MeasPRSwithDiffRxTEGs\_Request\_RSTD defines the total maximum number of different UE RxTEGs that can be measured for the same DL PRS*
	+ *The parameter numOfUERxTEG-PerPRSResource defines the maximum number of different UE RxTEGs that can be measured simultaneously in time for the same DL PRS resource*
	+ *Enhance the description of the corresponding parameters in the higher layer parameters list in R1-2112976 clarifying the difference*
* ***(Intel, R1-2201697[8])******Proposal 5****: Discuss in RAN WG1 the following modifications for the parameters MeasPosSRSwithDiffRxTEGs\_Request and numOfTRPRxTEG-PerPRSResource\_RTOA:*
	+ *Rename the parameter "MeasPosSRSwithDiffRxTEGs\_Request" to "MeasPosSRSwithDiffRxTEGs\_Request\_RTOA"*
	+ *Clarify that this parameter defines the total maximum number of different TRP RxTEGs that can be measured for the same UL SRS*
	+ *Rename the parameter "numOfTRPRxTEG-PerPRSResource\_RTOA" to "numOfTRPRxTEG-PerSRSResource"*
	+ *Clarify that this parameter defines the maximum number of different TRP RxTEGs that can be measured simultaneously in time for the same UL SRS resource*
	+ *Enhance the description of the corresponding parameters in the higher layer parameters list in R1-2112976 clarifying the difference*
	+ *Send the reply to LS for RAN WG2 on the duplicated parameters issue (R1-2200878) clarifying the changes above*
* ***(Intel, R1-2201697[8]) Proposal 6****: Clarify the correct number for the maxNumOfUE-RxTEG parameter, i.e. [8] or [32] should be used*
* ***(Qualcomm, R1-2202140[12]) Observation 1****: According to the previous agreement, a UE may support reporting both {Rx TEG ID, Tx TEG ID} and {RxTx TEG ID}.*
* ***(Qualcomm, R1-2202140[12]) Observation 2****: There is no need to include the SRS-PosResourceSetId in the Tx TEG SRS association.*
* ***(Qualcomm, R1-2202140[12]) Proposal 2:*** *Proposal 2: An M-RTT report is across all the bands that the UE has been configured with DL-PRS and SRS. The Tx TEG SRS Association report should include the option of optionally reporting an association of the SRS resource IDs to an SRS Frequency (NR ARFCN: The carrier frequency of SRS Transmission Bandwiwdth) to avoid any ambiguities if the same SRS resource ID is being used across multiple CCs.*
* ***(Qualcomm, R1-2202140[12]) Proposal 3:*** *With regards to the Tx TEG SRS Association inside an M-RTT report, support a maximum of 1024 Tx TEG SRS associations (up to 8 Tx TEG per band \* Up to 4 bands \* Up to 32 timestamps).*

FL comments

Above proposals related to RAN2 LS (R2-2201776) on RRC parameters will be discussed in Section 8.5.

# Proposals for GTW Session

##  First GTW Session

TBD

## Second GTW Session

TBD

# References

1. [R1-2200920](file:////Users/renda000/Downloads/2022_02_RAN1_108e/Docs/R1-2200920.doc) Maintenance of Rx/Tx timing error, Huawei, HiSilicon
2. [R1-2201093](file:////Users/renda000/Downloads/2022_02_RAN1_108e/Docs/R1-2201093.doc) Maintenance on enhancements for RX/TX timing delay mitigating vivo
3. [R1-2201193](file:////Users/renda000/Downloads/2022_02_RAN1_108e/Docs/R1-2201193.doc) Remaining issues on timing delay mitigation for NR positioning ZTE
4. [R1-2201239](file:////Users/renda000/Downloads/2022_02_RAN1_108e/Docs/R1-2201239.doc) Enhancement of timing-based positioning by mitigating UE Rx/Tx and/or gNB Rx/Tx timing delays OPPO
5. [R1-2201361](file:////Users/renda000/Downloads/2022_02_RAN1_108e/Docs/R1-2201361.doc) Remaining issues on mitigating UE and gNB Rx/Tx timing errors CATT
6. [R1-2201582](file:////Users/renda000/Downloads/2022_02_RAN1_108e/Docs/R1-2201582.doc) Remaining Issues on Mitigating Rx/Tx Timing Delays Sony
7. [R1-2201634](file:////Users/renda000/Downloads/2022_02_RAN1_108e/Docs/R1-2201634.doc) Maintenance of mitigating UE and gNB Rx/Tx timing errors Nokia, Nokia Shanghai Bell
8. [R1-2201697](file:////Users/renda000/Downloads/2022_02_RAN1_108e/Docs/R1-2201697.doc) Maintenance for mitigation UE Rx/Tx and/or gNB Rx/Tx timing delays Intel Corporation
9. [R1-2201824](file:////Users/renda000/Downloads/2022_02_RAN1_108e/Docs/R1-2201824.doc) Discussion on accuracy improvements by mitigating timing delays InterDigital, Inc.
10. [R1-2201856](file:////Users/renda000/Downloads/2022_02_RAN1_108e/Docs/R1-2201856.doc) Remaining issues on UE/gNB Rx/Tx timing errors mitigation CMCC
11. [R1-2202014](file:////Users/renda000/Downloads/2022_02_RAN1_108e/Docs/R1-2202014.doc) Discussion on accuracy improvements by mitigating UE Rx/Tx and/or gNB Rx/Tx timing delays Samsung
12. [R1-2202140](file:////Users/renda000/Downloads/2022_02_RAN1_108e/Docs/R1-2202140.doc) Maintenance for Timing Error Mitigations for improved Accuracy Qualcomm Incorporated
13. [R1-2202291](file:////Users/renda000/Downloads/2022_02_RAN1_108e/Docs/R1-2202291.doc) Discussion on accuracy improvement by mitigating UE Rx/Tx and gNB Rx/Tx timing delays LG Electronics
14. [R1-2202366](file:////Users/renda000/Downloads/2022_02_RAN1_108e/Docs/R1-2202366.doc) Maintenance for Rx/Tx timing delays mitigation Fraunhofer IIS, Fraunhofer HHI
15. [R1-2202370](file:////Users/renda000/Downloads/2022_02_RAN1_108e/Docs/R1-2202370.doc) Tx/Rx timing error mitigation maintenance issues, Lenovo, Motorola Mobility
16. [R1-2202389](file:////Users/renda000/Downloads/2022_02_RAN1_108e/Docs/R1-2202389.doc) Techniques mitigating Rx/Tx timing delays Ericsson
17. R1-2112513, FL Summary #4 for accuracy improvements by mitigating UE Rx/Tx and/or gNB Rx/Tx timing delays, Moderator (CATT)
18. R1-2200862, Response LS on Positioning Reference Units (PRUs) for enhancing positioning performance, SA2, CATT
19. R1-2200857, Response LS on Positioning Reference Units (PRUs) for enhancing positioning performance, RAN2, Qualcomm, CATT
20. R1-2201046 Draft reply LS on Positioning Reference Units (PRUs) for enhancing positioning performance vivo
21. R1-2201205 Draft reply LS to RAN2 on Positioning Reference Units (PRUs) ZTE
22. R1-2201246 Discussion on "response LS on Positioning Reference Units (PRUs) for enhancing positioning performance" OPPO
23. [R1-2201315](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201315.zip) Discussion on PRU for enhancing positioning performance CATT
24. [R1-2201316](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201316.zip) Draft reply LS on the PRU for enhancing positioning performance CATT
25. [R1-2201822](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201822.zip) Draft reply LS on Positioning Reference Units (PRUs) for enhancing positioning performance InterDigital, Inc.
26. [R1-2201838](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201838.zip) Discussion on RAN2 LS on Positioning Reference Units (PRUs) for enhancing positioning performance CMCC
27. [R1-2202108](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2202108.zip) Draft Reply to RAN2 LS on Positioning Reference Units (PRUs) for enhancing positioning performance Qualcomm Incorporated
28. [R1-2202296](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2202296.zip) Draft Reply LS on Positioning Reference Units (PRUs) for enhancing positioning LG Electronics
29. [R1-2202323](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2202323.zip) Draft reply to LS on Positioning Reference Units (PRUs) for enhancing positioning performance Ericsson
30. [R1-2202454](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2202454.zip) Discussion on the functionality of PRU Huawei, HiSilicon
31. R1-2200878 Response LS on the reporting of the Tx TEG association information RAN2, CATT
32. R1-2200900 LS on SRS for multi-RTT positioning RAN4, Huawei
33. R1-2201010 Draft reply LS on SRS for multi-RTT positioning Huawei
34. R1-2201053 Draft reply LS on SRS for multi-RTT positioning vivo
35. R1-2201210 Draft reply LS on SRS for multi-RTT positioning ZTE
36. R1-2201248 Discussion on "LS on SRS for multi-RTT positioning" OPPO
37. R1-2201309 Discussion on SRS for multi-RTT positioning CATT
38. R1-2201310 Draft reply LS on SRS for multi-RTT positioning CATT
39. R1-2202104 Draft Reply to RAN4 LS on SRS for multi-RTT positioning Qualcomm Incorporated
40. R1-2202457 Discussion on use of MIMO-SRS for Multi-RTT positioning Huawei, HiSilicon
41. R1-2202400 views on LS on SRS for multi-RTT positioning Ericsson
42. R1-2200899 Reply LS on lower Rx beam sweeping factor for latency improvement RAN4, CATT
43. R1-2200902 Reply LS on reporting of the Tx TEG association information RAN4, Huawei