**3GPP TSG RAN WG1 Meeting #106bis-e** [**R1-2110391**](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110391.doc)

**e-meeting, October 11th – 19th, 2021**

**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:

[106bis-e-NR-ePos-01] Email discussion/approval on accuracy improvements by mitigating UE Rx/Tx and/or gNB Rx/Tx timing delays with checkpoints for agreements on October 14 and 19 – Ren Da (CATT)

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 document covers the following aspects related to potential enhancements related to the accuracy improvements by mitigating UE Rx/Tx and/or gNB Rx/Tx timing delays based on the contributions [1-18]:

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| 1. Definitions of UE/TRP Rx/Tx timing errors and Timing Error Groups
2. Methods for mitigating UE/TRP Tx/Rx timing errors
3. Reference devices for mitigating UE/gNB Tx/Rx timing errors
4. Measurement enhancements for mitigating UE/gNB Tx/Rx timing errors
5. Additional proposals
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**Notes:**

* The following highlights will be used in this summary:
	+ “Pink highlights” are used for proposals with high priority
	+ “Yellow highlights” are used for proposals with medium 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/medium/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.

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

## Clarification of Rx/Tx/RxTx TEG definitions

*Background*

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| Agreement: (RAN1#104e)The following definitions are used for discussion of internal timing errors (*these terms are not agreed to be included in the specifications):** **Tx timing error**: From a signal transmission perspective, there will be a time delay from the time when the digital signal is generated at baseband to the time when the RF signal is transmitted from the Tx antenna. For supporting positioning, the UE/TRP may implement an internal calibration/compensation of the Tx time delay for the transmission of the DL PRS/UL SRS signals, which may also include the calibration/compensation of the relative time delay between different RF chains in the same TRP/UE. The compensation may also possibly consider the offset of the Tx antenna phase center to the physical antenna center. However, the calibration may not be perfect. The remaining Tx time delay after the calibration, or the uncalibrated Tx time delay is defined as *Tx timing error*.
* **Rx timing error**: From a signal reception perspective, there will be a time delay from the time when the RF signal arrives at the Rx antenna to the time when the signal is digitized and time-stamped at the baseband. For supporting positioning, the UE/TRP may implement an internal calibration/compensation of the Rx time delay before it reports the measurements that are obtained from the DL PRS/UL SRS signals, which may also include the calibration/compensation of the relative time delay between different RF chains in the same TRP/UE. The compensation may also possibly consider the offset of the Rx antenna phase center to the physical antenna center. However, the calibration may not be perfect. The remaining Rx time delay after the calibration, or the uncalibrated Rx time delay is defined as Rx timing error.
* **UE Tx ‘timing error group’ (UE Tx TEG):** A UE Tx TEG is associated with the transmissions of one or more UL SRS resources for the positioning purpose, which have the Tx timing errors within a certain margin.
* **TRP Tx ‘timing error group’ (TRP Tx TEG):** A TRP Tx TEG is associated with the transmissions of one or more DL PRS resources, which have the Tx timing errors within a certain margin.
* **UE Rx ‘timing error group’ (UE Rx TEG):** A UE Rx TEG is associated with one or more DL measurements, which have the Rx timing errors within a certain margin.
* **TRP Rx ‘timing error group’ (TRP Rx TEG):** A TRP Rx TEG is associated with one or more UL measurements, which have the Rx timing errors within a margin.
* **UE RxTx ‘timing error group’ (UE RxTx TEG):** A UE RxTx TEG is associated with one or more UE Rx-Tx time difference measurements, and one or more UL SRS resources for the positioning purpose, which have the ‘Rx timing errors+Tx timing errors’ within a certain margin.
* **TRP RxTx ‘timing error group’ (TRP RxTx TEG):** A TRP RxTx TEG is associated with one or more gNB Rx-Tx time difference measurements and one or more DL PRS resources, which have the ‘Rx timing errors+Tx timing errors’ within a certain margin.
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Submitted proposals

* ***(ZTE,*** [***R1-2108878***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108878.doc)***[2]) Proposal 1: Revise the definitions of TEG to reflect the understanding from RAN4 as following,***
	+ ***UE Tx ‘timing error group’ (UE Tx TEG):*** *A UE Tx TEG is associated with the transmissions of one or more UL SRS resources for the positioning purpose, which have the Tx timing error**~~s~~ differences between different transmissions within a certain margin.*
	+ ***TRP Tx ‘timing error group’ (TRP Tx TEG):*** *A TRP Tx TEG is associated with the transmissions of one or more DL PRS resources, which have the Tx timing error~~s~~ differences between different transmissions within a certain margin.*
	+ ***UE Rx ‘timing error group’ (UE Rx TEG):*** *A UE Rx TEG is associated with one or more DL measurements, which have the Rx timing error~~s~~ differences between different measurements within a certain margin.*
	+ ***TRP Rx ‘timing error group’ (TRP Rx TEG):*** *A TRP Rx TEG is associated with one or more UL measurements, which have the Rx timing error~~s~~ differences between different measurements within a margin.*
	+ ***UE RxTx ‘timing error group’ (UE RxTx TEG):*** *A UE RxTx TEG is associated with one or more UE Rx-Tx time difference measurements, and one or more UL SRS resources for the positioning purpose, which have the ‘Rx timing error~~s~~+Tx timing error~~s~~’ differences between different combinations of measurement and transmission within a certain margin.*
	+ ***TRP RxTx ‘timing error group’ (TRP RxTx TEG):*** *A TRP RxTx TEG is associated with one or more gNB Rx-Tx time difference measurements and one or more DL PRS resources, which have the ‘Rx timing error~~s~~+Tx timing error~~s~~’ differences between different combinations of measurement and transmission within a certain margin.*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 32*** *RAN1 to clarify the definition of timing error groups as given by the text (Ericsson,* [*R1-2110349*](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)*[18])Proposal in section 11.*

***---------------------------------------------- start text proposal ---------------------------------------------***

* + **UE Tx ‘timing error group’ (UE Tx TEG):** A UE Tx TEG is associated with the transmissions of one or more UL SRS resources for the positioning purpose, which have the Tx timing errors within a certain margin , i.e. the difference in UE TX timing error between two UL SRS resources associated to the same UE Tx TEG is smaller than the margin .
	+ **TRP Tx ‘timing error group’ (TRP Tx TEG):** A TRP Tx TEG is associated with the transmissions of one or more DL PRS resources, which have the Tx timing errors within a certain margin , i.e. the difference in TRP TX timing error between two DL PRS resources associated to the same TRP Tx TEG is smaller than the margin .
	+ **UE Rx ‘timing error group’ (UE Rx TEG):** A UE Rx TEG is associated with one or more DL measurements, which have the Rx timing errors within a certain margin , i.e. the difference in UE Rx timing error between two DL measurements associated to the same UE Rx TEG is smaller than the margin .
	+ **TRP Rx ‘timing error group’ (TRP Rx TEG):** A TRP Rx TEG is associated with one or more UL measurements, which have the Rx timing errors within a margin , i.e. the difference in TRP Rx timing error between two UL measurements associated to the same TRP Rx TEG is smaller than the margin .
	+ **UE RxTx ‘timing error group’ (UE RxTx TEG):** A UE RxTx TEG is associated with one or more UE Rx-Tx time difference measurements, and one or more UL SRS resources for the positioning purpose, which have the ‘Rx timing errors+Tx timing errors’ within a certain margin , i.e. the difference in UE RxTx timing error between two UE Rx-Tx time difference measurements and two corresponding UL SRS resources associated to the same UE RxTx TEG is smaller than the margin .
	+ **TRP RxTx ‘timing error group’ (TRP RxTx TEG):** A TRP RxTx TEG is associated with one or more gNB Rx-Tx time difference measurements and one or more DL PRS resources, which have the ‘Rx timing errors+Tx timing errors’ within a certain margin , i.e. the difference in TRP RxTx timing error between two gNB Rx-Tx time difference measurements and two corresponding DL PRS resources associated to the same TRP RxTx TEG is smaller than the margin .

FL comments

For Rx/Tx/RxTx TEG definitions made in RAN1#104e, the Rx/Tx/RxTx ***timing errors*** in a TEG are defined to be within a margin. In RAN4’s reply LS ([R1-2108707](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108707.doc)), however, it is said “*TEG framework enables association information without limiting implementation to ensure that* ***the timing error difference******between measurements/transmissions associated to the same TEG******are within a certain margin***”. That is, RAN4 has a slightly different view on Tx/RxTx TEG definitions. Obviously, if Rx/Tx/RxTx timing errors in a TEG are within the margin *M (RAN1’s definition)*, the timing error difference between any two timing errors is also within the margin *2M (RAN4’s definition).* On the other hand, if the timing error difference between any two timing errors is within the margin *2M,* the Rx/Tx/RxTx timing errors in a TEG may not necessarily be within the margin *M.* The definitions given by RAN4 may make the UE/TRP to determine the TEGss easier in the implementation, because the UE/TRP only need to make sure the relative timing error difference in a TEG is within the margin, but no need to know the absolute timing errors in a TEG are within the margin. It seems *RAN1 needs to modify the definitions of* the Rx/Tx/RxTx TEG definitions with the consideration of RAN4’s inputs, as suggested in [2][18].

Another issue that needs to be discussed is that when RAN1 agreed on Rx/Tx/RxTx TEG definitions in RAN1#104e, the main intention at that time was to have the common ground for the discussions on how to mitigating the Rx/Tx/RxTx timing errors, but it is unclear whether the definitions agreed at that time are adequate to be included in the specification. Now we are near the close of the WI, it is time for us to consider finalizing these definitions for the specifications.

### Proposal 2.1

*Replace the definitions of timing error groups agreed in RAN1#104e with the following modified definitions and adopt them in the specifications:*

* + ***Tx timing error:*** *From a signal transmission perspective, there will be a time delay from the time when the digital signal is generated at the baseband to the time when the RF signal is transmitted from the Tx antenna. For supporting positioning, the UE/TRP may implement an internal calibration/compensation of the Tx time delay for the transmission of the DL PRS/UL SRS signals, which may also include the calibration/compensation of the relative time delay between different RF chains in the same TRP/UE. The compensation may also possibly consider the offset of the Tx antenna phase center to the physical antenna center. However, the calibration may not be perfect. The remaining Tx time delay after the calibration, or the uncalibrated Tx time delay is defined as Tx timing error.*
	+ ***Rx timing error:*** *From a signal reception perspective, there will be a time delay from the time when the RF signal arrives at the Rx antenna to the time when the signal is digitized and time-stamped at the baseband. For supporting positioning, the UE/TRP may implement an internal calibration/compensation of the Rx time delay before it reports the measurements that are obtained from the DL PRS/UL SRS signals, which may also include the calibration/compensation of the relative time delay between different RF chains in the same TRP/UE. The compensation may also possibly consider the offset of the Rx antenna phase center to the physical antenna center. However, the calibration may not be perfect. The remaining Rx time delay after the calibration, or the uncalibrated Rx time delay is defined as Rx timing error.*
	+ ***UE Tx ‘timing error group’ (UE Tx TEG):*** *A UE Tx TEG is associated with the transmissions of one or more UL SRS resources for the positioning purpose~~, which have the Tx timing errors within a certain margin~~. The difference in UE TX timing error between two UL SRS resources associated with the same UE Tx TEG is within a certain margin.*
	+ ***TRP Tx ‘timing error group’ (TRP Tx TEG):*** *A TRP Tx TEG is associated with the transmissions of one or more DL PRS resources~~, which have the Tx timing errors within a certain margin~~ The difference in TRP TX timing error between two DL PRS resources associated with the same TRP Tx TEG is within a certain margin.*
	+ ***UE Rx ‘timing error group’ (UE Rx TEG):*** *A UE Rx TEG is associated with one or more DL measurements~~, which have the Rx timing errors within a certain margin~~ The differences in UE Rx timing errors between any two DL measurements associated with the same UE Rx TEG is within the same margin.*
	+ ***TRP Rx ‘timing error group’ (TRP Rx TEG):*** *A TRP Rx TEG is associated with one or more UL measurements~~, which have the Rx timing errors within a margin~~. The differences in UE Rx timing errors between any two DL measurements associated with the same UE Rx TEG are within the same margin.*
	+ ***UE RxTx ‘timing error group’ (UE RxTx TEG):*** *A UE RxTx TEG is associated with one or more UE Rx-Tx time difference measurements, and one or more UL SRS resources for the positioning purpose~~, which have the ‘Rx timing errors+Tx timing errors’ within a certain margin.~~ The differences in UE RxTx timing errors between any two UE Rx-Tx time difference measurements associated with the same UE RxTx TEG are within the same margin.*
	+ ***TRP RxTx ‘timing error group’ (TRP RxTx TEG):*** *A TRP RxTx TEG is associated with one or more gNB Rx-Tx time difference measurements and one or more DL PRS resources~~, which have the ‘Rx timing errors+Tx timing errors’ within a certain margin~~ The differences in TRP RxTx timing errors between any two gNB Rx-Tx time difference measurements associated with the same TRP RxTx TEG are within the same margin.*

Comments

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| **Company** | **Comments**  |
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## Antenna phase center offset (PCO)

Submitted Proposals

* ***(Nokia,*** [***R1-2109363***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109363.doc)***[7])Proposal 1:*** *UE to include reporting of gNB specific SRS-Pos TOD offsets to gNB/LMF for post-compensation of direction specific UE antenna phase center offsets thereby enhancing the positioning accuracy.*
* ***(Nokia,*** [***R1-2109363***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109363.doc)***[7])Proposal 2:*** *UE to signal to gNB/LMF its capability to compensate for antenna phase center offsets for time based positioning. Note this could apply to both broad beam and narrow beam SRS-Pos transmissions.*
* ***(Nokia,*** [***R1-2109363***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109363.doc)***[7])Proposal 3:*** *Include the impact of antenna PCO in the definition of RX/TX timing errors and associated TEGs.*
* ***(Nokia,*** [***R1-2109363***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109363.doc)***[7])Proposal 4:*** *The UE TEG reporting to be extended with an angular validity region and direction reference for which the TEG certain margin remains valid.*

FL comments

The phase center offsets (PCOs) can be different for different antenna panels and different beam directions, which may result in different timing delays or time of departure (TOD) for different beam directions, and have an impact on the measurement and positioning accuracy. Due to the impact of the PCOs, the true coordinates of the antenna center for the RF signal Tx/Rx may be different from the physical antenna reference point (ARP) for different beams and different positioning frequency layers (PFLs). Similar to the Rx/Tx timing errors, the impact of the PCOs could be compensated if they are known. However, the transmitter and/or the receivers may or may not know the PCOs, and if compensated, there can be remaining errors after the calibration.

The impact of PCOs as a part of timing errors are already included in some extent into the definition of the Rx/Tx timing errors and TEGs (as shown in the definitions of the Tx/Rx timing error, i.e., ‘*The compensation may also possibly consider the offset of the Tx antenna phase center to the physical antenna center.’*).

A similar proposal was discussed in previous meetings, but only a few companies provided the comments in the email discussion. We would need more inputs from interested companies to make the decision in this meeting.

### Proposal 2.2

* *UE to include reporting of gNB specific SRS-Pos TOD offsets to gNB/LMF for post-compensation of direction specific UE antenna phase center offsets thereby enhancing the positioning accuracy.*
* *UE to signal to gNB/LMF its capability to compensate for antenna phase center offsets for time based positioning. Note this could apply to both broad beam and narrow beam SRS-Pos transmissions.*
* *The UE TEG reporting to be extended with an angular validity region and direction reference for which the TEG certain margin remains valid.*

Comments

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

## TRP Tx/UE Rx timing errors and/or UE Rx timing errors for DL TDOA

## Measurement enhancements with different UE Rx TEGs

Background

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| **Agreement (RAN1#106e)*** Subject to UE capability, support the LMF to request a UE to optionally measure the same DL PRS resource of a TRP with N different UE Rx TEGs and report the corresponding multiple RSTD measurements.
	+ - FFS: N=[2, 3, 4] or other values, where the maximum value of N depends on UE capability.
	+ FFS: whether the TRP can be either a “RSTD” reference TRP or a neighbour TRP
	+ FFS: details of the signalling, procedures, and UE capability
	+ FFS: The multiple RSTD measurements can share the same time stamp
	+ Note: All RSTD measurements are relative to a single reference timing
* Support the LMF to request a TRP to optionally measure the same SRS resource of a UE with M different TRP Rx TEGs and report the corresponding multiple RTOA measurements.
	+ FFS: M = [2, 3, 4] or other values
	+ FFS: details of the signalling, procedures
	+ FFS: The multiple RTOA measurements can share the same time stamp
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Submitted proposals

* ***(ZTE,*** [***R1-2108878***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108878.doc)***[2]) Proposal 4:*** *Subject to UE capability, support the LMF to request a UE to optionally measure the same DL PRS resource of a TRP with N different UE Rx TEGs and report the corresponding multiple RSTD measurements.*
	+ *N=[2, 3, 4], where the maximum value of N depends on UE capability.*
	+ *Subject to UE capability, up to N' (N'<=N) RSTD measurements of the multiple RSTD measurements can share the same time stamp.*
		- *N'=[2, 3, 4], where the maximum value of N' depends on UE capability*
* ***(ZTE,*** [***R1-2108878***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108878.doc)***[2]) Proposal 5:*** *Support the LMF to request a TRP to optionally measure the same SRS resource of a UE with M different TRP Rx TEGs and report the corresponding multiple RTOA measurements.*
	+ *M = [2, 3, 4]*
	+ *Up to M' (M'<=M) RTOA measurements of the multiple RTOA measurements can share the same time stamp.*
		- *M'=[2, 3, 4]*
* ***(vivo,*** [***R1-2108975***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108975.doc)***[3])Proposal 2:*** *Regarding UE reporting RSTD measurements associated with different Rx TEG for a PRS resource of a TRP, support the following*
	+ *The TRP can be either a ‘RSTD’ reference TRP or a neighbor TRP*
	+ *The time stamps of multiple RSTD measurements time stamp can be the same or different*
* ***(OPPO,***[***R1-2109051***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109051.doc)***[4]) Proposal 3:***
	+ *For a UE to measure the same DL PRS resource of a TRP with N different UE Rx TEGs and report the corresponding multiple RSTD measurements*
		- *N = [2,3,4], which is based on UE capability reporting*
		- *The TRP can be either a "RSTD" reference TRP or a neighbor TRP*
		- *An associated time stamp is reported associated with each RSTD measurement*
			* *It is up to UE to report the same value of different values for the timestamps of different RSTD measurements*
	+ *For TRP to measure the same SRS resource of a UE with M different TRP Rx TEGs and report the corresponding multiple RTOA measurements:*
		- *M = [2,3,4]*
		- *An associated timestamp is reported associated with each RSTD measurement*
			* *It is up to TRP to report the same value of different values for the timestamps of different RSTD measurement*
* ***(CATT,*** [***R1-2109224***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109224.doc)***[5])Proposal 1:*** *For the maximum values of N and M in the agreement of previous RAN1#106-e meeting, in order for LMF to obtain the information of all UE/TRP Rx TEGs, the maximum values of N and M should be equal to the maximum number of UE Rx TEGs and TRP Rx TEGs respectively.*
* ***(CATT,*** [***R1-2109224***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109224.doc)***[5])Proposal 2:*** *The mentioned TRP in the second FFS of the agreement of RAN1#106-e transmitting the same DL-PRS resource for UE measurement can be any TRP from which UE can receive the DL-PRS resource, including a “RSTD” reference TRP or a neighbor TRP.*
* ***(CATT,*** [***R1-2109224***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109224.doc)***[5])Proposal 3****: If the UE has the ability to use multiple Rx TEGs to measure the same instance of DL PRS resource at the same time, multiple RSTD measurements should have the same timestamp. If UE does not have the ability to use multiple Rx TEGs to measure the same instance of DL PRS resource at the same time, then UE may use different Rx TEGs to measure different repetitions of the same PRS resource at different times. In this case, multiple RSTD measurements should have different time stamps.*
* ***(Samsung,***[***R1-2109490***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109490.doc)***[8]) Proposal 5:*** *if TRP can be either a “RSTD” reference TRP or a neighbor TRP， then the RSTD value is calculated based on the RTOA measurements corresponding to the same UE Rx TEG.*
* ***(Samsung,*** [***R1-2109490***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109490.doc)***[8]) Proposal 6:*** *The multiple RSTD/RTOA measurements can share the same time stamp.*
* ***(Intel,*** [***R1-2109611***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109611.doc)***[9]) Proposal*** 2, *Support the LMF to request a UE to optionally measure the same DL PRS Resource of a TRP with N different UE RX TEG IDs and report the corresponding multiple RSTD measurements*
	+ *Support the maximum number of N values equal to 4*
	+ *The TRP can be a reference TRP or a neighbor TRP*
	+ *The reference TRP and the neighbor TRP can be measured with different UE RX TEG IDs*
	+ *The measurements can be performed for the same DL PRS Resource within a single transmission period or across multiple transmission periods*
	+ *For the multiple measurements performed within a single transmission period, the following measurement format can be used:*
		- *{RSTD, UE RX TEG ID for reference TRP, UE RX TEG ID for neighbor TRP} for the nth measurement, where n = 1, 2, ‚Ä¶, N*
* ***(Intel,*** [***R1-2109611***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109611.doc)***[9]) Proposal 3.*** *Support the LMF to request a TRP to optionally measure the same UL SRS Resource for positioning of a UE with M different TRP RX TEG IDs and report the multiple corresponding RTOA measurements*
	+ *Support the maximum number of M values equal to 4*
	+ *For the multiple measurements performed within a single transmission period, the following measurement format can be used:*
	+ *{RTOA, TRP RX TEG ID} for the mth measurement, where m = 1, 2, ‚Ä¶, M*
* ***(Apple,*** [***R1-2110035***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110035.doc)***[12])Proposal 1****: Subject to UE capability, support the LMF to request a UE to optionally measure the same DL PRS resource of a target TRP with N different UE Rx TEGs, while Rx TEG for reference TRP is fixed, and report the corresponding multiple RSTD measurements.*
* ***(Apple,*** [***R1-2110035***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110035.doc)***[12])Proposal 2****: For mitigating UE Rx timing errors, support LMF to request a TRP transmitting a PRS with the same Tx TEG on different occasions.*
* ***(LGE,*** [***R1-2110088***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110088.doc)***[13])Proposal #2:*** *Regarding the number of UE Rx TEGs (N), we think that N=4 is appropriate by considering current rule that UE may report up to 4 DL RSTD measurements per TRP.*
* ***(LGE,*** [***R1-2110088***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110088.doc)***[13])Proposal #3****:"TRP" that UE can measure PRS with different Rx TEGs needs to be a neighbour TRP.*
* ***(Qualcomm, R1- 2110187[15])Proposal 3:*** *With regards to measuring the same PRS resource with N>1 Rx TEGs:*
	+ *The PRS resource can be transmitted from a serving or neighbor TRP*
	+ *Up to N values can be requested, where N = [2, 3, 4, 6, 8] is a new UE capability on the maximum number of Rx TEGs that can be used to measure a single PRS resource.*
	+ *Note: It shall not be expected that the UE must do those measurements with the same timestamp (i.e up to UE's decision whether a same or different time stamp shall be used).*
* ***(MediaTek,*** [***R1-2110254***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110254.doc)***[16])Proposal 4-1:*** *For measuring same PRS resource by different RX TEGs, since the number of RX TEGs is related to implementation, then N = [2, 3, 4] and M= [2, 3, 4] are supportive based on capability*
* ***(MediaTek,*** [***R1-2110254***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110254.doc)***[16])Proposal 4-2****: For measuring same PRS resource by different RX TEGs, the RSTD measurement corresponding to any pair of RX TEGs is not limited to the PRS resource from the PRS reference TRP*
* ***(MediaTek,*** [***R1-2110254***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110254.doc)***[16])Proposal 4-3:*** *All the RSTD measurements, each associated to a pair of RX TEGs for measuring a same PRS resource, don't need to be associated to a same resource of same TRP*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 1:*** *Subject to UE capability, support the LMF to request a UE to optionally measure the same DL PRS resource of a TRP with N different UE Rx TEGs and report the corresponding multiple RSTD measurements, where N=[2, 3,… ,Nmax], where Nmax is the numbe`r of UE RX TEGs which depends on UE capability. Nmax =[2, 3, 4] is supported. FFS: additional values for Nmax*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 2:*** *Each RSTD measurement should be reported with it’s own timestamp.*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 3****: Support a UE to perform multiple RSTD measurements towards the same TRP based on (1) different repetitions of the same DL PRS resource, (2) different symbols of the same DL PRS resource, (3) different occasions of the same DL PRS resource, and (4) simultaneous reception of the same DL PRS, and to report these measurements to the LMF.*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 4****: Support configuration of UE to perform multiple RSTD measurements towards the same TRP, utilizing different UE RX TEGs, e.g. by including an indicator in the NR-DL-TDOA-RequestLocationInformation IE.*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 5****: 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

Based on the feedback,

* For “FFS: N=[2, 3, 4], M=[2,3,4] and other values”：
	+ Most of the feedbacks [2][4][9][13][15][16][18] are fine to support N=[2, 3, 4] with the maximum value of N depends on UE capability, and M=[2,3,4]. One company [5] suggests the maximum values of N and M should be equal to the maximum number of UE Rx TEGs and TRP Rx TEGs respectively, and one company [15] proposes to include N=[6, 8].
* For “FFS: whether the TRP can be either a “RSTD” reference TRP or a neighbour TRP”:
	+ Most of the feedbacks [3][4][5][6][7][16][18] consider the TRP can be either a “RSTD” reference TRP or a neighbour TRP. One company [13] considers the TRP can only be a neighbour TRP.
* For “FFS: whether the multiple RSTD measurements can share the same time stamp”:
	+ Most companies [2][3][4][5][8][15] support the multiple RSTD measurements sharing the same timestamp. Some of them [3][4][5][15] also support the multiple RSTD measurements having different time stamps. It seems obvious that if a UE supports multiple RSTD measurements share the same timestamp, it will always support multiple RSTD measurements having different same timestamps, e.g., when the UE measures the DL PRS transmitted in different time instances with the same Rx TEG. When to use the same or the same timestamp or different timestamps is obviously depends on how the UE/TRP makes the measurements.

### Proposal 3.1-1

Make the following modifications on the previous agreements in RAN1#106e:

* Subject to UE capability, support the LMF to request a UE to optionally measure the same DL PRS resource of a TRP with N different UE Rx TEGs and report the corresponding multiple RSTD measurements.
	+ - ~~FFS:~~ N=[2, 3, 4] ~~or other values~~, where the maximum value of N depends on UE capability.
	+ ~~FFS: whether~~ the TRP can be either a “RSTD” reference TRP or a neighbour TRP
	+ FFS: details of the signalling, procedures, and UE capability
	+ ~~FFS:~~ The multiple RSTD measurements can share the same timestamp or have different timestamps.
		- Note: It is up to UE’s implementation to use the same timestamp or different timestamps.
	+ Note: All RSTD measurements are relative to a single reference timing
* Support the LMF to request a TRP to optionally measure the same SRS resource of a UE with M different TRP Rx TEGs and report the corresponding multiple RTOA measurements.
	+ ~~FFS:~~ M = [2, 3, 4] ~~or other values~~
	+ FFS: details of the signalling, procedures
	+ ~~FFS:~~ The multiple RTOA measurements can share the same timestamp or have different timestamps.
		- Note: It is up to TRP’s implementation to use the same timestamp or different timestamps.

Comments

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| **Company** | **Comments**  |
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## Association of UE Rx TEGs with RSTD measurements

Background

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| Agreement: (RAN1#104bis-e)* Support the following for mitigating TRP Tx timing errors and/or UE Rx timing errors for DL TDOA
	+ Support a UE to provide the association information of RSTD measurements with UE Rx TEG(s) to the LMF when the UE reports the RSTD measurements to the LMF if the UE has multiple TEGs
	+ Support a TRP providing the association information of DL PRS resources with Tx TEGs to the LMF if the TRP has multiple TEGs
	+ Support the LMF to provide the association information of DL PRS resources with Tx TEGs to a UE for UE-based positioning if the TRP has multiple TEGs
	+ FFS: the details of the signaling, procedures, and UE capability
* Send an LS to RAN4 to check if there is any issue to support the above enhancements
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Submitted Proposal

* ***(vivo,*** [***R1-2108975***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108975.doc)***[3])Proposal 1:*** *The UE can be requested to provide the association information of RSTD measurements with UE Rx TEG(s) to LMF.*
* ***(Nokia,*** [***R1-2109363***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109363.doc)***[7])Proposal 5:*** *RAN1 should prioritize discussion on the basic phases of the TEG concept: TEG declaration and TEG association.*
* ***(Qualcomm, R1- 2110187[15])Proposal 4:*** *For UE-based DL-TDOA, support a UE receiving the Tx-TEG information for each PRS resource in the unicast or broadcast assistance data.*
	+ *Send an LS to RAN2 to continue the design*

FL comments

For the proposal in [3] that “*the UE can be requested to provide the association information of RSTD measurements with UE Rx TEG(s) to LMF”,* based on the existing agreement, it supports UE to provide the information to the LMF when the UE reports the RSTD measurements to the LMF. Thus, for a UE that has the capability to support UE Rx TEG, I assume the UE can be requested *to* provide the Rx TEG information when the UE reports the RSTD measurements. However, we may need to further discuss whether there is a need for LMF to request the association information separately from the RSTD measurement report.

For the proposal in [15], it was agreed to support the LMF to provide the association information of DL PRS resources with Tx TEGs to a UE for UE-based DL-TDOA. In my view, how the information is sent to UE (e.g., with the unicast or broadcast assistance data) can be decided by RAN2.

### Proposal 3.1-2(a)

* *The UE can be requested to provide the association information of RSTD measurements with UE Rx TEG(s) to LMF, separate from the RSTD measurement report.*

Comments

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| **Company** | **Comments**  |
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### Proposal 3.1-2(b)

* *For UE-based DL-TDOA, support a UE receiving the Tx-TEG information for each PRS resource in the unicast or broadcast assistance data.*
	+ *Send an LS to RAN2 to continue the design*

Comments

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| **Company** | **Comments**  |
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## UE Tx and TRP Rx timing errors for UL TDOA

Background

The following conclusion was made in RAN1#104e and RAN1#104bis-e, related to the option(s) for mitigating UE Tx and TRP Rx timing errors for UL TDOA.

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| Agreement (RAN1#104bis-e):Support the following for mitigating UE Tx timing errors and/or TRP Rx timing errors for UL TDOA* Support a TRP to provide the association information of RTOA measurements with TRP Rx TEG(s) to the LMF when the TRP reports the RTOA measurements to the LMF if the TRP has multiple Rx TEGs
* Support a UE to provide under capability the association information of UL SRS resources for positioning with Tx TEGs to the LMF if the UE has multiple Tx TEGs
	+ FFS: Whether to support a UE to provide the association information of UL SRS resources for MIMO with Tx TEGs to the LMF if the UE has multiple Tx TEGs
	+ FFS: Whether the association information is sent directly from UE to LMF, or is first provided to gNB and then forwarded to LMF;
* FFS: the details of the Signaling, procedures, and UE capability
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## Association information of SRS resources and UE Tx TEGs

Background

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| Agreement: (RAN1#105e)* For mitigating UE Tx timing errors for UL TDOA, support one of the following options:
	+ Option 1:
		- Subject to UE’s capability, support a UE providing the association information of UL SRS resources for positioning with Tx TEGs *directly* to the LMF if the UE has multiple Tx TEGs.
		- FFS: Support LMF to forward the association information provided by the UE to the serving and neighboring gNBs
	+ Option 2:
		- Subject to UE’s capability, support a UE providing the association information of UL SRS resources for positioning with Tx TEGs to the *serving* gNB if the UE has multiple Tx TEGs.
		- Support the *serving* gNB to forward the association information provided by the UE to the LMF
		- FFS: Support LMF to forward the association information from the *serving* gNB for the UE to the neighboring gNBs
* FFS: UE should be able to report capability information related to Tx TEGs to LMF via LPP signaling
* Support gNB to report the associated SRS resource ID/resource set ID of the RTOA measurement to LMF
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Submitted Proposals and FL comments

* ***(Huawei,*** [***R1-2108730***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108730.doc)***[1]) Proposal 2:*** *The SRS-TEG association reported via RRC is supported.*
	+ *UE may be requested in RRCReconfiguration message to provide the SRS-TEG association in the RRCReconfigurationComplete message*
* ***(ZTE,*** [***R1-2108878***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108878.doc)***[2]) Proposal 2:*** *For mitigating UE Tx timing errors for UL TDOA, support both of the following options:*
	+ *Option 1:*
		- *Subject to UE's capability, support a UE providing the association information of UL SRS resources for positioning with Tx TEGs directly to the LMF if the UE has multiple Tx TEGs.*
	+ *Option 2:*
		- *Subject to UE's capability, support a UE providing the association information of UL SRS resources for positioning with Tx TEGs to the serving gNB if the UE has multiple Tx TEGs.*
		- *Support the serving gNB to forward the association information provided by the UE to the LMF*
	+ *Support gNB to report the associated SRS resource ID/resource set ID of the RTOA measurement to LMF*
	+ *Note: There is no need for LMF to forward the association information to the neighboring gNBs*
* ***(ZTE,*** [***R1-2108878***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108878.doc)***[2]) Proposal 8:*** *The association of the Tx TEG ID to the UL SRS resource(s) at least can be included in the location measurement report.*
	+ *Depending on the outcome for UL-TDOA positioning method to decide whether the association of the Tx TEG ID to the UL SRS resource(s) can also be provided to serving gNB first, then the serving gNB forwards the association information to LMF.*
* *(****vivo,*** [***R1-2108975***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108975.doc)***[3])Proposal 4****: Support LMF to forward the UE Tx TEG information associated with SRS resource(s) provided by the UE to the serving and neighboring gNBs.*
* ***(vivo,*** [***R1-2108975***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108975.doc)***[3])Proposal 5:*** *Support the UE to directly provide the association information of SRS resources for positioning with UE Tx TEG(s) to LMF via LPP message.*
* ***(OPPO,*** [***R1-2109051***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109051.doc)***[4]) Proposal 4****: For the association information of TEGs and SRS resources for positioning, Rel-17 supports UE to report it to gNB and gNB to forward it to LMF via NRPPa, i.e.g,*
	+ *Subject to UE's capability, support a UE providing the association information of UL SRS resources for positioning with Tx TEGs to the serving gNB if the UE has multiple Tx TEGs.*
	+ *Support the serving gNB to forward the association information provided by the UE to the LMF*
* ***(OPPO,*** [***R1-2109051***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109051.doc)***[4]) Proposal 5****: R17 doesn’t support LMF to forward the association Tx TEG information of a UE from the serving gNB to the neighboring gNBs*
* ***(CATT,*** [***R1-2109224***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109224.doc)***[5])Proposal 4****: For mitigating UE Tx timing errors for UL TDOA, support the following Option 1 in RAN1#106-e:*
	+ *Option 1: Subject to UE's capability, support a UE providing the association information of UL SRS resources for positioning with Tx TEGs directly to the LMF if the UE has multiple Tx TEGs.*
* ***(CATT,*** [***R1-2109224***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109224.doc)***[5])Proposal 5****: No need to support LMF to forward the association information of UL SRS resources for positioning with Tx TEGs provided by the UE to the serving and neighboring gNBs.*
* ***(CATT,*** [***R1-2109224***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109224.doc)***[5])Proposal 6****: If RAN1 still cannot reach the consensus on which of options to support, which is related to UE providing the association information of UL SRS resources for positioning with Tx TEGs, in RAN1#106b-e, send an LS to RAN2 and let RAN2 make the decision.*
* ***(CMCC,*** [***R1-2109283***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109283.doc)***[6]) Proposal 1****: From RAN1 perspective, it is beneficial to support a UE providing the association information of UL SRS resources for positioning with Tx TEGs directly to the LMF if the UE has multiple Tx TEGs.*
	+ *Decision can be finally made up to RAN2/3.*
* ***(Nokia,*** [***R1-2109363***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109363.doc)***[7])Proposal 8:*** *As part of measurement reporting using LPP and NRPPa the TEG associations should also be reported.*
* ***(Nokia,*** [***R1-2109363***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109363.doc)***[7])Proposal 9:*** *Support option 2 from the prior agreement: UE reports Tx TEG IDs to the serving gNB and the serving gNB forwards to the LMF.*
* ***(Samsung,*** [***R1-2109490***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109490.doc)***[8])Proposal 1:*** *The association information of UL SRS resources for positioning with Tx TEGs is sent directly from UE to LMF.*
* ***(NTT DCM,*** [***R1-2109679***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109679.doc)***[10]) Proposal 1****:We can consider the following option to support mitigating UE Tx timing errors for UL-TDOA*
	+ *Option 2:*
		- *Subject to UE's capability, support a UE providing the association information of UL SRS resources for positioning with Tx TEGs to the serving gNB if the UE has multiple Tx TEGs.*
		- *Support the serving gNB to forward the association information provided by the UE to the LMF*
		- *FFS: Support LMF to forward the association information from the serving gNB for the UE to the neighboring gNBs*
* ***(Apple,*** [***R1-2110035***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110035.doc)***[12])Proposal 3:*** *For mitigating UE Tx timing errors for UL TDOA, subject to UE’s capability, support a UE providing the association information of UL positioning SRS resources with Tx TEGs directly to the LMF if the UE has multiple Tx TEGs.*
* ***(Qualcomm, R1- 2110187[15])Proposal 5:*** *Support TxTEG-to-SRS association reporting as part of the LPP signaling framework.*
	+ *The reporting of the association is happening after the SRS is transmitted, together with an UL timestamp, and an associated UL Timing Error margin.*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 6****: RAN1 to decide on option 2 in the agreement on UE Tx timing errors for UL TDOA at RAN1#105-e, i.e. the UE TX TEG association of UL SRS transmissions should be sent by the UE to the gNB and then forwarded to the LMF.`*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 8****: The UE can be configured with a list of SRS resource sets for which UE TX TEG association reporting should be performed.*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 10*** *It shall be possible to configure a UE with an SRS with a restriction for the UE to utilize a certain UE TX TEG when transmitting the SRS.*

FL comments

About the two options in the above agreement, it seems we still have a diverged views according to the contributions to this meeting:

* + *Option 1:*
		- *Subject to UE’s capability, support a UE providing the association information of UL SRS resources for positioning with Tx TEGs directly to the LMF if the UE has multiple Tx TEGs.*
			* ***Supported by:*** *ZTE[2], vivo[3], CATT[5], CMCC[6], Samsung[8], Apple[12], Qualcomm[15]*
		- *FFS: Support LMF to forward the association information provided by the UE to the serving and neighboring gNBs*
			* ***Supported by****: vivo*
			* ***Not supported by****: ZTE, CATT*
	+ *Option 2:*
		- *Subject to UE’s capability, support a UE providing the association information of UL SRS resources for positioning with Tx TEGs to the serving gNB if the UE has multiple Tx TEGs.*
		- *Support the serving gNB to forward the association information provided by the UE to the LMF*
			* ***Supported by****: Huawei[1], ZTE[2], OPPO[4], Nokia[7], NTT DCM[10], Ericsson[18]*
		- *FFS: Support LMF to forward the association information from the serving gNB for the UE to the neighboring gNBs*
			* ***Supported by****:*
			* ***Not supported by****: ZTE, CATT*

It seems we may need to have a further discussion in this meeting to see if we can reach a compromise in this meeting, and whether to

About the FFS on whether to forward the association information to serving and neighboring gNBs, it seems only one company [3] proposes to support it, while three companies [2][4][5] propose not to support it. We may consider removing the FFS related to forward the association information to serving and neighboring gNBs, and then focus on the discussion on whether the association information is sent to LMF via serving gNB, or directly from UE to LMF.

About the “FFS: UE should be able to report capability information related to Tx TEGs to LMF via LPP signalling”, for Option 1, it seems obvious that UE should report capability information related to Tx TEGs to LMF via LPP signalling. If Option 2 is selected, then it seems there is a need to discuss whether the UE should report capability information related to Tx TEGs to LMF via LPP signalling.

One possible resolution (as Option 3 in the following Proposal 3.2-1) is that both Option 1 and Option 2 are supported in the specification. Then, it is up to UE to support which of the options. If we cannot reach a consensus on these options, then we may need to consider letting RAN2 make the decision (Option 4 in Proposal 3.2-1).

One company [18] also proposes to let the network to configure which UE TX TEG associations to report and which UE TX TEGs are used for transmitting the SRS. We may further discuss whether to support them.

### Proposal 3.2-1 (H)

* For mitigating UE Tx timing errors for UL TDOA, support one of the following options:
	+ Option 1:
		- Subject to UE’s capability, support the LMF to request a UE providing the association information of UL SRS resources for positioning with Tx TEGs *directly* to the LMF if the UE has multiple Tx TEGs.
		- UE reports the capability information related to Tx TEGs to LMF via LPP signaling
		- FFS: Support LMF to forward the association information provided by the UE to the serving and neighboring gNBs
	+ Option 2:
		- Subject to UE’s capability, support the serving gNB to request a UE providing the association information of UL SRS resources for positioning with Tx TEGs to the *serving* gNB if the UE has multiple Tx TEGs.
		- Support the *serving* gNB to forward the association information provided by the UE to the LMF
		- FFS: Support LMF to forward the association information from the *serving* gNB for the UE to the neighboring gNBs
		- FFS: Whether UE should be able to report capability information related to Tx TEGs to LMF via LPP signaling
	+ Option 3:
		- Support both Option 1 and Option 2 in the specification. It is up to UE to support either Option 1 or Option 2, or both.
	+ Option 4:
		- Send an LS to RAN2 (cc RAN3), requesting RAN2 to make the decision on which option(s) to support.

Comments

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| **Company** | **Comments**  |
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## RTOA measurements with multiple TRP Rx TEG(s)

FL Comments

* ***(vivo,*** [***R1-2108975***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108975.doc)***[3])Proposal 6:*** *In UL-TDOA method, to eliminate the positioning error caused by the UE Tx timing errors of more than one UE Tx TEGs, the RTOA measurement report for more than one UE Tx TEGs can be supported if the gNB is able to measure SRS resources associated different UE Tx TEGs*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 8****: The UE can be configured with a list of SRS resource sets for which UE TX TEG association reporting should be performed.*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 10*** *It shall be possible to configure a UE with an SRS with a restriction for the UE to utilize a certain UE TX TEG when transmitting the SRS.*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 12*** *For UL-TDOA positioning, support a gNB to report RTOA measurements associated with different UE Tx TEGs from a UE*

FL Comments

In [3][18], it was proposed to let gNB to measure SRS resources associated with different UE Tx TEGs to mitigating the positioning error caused by UE Tx timing errors. For that, the gNB may need to first have the information of the UE Tx TEG information before the gNB provides the RTOA measurements.

In [18], it was also proposed the UE can be configured with a list of SRS resource sets for which UE TX TEG association reporting should be performed, and with a restriction for the UE to utilize a certain UE TX TEG when transmitting the SRS.

### Proposal 3.2-2a

* *For UL-TDOA positioning, support LMF to request a gNB to report RTOA measurements associated with different UE Tx TEGs from a UE.*
	+ *FFS: How the gNB obtains the association information of UE Tx TEG with the positioning SRS resources of the UE.*

Comments

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| **Company** | **Comments**  |
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### Proposal 3.2-2b

* *The UE can be configured with a list of SRS resource sets for which UE TX TEG association reporting should be performed.*
* *It shall be possible to configure a UE with an SRS with a restriction for the UE to utilize a certain UE TX TEG when transmitting the SRS.*

Comments

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| **Company** | **Comments**  |
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## Report of the SRS port IDs with the RTOA measurements

Submitted Proposals

* ***(Huawei,*** [***R1-2108730***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108730.doc)***[1]) Proposal 4:*** *Support gNB to report the associated SRS port ID of the RTOA measurement along with the SRS resource ID/resource set ID, when the measurements are based on multi-port SRS (e.g. MIMO-SRS).*
	+ *The port index may take the value {0, 1, 2, 3} to map to the SRS ports {1000, 1001, 1002, 1003}, respectively.*
	+ *Note: The use of SRS for MIMO resource is transparent to the UE.*

Comments

In RAN1#105e, it was agreed “*Support gNB to report the associated SRS resource ID/resource set ID of the RTOA measurement to LMF”.* For MIMO SRS, the SRS signals can be transmitted in different ports. In [11], it was proposed to support gNB to report the associated SRS port ID of the RTOA measurement for improving the positioning performance. The proposed enhancement seems having no impact on UE.

A similar proposal was discussed in previous meetings, but only a few companies provided the comments in the email discussion. We would need more inputs from interested companies to make the decision in this meeting.

### Proposal 3.2-3

* *Support gNB to report the associated SRS port ID of the RTOA measurement along with the SRS resource ID/resource set ID, when the measurements are based on multi-port SRS (e.g. MIMO-SRS).*
	+ *The port index may take the value {0, 1, 2, 3} to map to the SRS ports {1000, 1001, 1002, 1003}, respectively.*
	+ *Note: The use of SRS for MIMO resource is transparent to the UE*

Comments

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| **Company** | **Comments**  |
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## Positioning SRS with antenna/beam switching

Submitted Proposals

* ***(Huawei,*** [***R1-2108730***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108730.doc)***[1]) Proposal 3:*** *Support positioning SRS with antenna switching as an optional UE capability.*
	+ *Introduce a new parameter for the positioning SRS resource set indicating "antenna switching", and each positioning SRS resource in the set is associated with a different UE antenna port.*
	+ *Introduce a new UE capability of antenna switching for positioning SRS resource, indicating*
		- *The number of positioning SRS resources in the positioning SRS resource set configured with "antenna switching"*
		- *The switching period follows the existing MIMO SRS antenna switching (15us as per R1-1710048).*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 13*** *Support SRS with beam and UE TX TEG sweeping.*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 14*** *The UE supporting UE TX TEG and beam sweeping shall report the number of UE TX TEGs and the number of beams to sweep per UE TX TEG as part of UE capabilities.*

FL Comments

In [1], it was proposed to positioning SRS with antenna switching as an optional UE capability. In [18], it was proposed to support UE TX TEG and beam sweeping. Companies are encouraged to take a look at the proposals and provide their opinions on the proposals.

### Proposal 3.2-4

* Support positioning SRS with antenna switching as an optional UE capability.
	+ Introduce a new parameter for the positioning SRS resource set indicating "antenna switching", and each positioning SRS resource in the set is associated with a different UE antenna port.
	+ Introduce a new UE capability of antenna switching for positioning SRS resource, indicating
	+ The number of positioning SRS resources in the positioning SRS resource set configured with "antenna switching"
	+ The switching period follows the existing MIMO SRS antenna switching (15us as per R1-1710048).
* Support SRS with beam and UE TX TEG sweeping as an optional UE capability.
	+ The UE supporting UE TX TEG and beam sweeping shall report the number of UE TX TEGs and the number of beams to sweep per UE TX TEG as part of UE capabilities.

Comments

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| **Company** | **Comments**  |
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## *Association of UE Tx TEG*s with the MIMO SRS

Submitted Proposals

* ***(OPPO,*** [***R1-2109051***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109051.doc)***[4])Proposal 1:*** *Rel-17 doesn’t support the association of TEG with MIMO SRS port(s).*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 7****: The UE can be configured to send UE TX TEG association reports for all SRS types.*

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. It seems unlikely to reach the agreement to support the feature. Thus, suggest no further discussion on the association of UE Tx TEG with MIMO SRS in this meeting.

Comments

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| **Company** | **Comments**  |
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## Mitigation of UE/gNB Rx/Tx timing errors for DL+UL positioning

Background

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| Agreement (RAN1#104bis-e)For mitigating UE/TRP Tx/Rx timing errors for DL+UL positioning, support one of the following alternatives:* Alt.1: Support a UE to provide the association information of a UE Rx-Tx time difference measurement with a pair of {Rx TEG, Tx TEG} to LMF, where the Rx TEG is used to receive the DL PRS and the Tx TEG is used to transmit the UL Positioning SRS;
* Alt.2: Support a UE to provide the association information of a UE Rx-Tx time difference measurement with a UE RxTx TEG to LMF according to one of the 2 following options:
	+ Option 1: the UE RxTx TEG is associated with one or more {DL PRS resource, UL Positioning SRS resource} pairs
		- FFS: whether UE provides the association information of DL PRS resources to UE Rx TEG to LMF for UE RxTx measurements specifically
	+ Option 2: the UE RxTx TEG is associated with one or more {Rx TEG, Tx TEG} pairs where the Rx TEG is used to receive the DL PRS and the Tx TEG is used to transmit the UL Positioning SRS.
* For both alternatives, the UE may provide the association information of SRS resources for positioning to UE Tx TEG to LMF
	+ FFS: Whether the association information is sent directly from UE to LMF, or is first provided to gNB and then forwarded to LMF
* FFS: the details of the signalling, procedures, and UE capability

Agreement: (RAN1#104bis-e)* For mitigating UE/TRP Tx/Rx timing errors for DL+UL positioning, support one of the following alternatives:
	+ Alt.1: Support a gNB to provide the association information of a gNB Rx-Tx time difference measurement with a pair of {Rx TEG, Tx TEG} to LMF
	+ Alt. 2: Support a gNB to provide the association information of a gNB Rx-Tx time difference measurement with a TRP RxTx TEG to LMF, if the TRP has multiple RxTx TEGs, according to one of the 2 following options:
		- Option 1: the TRP RxTx TEG is associated with one or more {DL PRS resource, UL Positioning SRS resource} pairs
			* FFS: whether gNB provides the association information of UL Positioning SRS resources to TRP Rx TEG to LMF, if the TRP has multiple Rx TEGs, for gNB RxTx measurements specifically
		- Option 2: the TRP RxTx TEG is associated with one or more {Rx TEG, Tx TEG} pairs where the Rx TEG is used to receive the UL Positioning SRS and the Tx TEG is used to transmit the DL PRS.
	+ For both alternatives, the gNB may provide the association information of DL PRS resources to TRP Tx TEG to LMF if the TRP has multiple Tx TEGs.
* FFS: the details of the signalling, procedures

Agreement: (RAN1#105e)For mitigating UE Tx/Rx timing errors for DL+UL positioning, a UE may support, up to UE capability, 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 RxTx TEG IDs are related/associated to Tx TEG IDs and/or Rx TEG IDs and to the Rx-Tx measurements.
* Option 2: Reporting of UE RxTx TEG ID is not supported by the UE; reporting of Rx TEG ID and Tx TEG ID is supported.
* In either option, a Tx TEG ID is associated with (downselection needed)
	+ Alt. 1: an UL SRS resource for positioning corresponding to the Tx timing of the Rx-Tx measurement
	+ Alt. 2: the Tx timing of the Rx-Tx measurement
	+ Alt. 3: one or more UL SRS resources for positioning
* Note: An 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 the 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
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## Reporting of UE Rx/Tx/RxTx TEG IDs with Rx-Tx time difference measurements

Background

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| Agreement: (RAN1#106e)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 the 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: : (RAN1#106e)* 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 the association of the Tx TEG ID to the UL SRS resource(s) is determined by UE.
	+ FFS: details of the signalling
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Submitted Proposals

* ***(ZTE,*** [***R1-2108878***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108878.doc)***[2]) Proposal 7:*** *When a UE Tx TEG ID is reported along with UE Rx-Tx time difference measurement, the UE Tx TEG ID corresponds to the Tx timing of the UE Rx-Tx time difference measurement.*

**FL:** Further discussion in Proposal 3.3-1.

* ***(vivo,*** [***R1-2108975***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108975.doc)***[3])Proposal 7:*** *Regarding association information of Tx TEG for mitigating UE Tx/Rx timing errors in DL+UL positioning, support Alt.3: a Tx TEG ID is associated with one or more UL SRS resources for positioning.*

**FL:** Further discussion in Proposal 3.3-1.

* ***(vivo,*** [***R1-2108975***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108975.doc)***[3])Proposal 8****: For mitigating UE Rx/Tx timing errors for DL+UL positioning, up to UE capability, the following should be supported.*
	+ *UE providing the association information of UE Rx TEG(s) with each UE Rx-Tx time difference measurements to LMF.*
	+ *UE providing the association information of UE Tx TEG(s) with all UL Positioning SRS resources to LMF.*
	+ *UE providing the mapping information of UE {Rx TEG ID, Tx TEG ID} to UE RxTx TEG IDs to LMF.*
* ***(OPPO,*** [***R1-2109051***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109051.doc)***[4]) Proposal 7****: For mitigating UE/TRP Tx/Rx timing errors for DL+UL positioning, a Tx TEG ID is associated with an UL SRS resource for positioning corresponding to the Tx timing of the Rx-Tx measurement (Alt.1).*

**FL:** Further discussion in Proposal 3.3-1.

* ***(OPPO,*** [***R1-2109051***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109051.doc)***[4]) Proposal 8****: For mitigating UE/TRP Tx/Rx timing errors for DL+UL positioning, a TRP should support, up to either one or both of the following options:*
	+ *Option 1: Reporting of TRP RxTx TEG ID*
		- *FFS: Further details on how the TRP RxTx TEG IDs are related/associated to TRP Tx TEG IDs and/or TRP Rx TEG IDs and to the gNB Rx-Tx measurements.*
	+ *Option 2: Reporting of TRP Rx TEG ID and TRP Tx TEG ID.*
	+ *If a Tx TEG ID is included with a Rx-Tx time difference measurement report, the TRP should report the association of the Tx TEG ID to DL PRS resource(s) corresponding to the Tx time of the measurement*
		- *Note 1: The association can be in a separate report from the Rx-Tx time difference measurement report.*
		- *Note 2: The association is the same for both DL-TDOA and DL+UL positioning by default*
	+ *FFS: The potential impact and modification on the definition of Rx-Tx time difference measurements*
* ***(CMCC,*** [***R1-2109283***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109283.doc)***[6]) Proposal 2****: Support a UE Tx TEG ID to be associated with one or more UL SRS resources for positioning.*

**FL:** Further discussion in Proposal 3.3-1.

* ***(Samsung,*** [***R1-2109490***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109490.doc)***[8]) Proposal 2****: Both options for UE TEG reporting (i.e., reporting the UE RxTx TEG ID or reporting both UE Rx TEG ID and UE Tx TEG ID) are supported for DL+UL positioning subject to the UE capability.*

**FL:** Already agreed.

* ***(Samsung,*** [***R1-2109490***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109490.doc)***[8]) Proposal 3:*** *For the reporting of UE Tx TEG in DL+UL positioning, a Tx TEG ID is associated with an UL SRS resource for positioning corresponding to the Tx timing of the Rx-Tx measurement.*

**FL:** Further discussion in Proposal 3.3-1.

* ***(Intel,*** [***R1-2109611***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109611.doc)***[9])Proposal 1:*** *Support reporting of the UE TX TEG ID and the UE RX TEG ID associated with the UE Rx-Tx time difference measurements, where:*
	+ *The UE TX TEG ID is associated with the UL SRS Resource for positioning corresponding to the TX timing of the UE Rx-Tx time difference measurement*

 **FL:** Further discussion in Proposal 3.3-1.

* + *The UE RX TEG ID is associated with one DL PRS Resource (or more DL PRS Resources) corresponding to the RX time of the measurement*

**FL:** Already included in the existing agreement.

* ***(LGE,*** [***R1-2110088***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110088.doc)***[13])Proposal #4:*** *For mitigating UE Tx/Rx timing errors for DL+UL positioning, select option #2 (i.e., UE to report Rx TEG ID and Tx TEG ID for each gNB Rx-Tx time difference measurement in a Multi-RTT measurement report.)*

**FL:** This option is already agreed.

* + *Tx TEG ID is associated with one UL PRS resource (or more UL SRS resources) to the Tx timing of the Rx-Tx measurement.*

 **FL:** Further discussion in Proposal 3.3-1.

* ***(InterDigital,*** [***R1-2110133***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110133.doc)***[14])Proposal 1:*** *For mitigating UE Tx/Rx timing errors for DL+UL positioning, support both Option 1 and Option 2. If supported by the UE capability, the UE reports RxTx TEG; otherwise, the UE reports Tx TEG and Rx TEG.*

**FL:** Already agreed.

* ***(Qualcomm, R1- 2110187[15])Proposal 6:*** *For mitigating UE Tx/Rx timing errors for DL+UL positioning, when the UE reports Tx TEG ID with a UE Rx-Tx time difference measurement, support the UE to optionally*
	+ *include, together with a Tx TEG ID, an SRS resource on the same measurement report, OR*
	+ *send, in a separate report the Tx TEG ID to SRS resource association.*
		- *Reuse the report that will be designed for UTDOA.*
	+ *Up to the UE's decision, whether it will report the Tx TEG association to SRS resource in the UE Rx-Tx measurement report or in the separate report.*

**FL:** Already agreed to report optionally the Tx TEG ID, and if Tx TEG ID is reported with with a UE Rx-Tx time difference measurement, the UE needs to report the Tx TEG association to SRS resource. Further discussion in Proposal 3.3-2.

* ***(MediaTek,*** [***R1-2110254***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110254.doc)***[16])Proposal 6-1****: It is up to UE implementation for the association between a TX TEG ID to a SRS resource*

 **FL:** Further discussion in Proposal 3.3-1.

* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 15*** *The UE should report the UE TX TEG association of all SRS transmissions that could potentially be used for gNB Rx-Tx time difference measurements. The SRSs for which UE TX TEG association should be reported by the UE could be configurable by the network or alternatively the UE could report UE TX TEG association for all configured SRSs.*

**FL:** Providing all the UE TX TEG association of all SRS transmissions may be necessary since the UE does not know which of the SRSs will be received by the gNB. However, it is unclear to me how the network configures which UE TX TEG associations to report, since the network may not know the UE TX TEG association before UE reports them. Also, the UE may not know which of them are potentially be used for gNB Rx-Tx time difference measurements. Thus, a simple way is that the UE reporsts all of the UE TX TEG associations.

* + *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).*

**FL:** Covered by existing agreements.

* + *There is no association of the Tx TEG ID to any specific UE Rx-Tx time difference measurement, they are only reported in the same multi-RTT report.*
	+ *The association of the UE Tx TEG ID to the UL SRS resource(s) is given by the UE TX TEG definition.*
	+ *The UE TX TEG ID is reported for all UL SRSs.*
	+ *FFS: details of the signalling.*

**FL:** The details of the reporting may be discussed in RAN2. Further discussion in Proposal 3.3-2.

* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 20*** *In the agreement at RAN1#106-e for mitigating UE Tx/Rx timing errors for DL+UL positioning, alternative 3 should be selected in the downselection of bullet three.*

 **FL:** Further discussion in Proposal 3.3-1.

* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 21*** *In the agreement at RAN1#106-e for mitigating UE Tx/Rx timing errors for DL+UL positioning, the FFS in bullet 5 is resolved by reporting a UE Tx TEG ID for each UL SRS resource. The LMF is then free to use a gNB Rx-Tx time difference measurement based on any UL SRS and will still know both the UE RX TEG and the UE TX TEG association.*

**FL:** Further discussion in Proposal 3.3-2.

In previous meeting, it was agreed to support both options for reporting of UE Rx/Tx/RxTx TEG IDs mitigating UE Tx/Rx timing errors for DL+UL positioning in the specification (It is up to UE’s capability to support either one, or both of them.

For the Tx TEG ID association, it was agreed to downselect from three alternatives. The feedbacks in this meeting may be summarized as follows:

* A Tx TEG ID is associated with
	+ Alt. 1: an UL SRS resource for positioning corresponding to the Tx timing of the Rx-Tx measurement

**Supported by**: OPPO, Samsung, Intel, LGE

* + Alt. 2: the Tx timing of the Rx-Tx measurement

**Supported by**: ZTE,

* + Alt. 3: one or more UL SRS resources for positioning

**Supported by**: CATT, vivo, CMCC, Ericsson

In previous agreement, it also contains “FFS: how the association of the Tx TEG ID to the UL SRS resource(s) is determined by UE.” In my view, the Tx timing of the Rx-Tx measurement should be determined based on the UL SRS resource for positioning that corresponds to the Tx timing of the Rx-Tx measurement. The reported Tx TEG ID should at least be associated with the UL SRS resource for positioning, but may not be limited to that UL SRS resource for positioning. That is, “t*he Tx TEG association of the Tx TEG ID should includes the UL positioning SRS resource corresponding to the Tx timing of the Rx-Tx measurement*.”

For example, assume the Tx timing of the Rx-Tx measurement is determined based on the UL SRS resource for positioning, *A1, which is sent from Antenna Panel 1 with* Tx TEG ID, *ID1.* Then, the reported *ID1*, should at least be associated with *A1.* If other UL SRS resources for positioning, say A2, A3…., are also sent from *Antenna Panel 1, the ID1 should be associated with not only A1, but also A2, A3, …*

### Proposal 3.3-1a(H)

Make the following modification of the previous agreement made in RAN1#106e:

* 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). The UE Tx TEG association of the Tx TEG ID should include the UL positioning SRS resource corresponding to the Tx timing of the Rx-Tx measurement.
	+ ~~FFS:~~ how the association of the Tx TEG ID to the UL SRS resource(s) is determined by UE.
	+ details of the signalling (e.g., via RRC/NRPPa to LMF, or via LPP to LMF)

Comments

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| **Company** | **Comments**  |
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### Proposal 3.3-1b (H)

* For mitigating UE Tx/Rx timing errors for DL+UL positioning, support LMF to request a UE to report the UE TxTEG associations of all configured SRS transmissions either together with the UE Rx-Tx measurement report or in a separate report.
	+ FFS: Details of the signaling (e.g., (e.g., via RRC/NRPPa to LMF, or via LPP to LMF)

Comments

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| **Company** | **Comments**  |
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FL Comments

The following proposal is for TRP side, which is a mirror proposal to the agreement made in UE side.

### Proposal 3.3-1c (H)

For mitigating TRP Tx/Rx timing errors for DL+UL positioning, when a gNB reports a gNB Rx-Tx time difference measurement, the gNB should support either or both of the following options:

* Option 1: Reporting of a TRP RxTx TEG ID, and optionally a TRP Tx TEG ID with the measurement
* Option 2: Reporting of a TRP Rx TEG ID and a TRP Tx TEG ID with the measurement
* Note: The TRP Rx TEG ID is associated with one UL positioning SRS resource (or more UL positioning SRS resources) corresponding to the Rx time of the gNB Rx-Tx time difference measurement.

If a TRP Tx TEG ID is reported with a gNB Rx-Tx time difference measurement, the UE should also report the association of the TRP Tx TEG ID to the DL PRS resource(s). The TRP Tx TEG association of the Tx TEG ID should includes the DL PRS resource corresponding to the Tx timing of the gNB Rx-Tx time difference measurement.

* FFS: how the association of the Tx TEG ID to the UL SRS resource(s) is determined by TRP.
* FFS: details of the signalling

Comments

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| **Company** | **Comments**  |
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## Impact of TA on UL measurements

Background

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| **Agreement (RAN1#106e)*** Consider supporting one of the following alternatives related to the UE Rx-Tx time difference (decision to be made in RAN1#106b):
	+ Option 1:
		- Subject to UE capability, the UE may report an additional UL Timestamp associated to a UE Rx-Tx measurement, corresponding to the timing of the uplink subframe of a positioning SRS.
		- Add the following to the UE Rx-Tx time difference definition (similar to the definition for HD-FDD UE in TS 36.214):
			* If the UE does not transmit SRS in subframe #j, and if the UE reports an additional timestamp for the positioning SRS associated to the measurement, it shall compensate for the difference in the transmit timing of uplink subframe #j and the transmission timing of the subframe containing positioning SRS.
	+ Option 2:
		- Subject to a UE capability, a UE may optionally report Timing Adjustment (TA) change information
			* Option 3A: The TA change information is included in the UE Tx TEG report
			* Option 3B: The TA change information is included in the Rx-Tx measurement report
			* Note: TA change information corresponds to: Tx Timing change with a timestamp that this change occurred.
	+ Option 3:
		- Subject to UE capability, the UE may report an additional UL Timestamp associated to a UE Rx-Tx measurement, corresponding to the timing of the uplink subframe of a positioning SRS.
		- Add the following to the UE Rx-Tx time difference definition (similar to the definition for HD-FDD UE in TS 36.214):
			* If the UE does not transmit SRS in subframe #j, and if the UE reports an additional timestamp for the positioning SRS associated to the measurement, it is up to UE to compensate for the difference in the transmit timing of uplink subframe #j and the transmission timing of the subframe containing positioning SRS, or include the difference (Timing Adjustment change) without compensation within the report
	+ Other options are not precluded.
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Submitted proposals

* ***(ZTE,*** [***R1-2108878***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108878.doc)***[2]) Proposal 6****: Subject to a UE capability, a UE may optionally report Timing Adjustment (TA) change information*
	+ *Option 3B: The TA change information is included in the UE Rx-Tx measurement report*
	+ *Note: TA change information corresponds to: Tx Timing change with a time stamp that this change occurred.*
* ***(vivo,*** [***R1-2108975***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108975.doc)***[3])Proposal 9:*** *Support Option 2 related to the UE Rx-Tx time difference with the following modifications.*

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| Option 2: * + - Subject to a UE capability, a UE may optionally report Timing Adjustment (TA) change information
			* ~~Option 3A:~~ The TA change information is included in the UE Tx TEG report
			* ~~Option 3B: The TA change information is included in the Rx-Tx measurement report~~
			* Note: TA change information corresponds to: SRS Tx Timing change with a timestamp ~~that this change occurred~~ corresponding to the SRS time occasion where change occurred.
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* ***(OPPO,*** [***R1-2109051***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109051.doc)***[4]) Proposal 6:*** *Among the three options regarding the UE Rx-Tx time difference, support Option 1, i.e.,*
	+ *Subject to UE capability, the UE may report an additional UL Timestamp associated to a UE Rx-Tx measurement, corresponding to the timing of the uplink subframe of a positioning SRS.*
	+ *Add the following to the UE Rx-Tx time difference definition (similar to the definition for HD-FDD UE in TS 36.214):*
		- *If the UE does not transmit SRS in subframe #j, and if the UE reports an additional timestamp for the positioning SRS associated to the measurement, it shall compensate for the difference in the transmit timing of uplink subframe #j and the transmission timing of the subframe containing positioning SRS.*
* ***(CMCC,*** [***R1-2109283***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109283.doc)***[6]) Proposal 3****: Support option 3 related to the UE Rx-Tx time difference:*
	+ *Option 3:*
		- *Subject to UE capability, the UE may report an additional UL Timestamp associated to a UE Rx-Tx measurement, corresponding to the timing of the uplink subframe of a positioning SRS.*
		- *Add the following to the UE Rx-Tx time difference definition (similar to the definition for HD-FDD UE in TS 36.214):*
			* *If the UE does not transmit SRS in subframe #j, and if the UE reports an additional timestamp for the positioning SRS associated to the measurement, it is up to UE to compensate for the difference in the transmit timing of uplink subframe #j and the transmission timing of the subframe containing positioning SRS, or include the difference (Timing Adjustment change) without compensation within the report*
* ***(CATT,*** [***R1-2109224***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109224.doc)***[5])Proposal 7:*** *Supporting the following Option 4 related to the UE Rx-Tx time difference:*
	+ *Option 4:*
		- *Subject to UE capability, the UE may report an UL Timestamp associated to a UE Rx-Tx measurement, corresponding to the timing of the uplink subframe of a positioning SRS, instead of the original DL Timestamp.*
		- *The nr-TimeStamp field in the IE NR-Multi-RTT-SignalMeasurementInformation in LPP should be redefined to specify the time instance for the uplink subframe of a positioning SRS related to the Tx time of the UE Rx-Tx measurement, instead of the original time instance for which the measurement is performed, related to the Rx time of the UE Rx-Tx measurement.*
		- *Add the following to the UE Rx-Tx time difference definition (similar to the definition for HD-FDD UE in TS 36.214):*
			* *If the UE does not transmit SRS in subframe #j, and if the UE reports an timestamp for the positioning SRS associated to the measurement, it shall compensate for the difference in the transmit timing of uplink subframe #j and the transmission timing of the subframe containing positioning SRS.*
* ***(CATT,*** [***R1-2109224***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109224.doc)***[5])Proposal 8****: When the UE uses the multiple samples of UE Rx-Tx time difference to calculate the measured value of UE Rx-Tx time difference, the UE should be expected that the transmit timing of SRS-Pos corresponding to all the samples used to calculate one UE Rx-Tx time difference measurement report or one UE Rx-Tx time difference measurement instance, should be subject to either no timing adjustment, or the same timing adjustment.*
* ***(Nokia,*** [***R1-2109363***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109363.doc)***[7])Proposal 10****: In case the LMF requests the gNB to report (RTOA, gNB Rx-Tx time difference) in a single report, the LMF indicates UE to report history information on transmission timing changes.*
* ***(Nokia,*** [***R1-2109363***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109363.doc)***[7])Proposal 11:*** *Support modified Option 1 where definition of the measurement is unchanged, but UE behaviour is specified to address the problem.*
* ***(Samsung,*** [***R1-2109490***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109490.doc)***[8]) Proposal 4****: UE may report an additional UL Timestamp associated to a UE Rx-Tx measurement, corresponding to the timing of the uplink subframe of a positioning SRS.*
	+ *Add the following to the UE Rx-Tx time difference definition:*
		- *If the UE does not transmit SRS in subframe #j, and if the UE reports an additional timestamp for the positioning SRS associated to the measurement, it shall compensate for the difference in the transmit timing of uplink subframe #j and the transmission timing of the subframe containing positioning SRS.*
* ***(Intel,*** [***R1-2109611***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109611.doc)***[9]) Proposal 4****: Support modification for the UE Rx-Tx time difference reporting, including the following:*
	+ *The TUE TX is the UE transmit timing of the uplink subframe #j, that is closest in time to the downlink subframe #i received from the TRP, unless the UE reported the UL timestamp associated with the measurement*
	+ *In case if UL timestamp is reported, the UE transmit timing TUE TX should correspond to the UE transmit timing of the reported subframe*
* ***(LGE,***[***R1-2110088***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110088.doc)***[13])Proposal #5:*** *To solve the differentiation problem from TA changes, following one or all of options should be adopted.*
	+ *UE reports TA change information (option #2)*
	+ *Introducing time duration (or window), in which UE applies fixed TA to transmit SRS.*
* ***(Qualcomm, R1- 2110187[15])Proposal 1****: For the purpose of enhancing the accuracy of RTT method, support Option 1.*
* ***(MediaTek,*** [***R1-2110254***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110254.doc)***[16])Proposal 5-1:*** *For enhancement for UE RX-TX time difference measurement, support option 3: it is up to UE to compensate for the difference in the transmit timing of uplink subframe #j and the transmission timing of the subframe containing positioning SRS, or include the difference (Timing Adjustment change) without compensation within the report. Or allow the LMF to indicate the TA change is compensated or not within the report*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 16*** *Support option 2 in the agreement related to the UE Rx-Tx time difference at RAN1#106e: Subject to a UE capability, a UE may optionally report Timing Adjustment (TA) change information*
	+ *Option 2A: The TA change information is included in the UE Tx TEG report*
	+ *Option 2B: The TA change information is included in the Rx-Tx measurement report*
	+ *Note: TA change information corresponds to: Tx Timing change with a timestamp that this change occurred.*
* ***(Ericsson,***[***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 17*** *Support option 2A in the agreement related to the UE Rx-Tx time difference at RAN1#106e: Subject to a UE capability, a UE may optionally report Timing Adjustment (TA) change information*
	+ *Option 2A: The TA change information is included in the UE Tx TEG report*
	+ *FFS whether the UE Tx TEG report is sent over RRC to the gNB or over LPP to the LMF and in the latter case if it’s included as a part of the multi RTT report*
	+ *Note: TA change information corresponds to: Tx Timing change with a timestamp that this change occurred.*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 18*** *TA command timing adjustments and autonomous timing adjustments should be reported separately even if applied in the same time instance.*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 19*** *Timing adjustments should be reported together with a timestamp and a cause, where the cause can be either ‘TA command’ or ‘Autonomous’.*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 22*** *In the agreement at RAN1#106-e for mitigating UE Tx/Rx timing errors for DL+UL positioning, the FFS in bullet 6 is resolved through reporting of timing adjustments. As a consequence there is no need to modify the definition of the Rx-Tx time difference measurement.*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 24*** *The definition of the UE Rx-Tx time difference measurement should not be changed.*

FL comments

The feedbacks for the options may be summarised as follows:

* Option 1:
	+ Subject to UE capability, the UE may report an additional UL Timestamp associated to a UE Rx-Tx measurement, corresponding to the timing of the uplink subframe of a positioning SRS.
	+ Add the following to the UE Rx-Tx time difference definition (similar to the definition for HD-FDD UE in TS 36.214):
		- If the UE does not transmit SRS in subframe #j, and if the UE reports an additional timestamp for the positioning SRS associated to the measurement, it shall compensate for the difference in the transmit timing of uplink subframe #j and the transmission timing of the subframe containing positioning SRS.

***Supported by:*** *OPPO, CATT (with a suggestion on the timestamp), Nokia (no change in definition), Samsung, Intel, Qualcomm*

* Option 2:
	+ Subject to a UE capability, a UE may optionally report Timing Adjustment (TA) change information
		- Option 3A: The TA change information is included in the UE Tx TEG report

***Supported by:*** *ZTE, vivo, LGE, Ericsson*

* + - Option 3B: The TA change information is included in the Rx-Tx measurement report
		- Note: TA change information corresponds to: Tx Timing change with a timestamp that this change occurred.
* Option 3:
	+ Subject to UE capability, the UE may report an additional UL Timestamp associated to a UE Rx-Tx measurement, corresponding to the timing of the uplink subframe of a positioning SRS.
	+ Add the following to the UE Rx-Tx time difference definition (similar to the definition for HD-FDD UE in TS 36.214):
		- If the UE does not transmit SRS in subframe #j, and if the UE reports an additional timestamp for the positioning SRS associated to the measurement, it is up to UE to compensate for the difference in the transmit timing of uplink subframe #j and the transmission timing of the subframe containing positioning SRS, or include the difference (Timing Adjustment change) without compensation within the report

***Supported by:*** *CMCC, MTK*

One of the main difference between Option 1 and Option 2 is whether the UE should compensate for the time changes/timing adjustment in the reported UE Rx-Tx measurements (Option 1), or the UE should report the time changes/timing adjustment (Option 2). It seems no company is supportive to Option 3B under Option 2. Thus, we may remove it in further discussion. Option 3 can be seen as to support both of the options, up to UE’s implementation. It seems all of the proposed options could resolve the issue caused by UE timing changes on the UE Rx-Tx measurements. Option 1 seems having less impact on the signalling support and the specification.

Since both Option 1 and Option 2 are “Subject to UE capability”, i.e., it is upto UE to support them, thus it seems Option 3 is really not needed in case we make the agreement to support both Option 1 and Option 2. Thus, suggest we focus on Option 1 and Option 2 to see if we want to support one of them in the specification, or we support both of them, and let UE to decide which of them will be supported based on the UE’s capability.

In [5], it was discussed that when a UE uses the multiple samples of UE Rx-Tx time difference to calculate the measured value of UE Rx-Tx time difference, the transmit timing of SRS-Pos corresponding to all the samples should be subject to either no timing adjustment, or the same timing adjustment.

### Proposal 3.3-2a(H)

* *Consider supporting one or both of the following alternatives related to the UE Rx-Tx time difference (decision to be made in RAN1#106b):*
	+ *Option 1:*
		- *Subject to UE capability, the UE may report an additional UL Timestamp associated to a UE Rx-Tx measurement, corresponding to the timing of the uplink subframe of a positioning SRS.*
		- *Add the following to the UE Rx-Tx time difference definition (similar to the definition for HD-FDD UE in TS 36.214):*
			* *If the UE does not transmit SRS in subframe #j, and if the UE reports an additional timestamp for the positioning SRS associated to the measurement, it shall compensate for the difference in the transmit timing of uplink subframe #j and the transmission timing of the subframe containing positioning SRS.*
	+ *Option 2:*
		- *Subject to a UE capability, a UE may optionally report Timing Adjustment (TA) change information*
			* *~~Option 3A:~~ The TA change information is included in the UE Tx TEG report*
			* *~~Option 3B: The TA change information is included in the Rx-Tx measurement report~~*
			* *Note: TA change information corresponds to: Tx Timing change with a timestamp that this change occurred.*

Comments

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| **Company** | **Comments**  |
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### Proposal 3.3-2b

* *When a UE uses the multiple samples of UE Rx-Tx time difference to calculate the measured value of UE Rx-Tx time difference, the transmit timing of SRS-Pos corresponding to all the samples used to calculate one UE Rx-Tx time difference measurement report or one UE Rx-Tx time difference measurement instance, should be subject to either no timing adjustment, or the same timing adjustment.*

Comments

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| **Company** | **Comments**  |
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## Reporting of uncertainties of a Rx/Tx/RxTx TEGs

Submitted Proposals

* ***(Nokia,*** [***R1-2109363***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109363.doc)***[7])Proposal 6:*** *The UE should signal to the LMF as part of UE capability the number of TEGs supported and the certain margins associated with each TEG. FFS: maximum number of TEGs and the possible values for certain margins.*
* ***(Qualcomm, R1- 2110187[15])Proposal 8:*** *For mitigating timing errors in DL-TDOA, UL-TDOA or DL+UL Positioning:*
	+ *Support providing at least a timing Error uncertainty/margin associated with a TEG ID.*
	+ *Consider either a UE capability reporting or a semi-static reporting (e.g. in an LPP message) of the timing margin associated with a TEG ID*

FL comments

In [7][15], it was proposed to support the UE/gNB to report the error margins associated with TEGs*.* The information can be useful for LMF in estimating UE position with the reported measurements. There may need to have different capabilities to support the reporting of the error margins associated with Rx TEGs, Tx TEGs, or RxTxTEGs if the proposals are agreeable.

### Proposal 3.3-3

* *For mitigating timing errors in DL-TDOA,*
	+ *Subject to the UE capability, support LMF to request a UE to provide the timing error margin associated with a UE Rx TEG.*
	+ *Support a TRP to provide the timing error margin associated with a TRP Tx TEG*
* *For mitigating timing errors in UL-TDOA,*
	+ *Subject to the UE capability, support LMF to request a UE to provide the timing error margin associated with a UE Tx TEG.*
	+ *Support a TRP to provide the timing error margin associated with a TRP Rx TEG*
* *For mitigating timing errors in DL+UL Positioning,*
	+ *Subject to UE capability, support a UE to provide the timing error margin associated with a UE Rx/Tx/RxTx TEG*
	+ *Support a TRP to provide the timing error margins associated with a TRP Rx/Tx/RxTx TEG*
* *FFS: how the error margin is defined (e.g., The statistics of variance, the error bound (maximum timing error), etc.)*
* *FFS: signaling details of the reporting (e.g., event-triggered, a semi-static, and/or periodic reporting via LPP or RRC, etc.)*

Comments

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| **Company** | **Comments**  |
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## Reporting of group time delys/errors of a Rx/Tx TEG

Submitted Proposals

* ***(OPPO,*** [***R1-2109051***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109051.doc)***[4]) Proposal 9:*** *Rel-17 doesn’t support UE/TRP to report RX+TX group time delays to LMF.*
* ***(CATT,*** [***R1-2109224***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109224.doc)***[5])Proposal 9****: Support UE/gNB to report UE/TRP Rx+Tx group time delays for the multiple pairs of UE/TRP {Rx TEG, Tx TEG} to LMF.*
	+ *Send LS to RAN4 to check whether it is feasible for UE/gNB to report of UE/TRP Rx+Tx group time delays*
* ***(Sony,*** [***R1-2109790***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109790.doc)***[11])****Proposal 2: Support UE and gNB to report the estimated Tx/Rx Timing error to LMF.*
* ***(MediaTek,*** [***R1-2110254***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110254.doc)***[16])Proposal 3-1:*** *Support UE to report RX+TX group delay per RF chain, or to implicit compensate RX+TX group delay within DL-RSTD report, in order to at least assist to resolve group delay difference between TEGs of UE*
* ***(MediaTek,*** [***R1-2110254***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110254.doc)***[16])Proposal 3-2:*** *If RX+TX group delay per RF chain is implicitly compensated within the DL-RSTD report, UE may additionally include a pair of TX TEG indexes in the DL-RSTD report.*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 30*** *Timing errors per UE/gNB RX/TX TEG should not be signalled by the UE/gNB to the LMF, nor from the LMF to the UE.*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 31*** *Timing errors differences between UE/gNB RX/TX TEGs should not be signalled by the UE/gNB to the LMF, nor from the LMF to the UE.*

FL comments

In [5][11][16], it was proposed to support the UE/gNB to report the estimated Tx/Rx or Rx+Tx timing errors to LMF, and in [4][18], it was proposed not to support the UE/gNB to report the estimated Tx/Rx or Rx+Tx timing errors to LMF. If the UE/gNB is capable of estimating Tx/Rx or Rx+Tx timing errors reliably, e.g., through the self-calibration, it seems the UE/gNB should compensate these errors in the reported measurements to minimize the impact on specifications and LMF implementation.

### Proposal 3.3-4

* Subject to the feasibility check by RAN4, if RAN4 considers it is feasible for UE to report of UE RX+TX group time delays to LMF, subject to the UE capability, support UE to report UE RX+TX group time delays for the multiple pairs of UE {RX TEG, TX TEG} to LMF;
	+ FFS: Whether the information is sent directly from UE to LMF, or is first provided to gNB and then forwarded to LMF
	+ Note: It is not required to report the group delays for all possible combinations of UE {Rx TEG, Tx TEG}
* FFS: Subject to the feasibility check by RAN4, if RAN4 considers it is feasible for gNB to report TRP RX+TX group time delays to LMF, support gNB to report TRP RX+TX group time delays for the multiple pairs of TRP {RX TEG, TX TEG} to LMF;
* Send LS to RAN4 to check whether it is feasible for UE/gNB to report UE/gNB RX+TX group time delays

Comments

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| **Company** | **Comments**  |
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## Reporting of multiple UE RX-TX time difference measurements

Submitted Proposals

* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 23*** *Introduce the possibility to configure the UE to perform multi UE-RX-TEG - UE RX-TX time difference measurements, i.e. one UE RX-TX time difference measurement for each UE RX TEG and TRP.*

FL comments

In [18], it was proposed to configure UE measure and report multiple UE RX-TX time difference measurements with multi UE Rx TEGs for the same DL PRS resource of a TRP for LMF to obtain the information of the timing difference of the UE Rx TEGs. In order to obtain the information on the timing difference of the UE Rx TEGs, it seems these UE RX-TX time difference measurements need to refer to the same Tx timing..

### Proposal 3.3-5

* *Introduce the possibility to configure the UE to measure and report multiple UE RX-TX time difference measurements with multi UE Rx TEGs for a TRP, i.e. one UE RX-TX time difference measurement for each UE RX TEG.*

Comments

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| **Company** | **Comments**  |
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## Parameters related to the maximum numbers and UE capabilities

Submitted proposals

* ***(LGE,*** [***R1-2110088***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110088.doc)***[13])Proposal #1:*** *RAN1 should consider extending the current maximum number of DL RSTD measurements per TRP in the same report.*
* ***(Nokia,*** [***R1-2109363***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109363.doc)***[7])Proposal 7:*** *The TRP should signal to the LMF as part of TRP information reporting the number of TEGs supported and the certain margins associated with each TEG. FFS: maximum number of TEGs and the possible values for certain margins.*
* ***(Qualcomm, R1- 2110187[15])Proposal 2****: With regards to the maximum number of RxTEGs, consider the specification to support at least 32 different Rx TEGs (4 PFLs \* 8 Rx Antennas = 32 Rx TEGs).*
	+ *Support a UE capability on the maximum number of RxTEGs the UE can support.*
	+ *The values that this capability can take is: [2,4,6,8,12,16,24,32]*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 11*** *The UE shall report the number of UE TX TEGs as part of UE capabilities.*

FL Comments

There is a need for us to first decide the maximum parameters of UE/TRP Rx/Tx/RxTx TEGs for DL-TDOA, UL-TDOA and DL+UL positioning. Then, we will decide which of them should be included in UE capabilities, and if included in UE capabilities, what are the potential values to be used for the UE capabilities.

The suggested parameter names and values are listed in the following table. Since only a few companies (e.g., [15]) have provided the suggestions, I made my suggestions for further discussion. In the table, I listed the parameters for DL-TDOA, UL-TDOA and DL+UL positioning separately. But, some of them may not need to. For example, the maximum number of UE TxTEGs for UL-RTOA and the maximum number of UE TxTEGs for Multi-RTT could be the same.

### Proposal 3.4a (H)

Support the following parameters and values related to the accuracy enhancement for mitigating UE Rx/Tx and/or gNB Rx/Tx timing errors:

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter Description** | **Values in specifications (e.g., TS 37.355, TS 38.455)** | **Values that can be signaled as part of UE Capability** | **Comments** |
| The maximum number of UE RxTEGs for DL RSTD measurements | [32] | [2,4,6,8,12,16,24,32] | Per UE, regardless of the number of DL positioning frequency layers.The parameter is used for supporting DL-TDOA |
| The maximum number of UE TxTEGs for UL-RTOA | [8] | [2,4,6,8] | Per UEThe parameter is used for supporting UL-TDOA |
| The maximum number of UE-RxTx TEGs  | [32] | [2,4,6,8,12,16,24,32] | Per UE, regardless of the number of DL positioning frequency layers.The value is used for supporting Multi-RTT |
| The maximum number of UE RxTEGs for UE Rx-Tx time difference measurements | [32] | [2,4,6,8,12,16,24,32] | Per UE, regardless of the number of DL positioning frequency layers.The parameter is used for supporting Multi-RTT |
| The maximum number of UE TxTEGs for Multi-RTT | [8] | [2,4,6,8] | Per UEThe parameter is used for supporting Multi-RTT |

**Note:** Above proposal does not constrain in any way how features and feature sets are defined. The values in the table above may or may not be signalled to be different for different features or feature sets.

Comments

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| **Company** | **Comments**  |
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### Proposal 3.4b (H)

* *For DL-TDOA, increase the maximum number of reported RSTD measurements per TRP pair from 4 to N(>4).*
	+ *FFS: N=[8, 16]*

Comments

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| **Company** | **Comments**  |
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## Reporting/updating of Rx/Tx/RxTx TEGs

Backgroud

Proposals regarding the reporting/updating of Tx TEG association with positioning SRS/PRS resources were discussed in previous meetings w/o conclusion. The latest FL proposal discussed in RAN1#106e meetings is as below:

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| * Consider supporting one or both of the following options (to be decided in RAN1#106b):
	+ Option 1: the LMF to request a UE/TRP to provide the periodic reporting of the association information between UE/TRP Tx TEG IDs and positioning SRS/PRS resources, based on a configured periodicity;
		- FFS: the values of the configurable periodicities
	+ Option 2: the LMF to request a UE/TRP to provide the report of the association information between UE/TRP Tx TEG IDs and positioning SRS/PRS resources whenever the UE/TRP determines the previous association information is no longer valid
		- Note: It is up to the UE/TRP to determine when and whether the previous association information is no longer valid
	+ FFS: The details of change of association information between Tx TEG IDs and SRS/PRS resources.
 |

Submttted proposals

* ***(Huawei,*** [***R1-2108730***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108730.doc)***[1]) Proposal 1:*** *The SRS-TEG association change should be defined as that: at least two SRS resources that used to belong to a same TEG no longer belong to a same TEG.*

**FL:** Do we need to introduce the new definition? I assume the SRS-TEG association change means the previous SRS-TEG association is no longer be valid. Also, the proposed definition seems not cover all cases. For example, if a UE is configured with one SRS resource for a UE with two Tx TEGs. The UE may send the SRS resource with different Tx TEGs in different time.

* ***(ZTE,*** [***R1-2108878***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108878.doc)***[2]) Proposal 3:*** *Support UE to periodically report the association information of UL SRS resources for positioning with UE Tx TEGs. In the report, UE should provide the association information for different time occasions if any.*

**FL:** I am wondering how the LMF to configure the periodicity properly. Further discussion in Proposal 3.5-1.

* ***(vivo,*** [***R1-2108975***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108975.doc)***[3])Proposal 3:*** *Support the LMF to request a UE to provide the report of the association information between UE Tx TEG IDs and positioning SRS/PRS resources whenever the UE determines the previous association information is no longer valid.*
	+ *For adjacent 2 triggered reports, the LMF can assume that Tx TEG information associated SRS transmission is relatively stable from the last SRS instance before the previous report to the penultimate SRS instance before the next report.*

Further discussion in Proposal 3.5-1.

* ***(OPPO,*** [***R1-2109051***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109051.doc)***[4])Proposal 2:*** *Regarding to the updating/reporting of the association of Tx TEG IDs and positioning SRS/PRS resources, support Option 2, i.e.,*
	+ *the LMF to request a UE/TRP to provide the report of the association information between UE/TRP Tx TEG IDs and positioning SRS/PRS resources whenever the UE/TRP determines the previous association information is no longer valid*
		- *Note: It is up to the UE/TRP to determine when and whether the previous association information is no longer valid*

Further discussion in Proposal 3.5-1.

* ***(Sony,*** [***R1-2109790***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109790.doc)***[11])****Proposal 1: Support UE/TRP to report time validity information associated with each TEG report to LMF.*

**FL:** Does it mean the LMF needs to request UE/TRP when the timer expires? If so, why not let the UE/TRP to report the updates autonomously without requesting? Further discussion in Proposal 3.5-1.

* ***(Apple, R1- 2110035[12])Proposal 4:*** *Support the LMF to request a UE/TRP to provide, subject to capability, the report of the association information between UE/TRP Tx (or Rx) TEG IDs and positioning SRS/PRS resources whenever LMF determines the previous association information is no longer valid.*

Further discussion in Proposal 3.5-1.

* ***(InterDigital,*** [***R1-2110133***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110133.doc)***[14])Proposal 2****: Support a UE to indicate TEG in the measurement reporting when TEG information is changed compared to the previous reporting.*

Further discussion in Proposal 3.5-1.

* ***(InterDigital,*** [***R1-2110133***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110133.doc)***[14])Proposal 3:*** *Support validity time for TEG, i.e., upon expiration of the validity time, the UE needs to update TEG*

**FL:** For this proposal, does it mean the LMF needs to request UE/TRP when the timer expires? If so, why not let the UE/TRP to report the updates autonomously without requesting? Further discussion in Proposal 3.5-1.

* ***(Qualcomm, R1- 2110187[15])Proposal 7:*** *With regards to TEG Information reporting, a device (UE or gNB) should be able to provide TEG-ID consistency information (e.g., a flag when TEG IDs are being reset). This applies to both Tx TEG, Rx TEG for both UEs and gNBs.*

**FL:** Not sure if a flag is enough. When TEG information changes, I assume there is a need to report the updated the TEG information. Further discussion in Proposal 3.5-1.

* ***(MediaTek,*** [***R1-2110254***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110254.doc)***[16])Proposal 6-2****: When the UE uses another antenna panel associated to a different RX TEG ID for receiving a same spatial relation RS, the change of association of a TX TEG ID to a SRS resource would happen accordingly. The update of the association change could be reported to LMF with time stamp when it happens*

**FL:** Not sure if the timerstamp is important here, assuming the LMF always use the latest TEG information. Further discussion in Proposal 3.5-1.

* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 9****: For reporting of UE Tx TEG association to SRS resources, support both the following options:*
	+ *Option 1: the LMF to request a UE to provide the periodic reporting of the association information between UE Tx TEG IDs and SRS resources, based on a configured periodicity*
	+ *Option 2: the LMF to request a UE to provide the report of the association information between UE Tx TEG IDs and SRS resources whenever the UE determines the previous association information is no longer valid*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 25*** *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. The timing error difference between two measurements based on the same UE RX TEG should be smaller than the margin if the difference in reported UE RX TTEI is smaller than a fixed value of N index steps. The UE RX TTEI difference between two subsequent UE RX TTEIs reported to the LMF should not be larger than N. FFS: [N=7], [Size of TTEI = 8].*

**FL:** It is unclear how the UE determins the TTEI, and how the LMF uses the TTEI information. Should the TTEI be associated with a predefined time error value?

* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 26*** *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. The timing error difference between two UL SRS transmissions based on the same UE TX TEG should be smaller than the margin if the difference in reported UE TX TTEI is smaller than a fixed value of N index steps. The UE TX TTEI difference between two subsequent UE TX TTEIs reported to the LMF should not be larger than N. FFS: [N=7], [Size of TTEI = 8].*

**FL:** Similar question as above.

* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 27*** *Study how to handle frequency-dependent timing errors in NR Rel-17.*

FL Comments

The timing errors of UE Rx/Tx/RxTx TEGs may changes with time for various reasons as discussed by multiple companies (e.g., [[1][2][3][4][11][12][14][15][16][18]). Different options regarding the reporting/updating of Tx TEG association with positioning SRS/PRS resources were discussed in previous meetings w/o the conclusion.

Two companies [2][18] proposes that UE/TRP provide the periodic reporting of the association information between UE/TRP Tx TEG IDs and positioning SRS/PRS resources. More companies [3][4][12][15][16][18] proposes it is up to the UE/TRP to determine when to provide the update of the association information between UE/TRP Tx TEG IDs and positioning SRS/PRS resources, e.g., whenever the UE/TRP determines the previous association information is no longer valid. Some companies propose the UE/TRP to provide the updates when a validity timer expires [11][14][16]. One company suggest using a flag to indicate the update, and one company proposes to use time error indexes to indicates the changes of the timing errors [18].

### Proposal 3.5 (H)

* *Supporting one or both of the following options for UE/TRP to provide the updates of the association information between UE/TRP Tx TEG IDs and positioning SRS/PRS resources:*
	+ *Option 1: the LMF to request a UE/TRP to report the association information between UE/TRP Tx TEG IDs and positioning SRS/PRS resources, based on a configured periodicity or a validity timer*
		- *FFS: the values of the configurable periodicities or a validity timer*
	+ *Option 2: the LMF to request a UE/TRP to report the updates of the association information between UE/TRP Tx TEG IDs and positioning SRS/PRS resources whenever the UE/TRP determines the previous association information is no longer valid*
		- *Note: It is up to the UE/TRP to determine when and whether the previous association information is no longer valid*
	+ *FFS: The details of signalling.*

Comments

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| **Company** | **Comments**  |
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# Reference devices for mitigating UE/gNB Tx/Rx timing errors

Background

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| 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_10_RAN1_106bis/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_10_RAN1_106bis/Docs/R1-2106326.doc) (Email endorsement) |

1. [R1-2108697](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108697.doc) Reply LS on Positioning Reference Units RAN3, Ericsson

*Submitted Proposals*

* ***(Sony,*** [***R1-2109790***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109790.doc)***[11])Proposal 3:*** *Support UE as PRU*
* ***(Sony,*** [***R1-2109790***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109790.doc)***[11])Proposal 4:*** *Support to introduce PRU identification based on the device capability, which enable LMF to select the capable devices UE to be PRU*
* ***(Sony,*** [***R1-2109790***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109790.doc)***[11])Proposal 5:*** *PRU with known location support the following functionalities: Location uncertainty information, stationary status, providing positioning measurement and/or estimated Tx/Rx Timing error report.*

FL comments

According to the previous agreement, the PRU functionalities will be decided by RAN2. RAN1 is currently waiting for RAN2’s response to see if RAN1 needs to take further action on the issue.

By the way, RAN3 has sent a reply LS on Positioning Reference Units (R1-2108697), in which it says “*If the PRU is realized as a UE (from LMF perspective), then RAN3 believes there are no RAN3 specification impacts. Since the PRU may support, at least, some of the Rel-16 positioning functionalities of UE and not necessarily introduce a new network node, some companies believe that this option (UE) is the most appropriate*.”

In addition, it seems regardless of which PRU functionalities RAN2 decide to support, there is a need for a UE to inform LMF that the UE can support the PRU functionalities. Thus, we may need to consider including a UE capability for this purpose.

### Proposal 3.5-1 (H)

* *Introduce a UE capability for the UE that is capable of supporting the PRU functionalities.*
	+ *Note: The functionalities to be supported by a PRU are determined by RAN2.*

Comments

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| **Company** | **Comments**  |
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# Measurement enhancements for mitigating UE/gNB Tx/Rx timing errors

Background

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| 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.
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## Measurement time window

Background

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| 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,*** [***R1-2108730***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108730.doc)***[1]) Proposal 5:*** *Support both Option 1 and option 2 for MTW configuration of UE and gNB, respectively.*
* ***(Huawei,*** [***R1-2108730***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108730.doc)***[1]) Proposal 6:*** *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 internal, which is the multiple of PRS/SRS periodicity and can divide or can be divided by 10.24s SFN period.*
* ***(ZTE,*** [***R1-2108878***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108878.doc)***[2]) Proposal 10:*** *There is no need to introduce measurement time window in Rel-17 NR positioning.*
* ***(OPPO,*** [***R1-2109051***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109051.doc)***[4]) Proposal 11****: Rel-17 doesn’t support the measurement time window (MTW) for the measurement instance.*
* ***(CATT,*** [***R1-2109224***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109224.doc)***[5])Proposal 10****: The configurable measurement time windows should be supported, in which the UE or TRP measurement instances are obtained.*
* ***(CATT,*** [***R1-2109224***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109224.doc)***[5])Proposal 11****: UE measurement time windows and TRP measurement time windows can be configured independently. They can be configured to be the same or different.*
	+ *UE measurement time window refers to the time window in which UE measures DL-PRS resources. In this time window, UE obtains at least one UE measurement instance by measuring DL-PRS resources.*
	+ *TRP measurement time window refers to the time window in which TRP measures SRS-Pos resources. In this time window, TRP obtains at least one TPR measurement instance by measuring SRS-Pos resources.*
* ***(CATT,*** [***R1-2109224***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109224.doc)***[5])Proposal 12****: UE (or TRP) is not expected to measure DL-PRS (or SRS-Pos) outside of the measurement time window.*
* ***(CATT,*** [***R1-2109224***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109224.doc)***[5])Proposal 13****: (Configuration method 1): UE/TRP measurement time window should 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.*
		- *J: The number of UE measurement instances included in the UE measurement time window.*
		- *Ni: The number of instances of DL-PRS resource set or DL-PRS occasions contained by the i-th UE measurement instance.*
	+ *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.*
		- *K: The number of TRP measurement instances included in the TRP measurement time window.*
		- *Mi: The number of instances of SRS-Pos resource set or SRS-Pos occasions contained by the i-th TRP measurement instance.*
* ***(CATT,*** [***R1-2109224***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109224.doc)***[5])Proposal 16:*** *For configuration method 1 and the periodic DL-PRS, the length of UE measurement time window* $MTW\_{UE} $*can be defined as:*

$$MTW\_{UE}=PD\_{DL-PRS}×\sum\_{i=1}^{J\_{P}}N\_{Pi}$$

* + - * + $PD\_{DL-PRS}$ *is the periodicity of DL-PRS resource set;*
				+ $J\_{P}$ *is the number of UE measurement instances included in the UE measurement time window,* $J\_{P}$≥1;
				+ $N\_{Pi}$ *is the number of instances of DL-PRS resource set or DL-PRS occasions contained by the i-th UE measurement instance，*$N\_{Pi}$≥1.
* ***(CATT,*** [***R1-2109224***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109224.doc)***[5])Proposal 17:*** *For configuration method 1 and the periodic/semi-persistent SRS-Pos, the length of TRP measurement time window* $MTW\_{TRP} $*can be defined as:*

$$MTW\_{TRP}=PD\_{SRS-Pos}×\sum\_{i=1}^{K\_{P}}M\_{Pi}$$

* + - * + $PD\_{SRS-Pos}$ *is the periodicity of SRS-Pos resource set;*
				+ $K\_{P}$ *is the number of TRP measurement instances included in the TRP measurement time window,* $K\_{P}$≥1;
				+ $M\_{Pi}$ *is the number of instances of SRS-Pos resource set or SRS-Pos occasions contained by the i-th TRP measurement instance，*$M\_{Pi}$≥1.
* ***(CATT,*** [***R1-2109224***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109224.doc)***[5])Proposal 18****: For configuration method 1, each UE or TRP measurement instance can be configured with at least one instance of DL-PRS resource set or SRS-Pos resource set.*
* *Each UE measurement instance can be configured with N instances of the DL-PRS resource set. N = [1, 2, …, 16], using 4 bits to indicate which value is configured for N.*
* *Each TRP measurement instance can be configured with M SRS-Pos resource set. M = [1, 2, … , 16] , using 4 bits to indicate which value is configured for M.*
* ***(CATT,*** [***R1-2109224***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109224.doc)***[5])Proposal 19:*** *For configuration method 2, 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.*
* ***CATT,*** [***R1-2109224***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109224.doc)***[5])Proposal 20:*** *Configuration method 1 should be adopted to configure the measurement time window, since it will help LMF to more effectively eliminate the influence of timing errors of TRPs and UE.*
* ***(LGE,*** [***R1-2110088***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110088.doc)***[13])Proposal #6:*** *RAN1 should support configuring MTW for both UE and gNB.*
* ***(LGE,*** [***R1-2110088***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110088.doc)***[13])Proposal #7:*** *Regarding configuration of measurement time window (MTW), RAN1 should consider following ways to indicate/configure it.*
	+ *Type #1: predefined configuration*
		- *Introducing positioning radio frame (PRF) in which a single or multiple MTW(s) may exist.*
		- *Start timing offset and/or duration and/or repetition factor (and/or including time gap) for de tail configuration of MTW(s).*
	+ *Type #2:dynamic configuration*
		- *MTW can starts after the message from LMF such as positioning measurement request.*
		- *Start timing offset and/or duration and/or repetition factor (and/or including time gap) for de tail configuration of MTW(s).*
* ***(LGE,*** [***R1-2110088***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110088.doc)***[13])Proposal #8:*** *RAN1 should allow both UE and gNB to perform positioning measurement regardless of MTW.*
* ***(LGE,*** [***R1-2110088***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110088.doc)***[13])Proposal #9:*** *Considering specific use cases that LMF wants to instruct both UE and gNB to perform positioning measurement within MTW, RAN1 also needs to discuss about it in detail such as related signaling, procedure and etc.*
* ***(InterDigital,*** [***R1-2110133***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110133.doc)***[14])Proposal 4:*** *Support Option 1 and Option 2 of the measurement time window.*
* ***(Qualcomm, R1- 2110187[15])Proposal 9:*** *With regards to the measurement time window (MTW) feature, support both options from the previous agreement.*
* ***(MediaTek,*** [***R1-2110254***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110254.doc)***[16])Proposal 2-1:*** *Support UE to report measurement behavior so that LMF could adapt the algorithm to extract the desired parameters*
* ***(MediaTek,*** [***R1-2110254***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110254.doc)***[16])Proposal 2-2:*** *After receiving the configuration of system parameters, UE reports the corresponding measurement behavior, for example, the DL-PRS measurement periodicity (not necessary equal to the transmission periodicity), and the measurement duration before reporting. FFS for the details of measurement behavior*
* ***(MediaTek,*** [***R1-2110254***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110254.doc)***[16])Proposal 2-3:*** *NW may configure SRS for each UE based on the reported measurement behavior of UE to get close the downlink and uplink measurements.*
* ***(Lenovo*** [***R1-2110298***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110298.doc)***[17])Proposal 1:*** *Support Options 1 and 2 for indicating the measurement time window for the UE and gNB, respectively.*
* ***(Lenovo*** [***R1-2110298***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110298.doc)***[17])Proposal 2:*** *The MTW configuration for a UE and gNB should at least include parameters such as time window length and periodicity, where applicable.*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 28*** *Clarify in the agreement from RAN1#104-e on measurement instances that there is one measurement time window for each measurement instance*
* ***(Ericsson,*** [***R1-2110349***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110349.doc)***[18])Proposal 29*** *It shall be possible to configure the measurement window for a measurement instance to be so short that there is no risk for the TEG associations to change during the measurement window.*

FL Comments

Based on the feedback, many companies (e.g., [1][5][13][14][15][17][18]) support LMF to configure the measurement time windows for UE and gNB. But, some companies (e.g., [2][4][16]) consider there is no need to do so.

In my understanding, one of the main motivations for LMF to configure the measurement time windows for UE and gNB is to enable UE and gNB to provide one or more measurement instances included in UE and gNB measurement reports to be closely time-aligned within the same time window to avoid potential miss-match the UL and DL measurements, especially for DL+UL positioning. Some companies believe the configuration of the measurement time windows may not be needed if DL PRS and UL SRS are configured for transmission with the same periodicity. But, the argument is that even for this case, there is a need to inform the UE and gNB to align the timing of the measurements. As an example, assume DL PRS and UL SRS are transmitted with the same periodicity, and UE uses 4 samples (DL PRS instances) to obtain one UE Rx-Tx time difference measurement instance (4-samples for a measurement instance is currently used by RAN4 to define performance requirements). To avoid mismatching of UE and gNB Rx-Tx time difference measurements, it is highly desirable for both UE and gNB also uses 4 samples (DL PRS/UL SRS instances) to provide UE/gNB Rx-Tx time difference measurements. This may not be possible if the measurement time window is not defined. Configuring the measurement time windows for both UE and gNB is more meaningful if we consider that the UE will need to make the adjustments of UL transmission time between the measurements now and then, but the serving and neighbouring gNBs do not have the information when the UE make the time adjustments. If the measurement time window is configured, both UE and gNB will make the measurements at the time durations when the UE does not make the UL timing adjustment. The impact of the TA adjustment will then be avoided. Therefore, the suggestion is to support measurement time windows for both UE and gNB.

If the measurement time windows are supported, we may need to consider the start time, the window length, and possibly, the periodicity for periodical measurements.

### Proposal 5.1 (H)

* *Support LMF to optionally configure the measurement time window (MTW) for a UE for the measurement instances included in a single measurement report.*
* *Support LMF to optionally indicate the measurement time window for a gNB for the measurement instances included in a single measurement report.*
* *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) derived based on the configuration of*
				+ *UE/gNB measurement instances for the MTW, and the*
				+ *the number of samples (PRS/SRS instances) for each UE/gNB measurement instance*
	+ *MTW periodicity for the cases of periodic reporting*

Comments

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| **Company** | **Comments**  |
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## Timestamp of measurement instance

Background

It was agreed in RAM1#104bis-e that each measurement instance has its own timestamp. The definition of the timestamp was also discussed in previous meetings w/o conclusion. The latest proposal in discussion of the last meeting is as follows.

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| (Round 2) Proposal 5-2a (H)*The timestamp for a measurement instance in a measurement report is defined by one of the following options (downselection in RAN1#106b):** *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.*
* *Option 2: The timestamp of the UE (or TRP) measurement instance corresponds to as a time window indicated by,*
	+ *A starting time instance corresponds to the reception time of the first instance of the DL PRS (or UL SRS) resources averaged/filtered over to give the reported measurement instance, and*
	+ *An ending time instance corresponds to a reception time of the last instance of the DL PRS (or UL SRS) resources averaged/filtered over to give the reported measurement instance*
* *Option 3: Up to UE implementation.*
 |

Submitted proposals and FL comments

* ***(ZTE,*** [***R1-2108878***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108878.doc)***[2]) Proposal 11:*** *The timestamp for a measurement instance in a measurement report is defined as a time window indicated by,*
	+ *A starting time instance corresponds to the reception time of the first instance of the DL PRS (or UL SRS) resources averaged/filtered over to give the reported measurement instance, and*
	+ *An ending time instance corresponds to a reception time of the last instance of the DL PRS (or UL SRS) resources averaged/filtered over to give the reported measurement instance.*
* ***(vivo,*** [***R1-2108975***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108975.doc)***[3])Proposal 10:***  *The UE or the TRP can be configured to report more than one measurement instances in a single measurement report to the LMF.*
* ***(vivo,*** [***R1-2108975***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108975.doc)***[3])Proposal 11:*** *Support to enable the UE to report PRS measurements derived from the most recent measurement instances in advance of a certain time before the measurement report.*
	+ *The certain time before the measurement report is related to PRS processing capability.*
* ***(OPPO,*** [***R1-2109051***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109051.doc)***[4]) Proposal 10:***  *For the timestamps for the measurement instances in a measurement report, support either Option 1 or Option 3:*
	+ *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. (1st preference)*
	+ *Option 3: Up to UE implementation. (2nd preference)*
* ***(CATT,*** [***R1-2109224***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109224.doc)***[5])Proposal 14****: When UE reports a measurement instance, it also reports the time stamp of the measurement instance, which corresponds to one certain reception time between the first and last DL-PRS resource sets that are used to determining the measurement instance.*
* ***(CATT,*** [***R1-2109224***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2109224.doc)***[5])Proposal 15****: When TRP reports a measurement instance, it also reports the time stamp of the measurement instance, which corresponds to one certain reception time between the first and last SRS-Pos resource sets that are used to determining the measurement instance.*
* ***(Lenovo*** [***R1-2110298***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110298.doc)***[17])Proposal 3:*** *It should be possible to support reporting of timestamps outside the configured MTWs.*
* ***(Lenovo*** [***R1-2110298***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110298.doc)***[17])Proposal 4****: RAN1 to clarify the definition between a measurement sample and measurement instance for timestamp reporting.*
* ***(Lenovo*** [***R1-2110298***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110298.doc)***[17])Proposal 5:*** *The timestamp should correspond to the reception time of the last received PRS resource for a single measurement instance.*

FL Comments

It seems companies still have different preferences on the three options discussed in the last meeting. We will continue the discussion on these options and make the decision at this meeting on which of the option to adopt. It seems the difference between Option 1 and Option 2 is that if multiple DL-PRS resource instances (or SRS resource instances) are used to obtain the measurement, whether there is a need to include the timestamps of the first DL-PRS resource instances (or SRS resource instances). With the known transmission periodicity of DL-PRS/UL SRS and the number of resource instances (or the number of samples) that are used for each measurement instance, it seems the time of the starting time instance can be derived, and thus no need to report.

### Proposal 5-2 (H)

*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.*

Comments

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| **Company** | **Comments**  |
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## Number of PRS resource set/SRS occasions for a measurement instance

Background

It remains undecided on how many whether a UE/TRP measurement instance can be configured with N/M instances of the DL-PRS Resource Set/ *SRS measurement time occasions.*

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| * *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)*
 |

Submitted proposals

* ***(ZTE,*** [***R1-2108878***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108878.doc)***[2]) Proposal 12:*** *Each UE measurement instance in a measurement report can be configured by LMF with N instances of the DL-PRS Resource Set, where N can be configured with one of the following alternatives:*
	+ *Alt.1: per measurement report*
	+ *Alt.2: per TRP*
	+ *Alt.3: per positioning frequency layer*
	+ *Alt.4: per DL PRS resource set*

*The values of N can be N=[1,2, 4, 8,‚Ä¶,256]*

**FL:** Further discussion in Proposal 5-3.

* ***(vivo,*** [***R1-2108975***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108975.doc)***[3])Proposal 12****: The relationship between ‘the number of DL-PRS Resources Set instances related to each UE measurement instance’ and ‘the number of PRS samples for RSTD/Rx-Tx time difference/PRS-RSRP measurements’ defined by RAN4’ should be clarified.*
	+ *Send an LS to RAN4 for consistent understanding.*

**FL:** The decision here on ‘the number of DL-PRS Resources Set instances related to each UE measurement instance’ can be independent on RAN4’s definition of the PRS samples for the moment. After RAN1 makes the decision, RAN1 may send LS to RAN4 for the alignment of the terminology.

* ***(vivo,*** [***R1-2108975***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108975.doc)***[3])Proposal 14****: For N instances of the DL-PRS Resource Set within one UE measurement instance, N can be recommended by the LMF and determined by the UE.*
	+ *For M SRS measurement time occasions within one TRP measurement instance, M can be recommended by the LMF and determined by the TRP.*

**FL:** While I share the similar view with the proposal, but I am not sure if we need to have agreement on this in RAN1. I would assume RAN4 may define performance requirements corresponding to the number of N (or M) instances. Then, how many of instances are used by the receiver to obtain a measurement is indeed up to the receiver implementation under the condition to meet the performance requirements.

* ***(CATT,*** [***R1-2109224***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108975.doc)***[6])Proposal 18:*** *For configuration method 1, each UE or TRP measurement instance can be configured with at least one instance of DL-PRS resource set or SRS-Pos resource set.*
	+ *Each UE measurement instance can be configured with N instances of the DL-PRS resource set. N = [1, 2, …, 16], using 4 bits to indicate which value is configured for N.*
	+ *Each TRP measurement instance can be configured with M SRS-Pos resource set. M = [1, 2, … , 16] , using 4 bits to indicate which value is configured for M.*

### Proposal 5-3 (H)

* *Each UE measurement instance in a measurement report can be configured by LMF with N instances of the DL-PRS Resource Set, where N can be configured with one or more of the following alternatives :*
	+ *Alt.1: per measurement report*
	+ *Alt.2: per TRP*
	+ *Alt.3: per positioning frequency layer*
	+ *Alt.4: per DL PRS resource set*
* *The values of N can be*
	+ *Option 1: N=[1, 2, … , 16]*
		- *FFS: N=[32, 64, 128, 256]*
	+ *Option 2: N is decided by RAN4*
* *Each gNB measurement instance in a measurement report can be configured by LMF with M SRS measurement time occasions, where M can be configured by LMF with one or more of the following alternatives (downseletion in RAN1#106b):*
	+ *Alt.1: per measurement report*
	+ *Alt.2: per UE*

*The values of M can be*

* + *Option 1: M=[1, 2, … , 16]*
		- *FFS: M=[32, 64, 128, 256]*
	+ *Option 2: M is decided by RAN4*
* *Send LS to RAN4 if the N/M are decided by RAN4.*

Comments

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| **Company** | **Comments**  |
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## Tx/Rx TEG for a measurement instance

Submitted proposals

* ***(ZTE,*** [***R1-2108878***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108878.doc)***[2]) Proposal 9:*** *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:** When multiple reference signals are used to obtain a measurement, it seems reasonable to enfore using the same RxTEG for receiving all of the reference signals.

* ***(vivo,*** [***R1-2108975***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108975.doc)***[3])Proposal 13****: For N instances of the DL PRS resource set on a PRS resource in one UE measurement instance, the same TEG across N instances should be ensured, wherein, the TEG includes UE Rx TEG and TRP Tx TEG.*
	+ *For M SRS measurement time occasions in one TRP measurement instance, the same TEG across M instances should be ensured, wherein, the TEG includes TRP Rx TEG and UE Tx TEG.*

**FL:** From the receiver side, it makes sense to enfore using one RxTEG across N instances. However, when a UE uses multiple DL PRS resources to obtain a DL measurement instance, it may not be able to ensure all of DL PRS resources are transmitted with the same Tx TEG, unless the UE has the information about which DL PRS resources are transmitted with which Tx TEGs.

### Proposal 5.4 (H)

* *When a UE uses multiple DL PRS resources and/or multiple DL PRS resource instances to obtain a measurement instance (including RSTD and UE Rx-Tx timing difference), the UE shall ensure the same UE Rx TEG is used across these DL PRS resources and/or DL PRS resource instances.*
	+ *FFS: whether and how to ensure a UE to use the DL PRS resources and/or DL PRS resource instances transmitted with the same TRP Tx TEG for a measurement instance.*
* *When a TRP uses multiple UL positioning SRS resources and/or multiple positioning SRS resource instances to obtain a measurement instance (including RTOA and gNB Rx-Tx timing difference), the TRP shall ensure the same TRP Rx TEG is used across these positioning SRS resources and/or multiple positioning SRS resource instances.*
	+ *FFS: whether and how to ensure a TRP to use UL positioning SRS resources and/or multiple positioning SRS resource instances transmitted with the same UE Tx TEG for a measurement instance.*

Comments

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| **Company** | **Comments**  |
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## The quality of timing-based measurement instances

Submitted proposals

* ***(Lenovo*** [***R1-2110298***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110298.doc)***[17])Proposal 6: The existing UE timing quality indication can be extended to indicate the quality of timing-based measurement instances including RSTD and UE Rx-Tx time difference measurements.***

FL Comments

It seems reasonable to allow each timing measurement instance (e.g., RSTD, RTOA, UE/gNB time difference measurements) to have an indication of the measurement quality (e.g., NR-TimingQuality-r16).

### Proposal 5-5

* *Support extend the existing UE/TRP timing quality indication of of RSTD, RTOA and UE/gNB Rx-Tx time difference measurements to indicate the quality of the measurement instances of RSTD, RTOA and UE/gNB Rx-Tx time difference measurements.*

Comments

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| **Company** | **Comments**  |
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## Measurement instances in a measurement report

Submitted proposals

* ***(ZTE,*** [***R1-2108878***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2108878.doc)***[2]) Proposal 13:*** *Further discuss the association between measurement instances and UE measurement report, at least consider one of the following options,*
	+ *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.*

*FFS: The relationship between the value N and the association between measurement instances and UE measurement report.*

FL comments

Based on the previous agreement that a single measurement report may contain one or more measurement instances of different types (e.g., RSTD/RTOA, DL/UL RSRP, and/or UE/gNB Rx-Tx time, and each measurement instance may be measured from one or more PRS/SRS resources. The impact of the agreements on LPP/NRPPs signalling may be further discussed in RAN2/3.

### Proposal 5-6

*Further discuss the association between measurement instances and UE measurement report, at least consider one of the following options,*

* + *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.*

*FFS: The relationship between the value N and the association between measurement instances and UE measurement report.*

Comments

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| **Company** | **Comments**  |
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# Additional proposals

## Multiple reference timings

Submitted Proposals

* ***(LGE,*** [***R1-2110088***](file:////Users/renda000/Downloads/2021_10_RAN1_106bis/Docs/R1-2110088.doc)***[13])Proposal #10:*** *RAN1 needs to consider the configuration of multiple reference timings for DL RSTD, DL PRS-RSRP, and UE Rx-Tx time difference measurements****.***

FL comments

For DL PRS-RSRP and UE Rx-Tx time difference measurements, my understanding is that it is up to UE on whether to use the configured reference. Thus, the benefits of configuring multiple reference timings need further study.

### Proposal 6-1

* *Study the benefits of configuration of multiple reference timings for DL RSTD, DL PRS-RSRP, and UE Rx-Tx time difference measurements.*

Comments

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| **Company** | **Comments**  |
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