**3GPP TSG RAN WG1 Meeting #106-e [R1-2108243](file:////Users/renda000/Documents/1%20RAN1/2021_08_TSGR_106e/docs/R1-2106259.doc)**

**e-meeting, Aug. 16th – 27th, 2021**

**Source: Moderator (CATT)**

**Title: FL Summary #3 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:

[106-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 August 19, 24 and 27 – 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 [1-19]:

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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 |

**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

*Background*

The following agreement was made in RAN1#104e for the definitions of the UE/TRP Tx/Rx timing errors and UE/TRP Tx/Rx TEGs. The definitions were agreed upon for purpose of discussion of methods, measurements, signalling, and procedures for mitigating UE Rx/Tx and/or gNB Rx/Tx timing errors, but was not agreed to be included in the specifications yet.

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| Agreement:  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. |

## Antenna phase center offset (PCO) and antenna reference point (ARP)

Submitted Proposals

* ***(Nokia,*** [***R1-2107057***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107057.doc)***[6]) 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,*** [***R1-2107057***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107057.doc)***[6])) Proposal 2: UE to signal to gNB/LMF its capabiltiy 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*** [***R1-2107057***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107057.doc)***[6]) Proposal 3: Include the impact of antenna PCO in the definition of RX/TX timing errors and associated TEGs.***
* ***(Fraunhofer,*** [***R1-2108101***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108101.doc)***[17]) Proposal 1: Support TRP to provide the LMF with ARP information related to the UL-SRS measurements. (similar to the DL-PRS ARP information).***
* ***(Fraunhofer,*** [***R1-2108101***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108101.doc)***[17]) Proposal 2: Support the UE to provide ARP information relative to a UE reference point using a UE coordinate system (UCS).***

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 and included 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.’*).

For DL PRS transmission, the effective ARPs of a TRP may be different for the transmission of different DL PRS resources/resource sets. In Rel-16, it is supported in NRPPa for gNB to report the location information of the effective ARPs to LMF. However, the specification currently does not support gNB to provide such information for UL-SRS measurements reception to the LMF.

### Proposal 2.1-1

* *Subject to UE’s capability, support 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*
  + *FFS: whether the information is relative to a UE reference point in a UE local coordinate system (LCS).*
* *Support UE to signal to gNB/LMF its capability to compensate for antenna phase center offsets for time-based positioning.*

Comments

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| **Company** | **Comments** |
| Huawei, HiSilicon | This has been proposed for a couple of meeting.  To our understanding, the precondition of UE directionally specific PCO reporting would also require panel center reporting (inter-panel offset reporting), if we interprete PCO as intra-panel offset.  This can be considered low priority unless we made process on UE panel-specific ARP reporting first. |
| **OPPO** | Not support.  As commented last meeting, the definition of Tx timing error and Rx timing error has included the impact of the phase center offsets  Additionally, one question for the clarification on “*gNB specific SRS-Pos TOD offsets*”. What does “gNB specific” mean here? In our understanding, UE doesn’t know which TRP/gNB will measure the SRS-Pos. |
| Ericsson | The expected errors are typically smaller than filter group delay. This can be lower priority for Rel-17 and may be discussed in Rel. 18. |
| CATT | We prefer to treat it as low priority. |
| **FL** | **It seems it is lack of the support for the proposal for this release. We may consider to make the conclusion of no further discussion on the phase center offsets (PCOs) in the WI.** |
| Nokia/NSB | We will feel that this issue is very important to meeting the requirements for the IIoT, in particular for an FR2 UE. We understand that many companies feel this issue is lower priority but we have provided simulation results that show that if this issue is not fixed that the requirements of 20 cm for IIoT are already in danger. As such we make the following compromise proposal:  PCO impact on the Tx/Rx timing errors will be discussed during UE capability. |

Proposal 2.1-2

* *Support gNB to provide LMF with the information of antenna reference point(s) (ARPs) related to the UL-SRS measurements (e.g., RTOA, UL-AoA/ZoA)*
  + *FFS: whether to support gNB to provide the direction-specific antenna phase center offsets (PCO) relative to a ARP to LMF*

Comments

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| **Company** | **Comments** |
| Ericsson | The expected errors are typically smaller than filter group delay. This can be lower priority for Rel-17 and may be discussed in Rel. 18. |
| CATT | We prefer to treat it as low priority. |
| ZTE | Support in general. Different ARPs may have different locations. We prefer to discuss this issue in UL-AOA agenda to avoid duplicated discussion. |
| **FL** | **ZTE’s suggestion is reasonable.** |

(Round 2) Proposal 2.1-2

Suggest closing the discuss in this AI and continue the discussion in UL-AOA agenda.

Comments

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| **Company** | **Comments** |
| Nokia/NSB | Don’t support. We will feel that this issue is very important to meeting the requirements for the IIoT, in particular for an FR2 UE. We understand that many companies feel this issue is lower priority but we have provided simulation results that show that if this issue is not fixed that the requirements of 20 cm for IIoT are already in danger. As such we make the following compromise proposal:  PCO impact on the Tx/Rx timing errors will be discussed during UE capability. |
| LG | We prefer to treat it as low priority. |
| **FL** | The following agreement was made in AI 8.5.2. Thus, the discussion related to TRP ARP can be closed here.  greement:  Further study and conclude whether association of UL-AOA, UL-TDOA, Multi-RTT measurements with ARP (Antenna Reference Point) information is supported at RAN1#106bis-e. |

### (Closed) Proposal 2.1-2

## Clarification of the ‘error margins’ in Rx/Tx/RxTx TEG definitions

Submitted proposals

* (Ericsson, [R1-2108164](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)[19])Proposal 26 RAN1 to clarify the definition of timing error groups as given by the text proposal.

***---------------------------------------------- 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

The clarification of the definition of timing error groups proposed in [19] seems reasonable to me. For the proposed TP, it seems no need to include the symbol .

### Proposal 2.2-1

***Make the following modifications to the definition of timing error groups:***

* ***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.*

Comments

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| **Company** | **Comments** |
| Qualcomm | We think it will be useful in the Rx TEGs to clarify: “between two TOA measurements” and not just say “DL measurements”: We observed in both RAN1 and Ran4 some misuncerstanding might exist that, Rx TEG might correspond to timing error of RSTD measurements. However, we believe that most companies in RAN1, when the above agreement was made, had in mind that Rx TEGs are associated with the “TOA”, (i.e. one Rx TEG ID for the reference TRP, and another Rx TEG ID for a target TRP). |
| OPPO | Not sure how much additional information added by this proposal. From our understanding, it is the same as the existing agreement. We can keep open on it if majority companies support to update the agreement in such way  By the way, we think QC’s clarification on TOA is reasonable (although it is a common understanding in RAN1). |
| Intel | We are supportive of the proposal, but we prefer not to spend time online rediscussing. In our view this modification, if needed, can be done by RAN4 directly. |
| **FL** | To Qualcomm’s comments: Yes. I share the same view that in our mind, “ Rx TEGs are associated with the TOA. QC’s proposal is also fine to me. However, the concern is that we have not define “TOA measurements”. How about we say: “*one or more DL time measurements”/* “*one or more UL time measurements”?*  To Intel’s comments: Yes. Let us try to see if we can rach the consensus through email discussion. I don’t think we have the chance to bring this to GTW session, given that there are so many issues that needs to be closed. |
| Ericsson | Support the proposal. |
| CATT | Support the proposal with the modifications “one or more DL time measurements”/ “one or more UL time measurements” to address Qualcomm’s concern. |
| ZTE | FL’s latest comments seems reasonable. We’re fine with the updates if majority companies think it’s necessary. |
| **FL** | Let us what for more comments to see if we can reach offline consensus. |

FL Comments

Let us to see if we can reach offline consensus through email discussion.

### (Round 2) Proposal 2.2-1

***Make the following modifications to the definition of timing error groups:***

* ***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 time measurements, which have the Rx timing errors within a certain margin, i.e. the difference in UE Rx timing error between two DL time 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 time measurements, which have the Rx timing errors within a margin, i.e. the difference in TRP Rx timing error between two UL time 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.*

Comments

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| **Company** | **Comments** |
| Nokia/NSB | We agree in principle with QC’s comments above but feel this issue is low priority. We can add an accurate description to the spec when we write it and don’t feel it is critical to spend time discussing this when the solutions are already being agreed. |
| Huawei, HiSilicon | I wonder why do we need to discuss this. Is it intended for capturing the spec, RAN1 or RAN4?  When we made the agreement on definition, we said it is not agreed to be included in the specification.  The following definitions are used for the purpose of discussion of internal timing errors (these terms are not agreed to be included in the specifications): |
| OPPO | Share the similar view as Nokia. Regarding an accurate definition for TEG, more factors may be needed, e.g., whether timing errors are smaller than the margin with a window or under some conditions ( it seems related to Proposal 3.5-1). |
| Ericsson | Support (Round 2) Proposal 2.2-1 |
| **FL** | **To Nokia’s comments:** Yes, I share the similar view that we should not spend too much time on it. But, it seems to me this is a quick fix for the definitions when I saw the proposal from Ericsson.  **To Huawei’s comments:** At the time when the agreement was made, it was unclear if TEGs would be introduced. Now that it was decided to have TEG, I assume the definitions will need to be captured somewhere in the specs. |

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

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

Background

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| **Conclusion** (RAN1#104-e):  Study the following options for mitigating TRP Tx timing errors and/or UE Rx timing errors for DL TDOA:   * Option 1:   + Support a TRP to provide the association information of DL PRS resources with Tx TEGs to LMF * Option 2:   + Support LMF to provide the association information of DL PRS resources with Tx TEGs to UE for UE-based positioning * Option 3:   + Support a TRP to provide the Tx timing errors per Tx TEG to LMF * Option 4:   + Support LMF to provide the Tx timing errors per Tx TEG of TRP to a UE for UE-based positioning * Option 5:   + Support a UE to provide the association information of RSTD measurements with UE Rx TEG(s) to LMF when the UE reports the RSTD measurements to LMF * Option 6:   + Support LMF to provide Rx timing errors per Rx TEG to a UE for UE-based positioning * Option7:   + Support a UE to provide Rx timing errors per Rx TEG to LMF for UE-assisted positioning * Option 8:   + Support a TRP to provide the Tx timing error differences between Tx TEGs of the TRP to LMF * Option 9:   + Support LMF to provide the Tx timing error differences between Tx TEGs of a TRP to a UE for UE-based positioning * Option10:   + Support a UE to provide Rx timing error differences between Rx TEGs to LMF for UE-assisted positioning * FFS: details of the ignaling, procedures, and UE capability * FFS: How the TEGs are determined by the UE or TRP (could be by implementation, i.e., no specification impact) * Note: Other options are not precluded. * Note: Depending on the discussion results, none/one/multiple of the above options may be adopted in Rel-17.   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 |

Submitted proposals

* *(ZTE,* [*R1-2106549*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106549.doc)*[2]) Proposal 2: For DL-TDOA, subject to UE’s capability, support a UE to*
  + *Measure the same DL PRS resource from a TRP with different UE Rx TEGs, and report corresponding RSTD measurements.*
    - *the TRP can be both ‘RSTD’ reference TRP and neighbour TRP*
    - *all RSTD measurements share the same timestamp*

**FL:** Further discussion in Proposal 3-1.2a. The timestamp of the measurement instances in a report can be discussed in Section 5.

* *(vivo,* [*R1-2106595*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106595.doc)*[3]) Proposal 1:* 
  + *The UE can be requested to provide the association information of RSTD measurements with UE Rx TEG(s) to LMF.*

**FL:** This seems already agreed.

* *(vivo,* [*R1-2106595*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106595.doc)*[3]) Proposal 2:* 
  + *When the UE is able to measure PRS(s) from a TRP associated with different UE Rx TEGs, support the UE to report original RSTD measurements (uncompensated measurements) and related Rx TEGs information to the LMF, rather than compensating ‘Rx timing error difference’ by UE implementation and then reporting compensated RSTD measurements to the LMF.*

**FL:** Further discussion in Proposal 3-1.2a (Proposal 3-1.4 is also related)

* *(vivo,* [*R1-2106595*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106595.doc)*[3]) Proposal 3:* 
  + *In DL-TDOA method, to eliminate the positioning error caused by the UE Rx timing errors of more than one UE Rx TEGs, the RSTD measurement report of a certain TRP for more than one UE Rx TEGs needs to be guaranteed if the UE is able to measure PRS(s) associated with different UE Rx TEGs.*
* *FFS the UE reporting rules to guarantee the RSTD measurement report for more than one UE Rx TEGs.*

**FL:** Whether to guarantee or up to UE implementation to report the number of RSTD measurements under a particular condition seems related to performance requirement and thus can be handled by RAN4 in my view.

* *(vivo,* [*R1-2106595*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106595.doc)*[3]) Proposal 4:* 
  + *In DL-TDOA method, to include different Rx TEG IDs for the same PRS resource in the DL RSTD measurement report, two options can be considered:*
    - *Option 1: Include one UE Rx TEG ID for one DL RSTD measurement.*
    - *Option 2: Include different UE Rx TEG IDs for one DL RSTD measurement, that is, associate additional UE Rx TEG ID with additional path group.*
  + *From the perspective of signallingg overhead, Option 2 is preferred.*

**FL:** Further discussion in Proposal 3-1.1

* *(Samsung,* [*R1-2106888*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106888.doc)*[5])Proposal 1: For DL-TDOA, the UE can report the association information of Rx TEGs associated with RSTD measurements to LMF (e.g., in the IE NR-DL-TDOA-SignalMeasurementInformation).*

**FL:** This seems already agreed. Which message to include the association information can be decided by RAN2.

* *(OPPO,* [*R1-2107213*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107213.doc)*[8])Proposal 2: Subject to UE capability, UE can report the following information in a DL TDOA measurement report (NR-DL-TDOA-SignalMeasurementInformation)*
  + *One Rx TEG ID for the RSTD reference TRP*
    - *It can be achieved by setting nr-RSTD and nr-RSTD-ResultDiff to be zero for the corresponding DL RSTD measurement*
  + *One Rx TEG ID for each DL RSTD measurement (NR-DL-TDOA-MeasElement)*
  + *One Rx TEG ID for each DL RSTD measurement for an additional path (NR-DL-TDOA-AdditionalMeasurementElement)*
* **FL:** Further discussion in Proposal 3-1.1. Including Rx TEG ID in NR-DL-TDOA-AdditionalMeasurementElement does not mean “one Rx TEG ID for each DL RSTD measurement for an additional path” in my view.
* *(OPPO,* [*R1-2107213*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107213.doc)*[8])Proposal 3: Rel-17 doesn’t support UE to report multiple DL RSTD measurement which are measured on the same DL PRS resource from a TRP with different UE Rx TEGs.*

**FL:** Further discussion in Proposal 3-1.2a. Most companies support reporting multiple DL RSTD measurements which are measured on the same DL PRS resource from a TRP with different UE Rx TEGs

* *(Qualcomm,* [*R1-2107345*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107345.doc)*[9]) Proposal 2: Subject to UE capability, support UE to include one UE Rx TEG ID for the RSTD reference time and one UE Rx TEG ID for each DL RSTD measurement, in a DL TDOA measurement report. The two UE Rx TEG IDs can be the same or different.* 
  + *Note: Two RSTD measurements derived on the same or different PFL can be associated with the same or different Rx TEG ID (i.e., Rx TEG IDs are defined across PFLs, and they are not PFL-specific).*

**FL:** Further discussion in Proposal 3-1.1. About the Note, while I share the same view that Rx TEGs should not be PFL-specific, my suggestion is not to add it. My consideration is that the definition of Rx TEG says clearly that the only condition for UE to determine whether two RSTD measurements belong to the same Rx TEG is based on the error margin, regardless of whether the margin is caused by the factors of time, frequency, etc. Adding the note may trigger the discussion of adding all these factors.

* *(Qualcomm,* [*R1-2107345*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107345.doc)*[9]) Proposal 3: Support to include in the location request message, a request to report multiple RSTD measurements, if available, derived on the same DL PRS resources with different UE Rx TEGs.*
  + *Up to UE implementation whether/if the UE will include in the report multiple Rx TEGs in the report for the same PRS resource.*

**FL:** Further discussion in Proposal 3-1.2a. Whether to gup to UE implementation to include in the report multiple Rx TEGs in the report for the same PRS resource may be handled by RAN4 in my view.

* *(Qualcomm,* [*R1-2107345*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107345.doc)*[9]) Proposal 5: 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:** We have the agreement to support the LMF to provide the association information of DL PRS resources with Tx TEGs to a UE for UE-based positioning. Share the similar view that RAN1 may send the LS to RAN2/3 for them to start working on the agreements made in RAN1.
* *(CMCC,* [*R1-2107403*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107403.doc)*[10])Proposal 1: Subject to UE capability, support UE to include a UE Rx TEG ID for each DL RSTD measurement in a DL TDOA measurement report.*

**FL:** Further discussion in Proposal 3-1.1

* *(CMCC,* [*R1-2107403*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107403.doc)*[10])Proposal 2: Subject to UE’s capability, support a UE to measure the same DL PRS resource from a TRP with different UE Rx TEGs, and report corresponding RSTD measurements.*

**FL:** Further discussion in Proposal 3-1.2a

* *(Intel,* [*R1-2107590*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107590.doc)*[12]) Proposal 1:*
  + *Support UE to include one UE RX TEG ID for the RSTD reference time (corresponding to the reference TRP) and one UE RX TEG ID for each DL RSTD measurement in a DL TDOA measurement report. The two UE RX TEG IDs can be the same or different.*

**FL:** Further discussion in Proposal 3-1.1

* *(InterDigital,* [*R1-2107643*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107643.doc)*[13]) Proposal 4: For UE-B positioning methods, support the UE to request the information of gNB TEG.*

**FL:** We have the agreement to support the LMF to provide the association information of DL PRS resources with Tx TEGs to a UE for UE-based positioning. Assume RAN2 will work on the details of request/response messages.

* *(Apple,* [*R1-2107740*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107740.doc)*[14]) Proposal 3: Subject to UE capability, support a UE reporting the RSTD measurements to the LMF to provide the association information of RSTD measurements with UE Rx TEG(s) for both the target and the reference TRPs to the LMF, if target and reference PRSs are associated with different RX TEG IDs*

**FL:** Further discussion in Proposal 3-1.2a

* *(MediaTek,* [*R1-2107822*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107822.doc)*[15]) Proposal 4-1: UE may indicate whether the delay difference between 2 RX TEGs is compensated at UE side for DL-RSTD reporting*

**FL:** Further discussion in Proposal 3-1.2a

* *(MediaTek,* [*R1-2107822*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107822.doc)*[15]) Proposal 4-2: If UE determines to compensate the delay difference between 2 RX TEGs for DL-RSTD measurement, then the delay difference reporting is not needed*

**FL:** Further discussion in Proposal 3-1.2a

* *(MediaTek,* [*R1-2107822*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107822.doc)*[15]) Proposal 4-4: Support UE to measure different DL PRS resources from a TRP with the same UE RX TEG, and report corresponding RSTD measurements*

**FL:** Further discussion in Proposal 3-1.2b

* *(Ericsson,* [*R1-2108164*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)*[19])Proposal 1 Support a UE to provide the association information of RSTD measurements with UE Rx TEG(s) for both the target and the reference TRP to the LMF when the UE reports the RSTD measurements to the LMF if the UE has multiple TEGs*

**FL:** Further discussion in Proposal 3-1.1

* *(Ericsson,* [*R1-2108164*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)*[19])Proposal 2 Support a UE to perform multiple RSTD measurements towards the same TRP utilizing different UE RX TEGs and to report these measurements to the LMF.*

**FL:** Further discussion in Proposal 3-1.2a

* *(Ericsson,* [*R1-2108164*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)*[19])Proposal 3 Support a UE to perform multiple RSTD measurements towards the same TRP based on different repetitions of the same DL PRS, utilizing different UE RX TEGs and to report these measurements to the LMF.*

**FL:** Further discussion in Proposal 3-1.2a. A RSTD measurement may be obtained from one or more repetitions of the same DL PRS in Rel-16.

* *(Ericsson,* [*R1-2108164*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)*[19])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.*

**FL:** Further discussion in Proposal 3-1.2a. Details of the signalling for the configuration can be handled by RAN2.

* *(Ericsson,* [*R1-2108164*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)*[19])Proposal 5 RAN1 to study further whether the UE should be capable of performing multiple RSTD measurements towards the same TRP utilizing different UE RX TEGs not only based on different repetitions of the same DL PRS but also based on a) different DL PRSs transmitted from the same TRP, b) different symbols of the same DL PRS, c) different occasions of the same DL PRS, d) different DL PRSs transmitted from the same TRP, and/or e) simultaneous reception of the same DL PRS.*

**FL:** Further discussion in Proposal 3-1.2b

## Association of UE Rx TEGs with RSTD measurements

FL comments

In RAN#105e, the association of the Rx TEG IDs with the RSTD measurements was discussed without conclusion. The last version for discussion in the previous meeting is as follows [21].

|  |
| --- |
| (RAN1#105e) Proposal 3.1-1 (Revision 4)(H)  * Subject to UE capability, support UE to include one UE Rx TEG ID for the RSTD reference time and one UE Rx TEG ID for each DL RSTD measurement in a DL TDOA measurement report. The two UE Rx TEG IDs can be the same or different. * FFS: Whether to include more than one UE Rx TEG ID for each DL RSTD measurement that including UE Rx TEG ID with each RelativeTimeDifference for the additional paths |

Based on the contributions submitted in this meeting, it seems the common view is that there should be one Rx TEG ID for the reference TRP(i.e., NR-DL-TDOA-SignalMeasurementInformation) (i.e., in *NR-DL-TDOA-MeasElement*) and one Rx TEG for each DL RSTD measurement (*NR-DL-TDOA-MeasElement* and *NR-DL-TDOA-AdditionalMeasurementElement*) (e.g., [2][3][5][6][7][8][9][10][12][14][19]). On the issue of whether to include Rx TEG ID for the RSTDs of the additional path, most companies do not think it is necessary. The consideration is that the RSTDs of the additional paths are all derived from the same CIR, and thus have the same Rx time delay. However, there are also suggestions to include Rx TEG ID for each DL RSTD measurement for an additional path (e.g., [3][8]).

NR-DL-TDOA-SignalMeasurementInformation-r16 ::= SEQUENCE {

dl-PRS-ReferenceInfo-r16 DL-PRS-ID-Info-r16,

nr-DL-TDOA-MeasList-r16 NR-DL-TDOA-MeasList-r16,

RxTEG ID for reference time

...

}

NR-DL-TDOA-MeasList-r16 ::= SEQUENCE (SIZE(1..nrMaxTRPs-r16)) OF NR-DL-TDOA-MeasElement-r16

NR-DL-TDOA-MeasElement-r16 ::= SEQUENCE {

dl-PRS-ID-r16 INTEGER (0..255),

nr-PhysCellID-r16 NR-PhysCellID-r16 OPTIONAL,

nr-CellGlobalID-r16 NCGI-r15 OPTIONAL,

nr-ARFCN-r16 ARFCN-ValueNR-r15 OPTIONAL,

nr-DL-PRS-ResourceID-r16 NR-DL-PRS-ResourceID-r16 OPTIONAL,

nr-DL-PRS-ResourceSetID-r16 NR-DL-PRS-ResourceSetID-r16 OPTIONAL,

nr-TimeStamp-r16 NR-TimeStamp-r16,

nr-RSTD-r16 CHOICE {

k0-r16 INTEGER (0..1970049),

k1-r16 INTEGER (0..985025),

k2-r16 INTEGER (0..492513),

k3-r16 INTEGER (0..246257),

k4-r16 INTEGER (0..123129),

k5-r16 INTEGER (0..61565),

...

},

RxTEG ID for each TDOA measurement

nr-AdditionalPathList-r16 NR-AdditionalPathList-r16 OPTIONAL,

nr-TimingQuality-r16 NR-TimingQuality-r16,

nr-DL-PRS-RSRP-Result-r16 INTEGER (0..126) OPTIONAL,

nr-DL-TDOA-AdditionalMeasurements-r16

NR-DL-TDOA-AdditionalMeasurements-r16 OPTIONAL,

...

}

NR-DL-TDOA-AdditionalMeasurements-r16 ::= SEQUENCE (SIZE (1..3)) OF

NR-DL-TDOA-AdditionalMeasurementElement-r16

RxTEG ID for each additional TDOA measurement

### (Closed) Proposal 3.1-1

* *Subject to UE capability, support a UE to include one UE Rx TEG ID for the RSTD reference time and one UE Rx TEG ID for each DL RSTD measurement (including each additional DL RSTD measurement), in a DL TDOA measurement report. The two UE Rx TEG IDs can be the same or different.*
* *FFS: Whether to include UE Rx TEG ID for the additional paths*

Comments

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We are supportive of the proposal, but we still think, in order to avoid future misunderstandings of what this proposal means, it would be good to clarify that the target TRP and the reference TRP can be in the same or different PFL, or can have same or different timestamp. If this is common understanding for everyone, we are OK to keep it as a note, but it is good to do keep discussion clear. |
| Huawei, HiSilicon | We are in general fine with this, since this was left-over from the last meeting. |
| Apple | Support |
| CATT | Support. Regarding the FFS, we don’t think it is necessary to include UE Rx TEG ID for the additional pahts based on the reasons mentioned by FL. |
| **vivo** | We are supportive of the proposal, but in order to avoid misunderstandings that a new parameter” the RSTD reference time” need to be introduced, it would be good to clarify that RSTD reference time can be the corresponding DL RSTD measurement that nr-RSTD and nr-RSTD-ResultDiff to be zero.  Therefore, we propose to change the proposal to Proposal 3.1-1 (H)  * *Subject to UE capability, support a UE to include one UE Rx TEG ID for the RSTD reference time and one UE Rx TEG ID for each DL RSTD measurement (including each additional DL RSTD measurement), in a DL TDOA measurement report. The two UE Rx TEG IDs can be the same or different.* * *FFS: Whether to include UE Rx TEG ID for the additional paths*   *Note: RSTD reference time can be the corresponding DL RSTD measurement that nr-RSTD and nr-RSTD-ResultDiff to be zero.*  In addition, just to clarify our understanding regarding **‘***include UE Rx TEG ID for the additional paths***’** in our paper**.**  We are not to associate Rx TEG with additional path, but to associate Rx TEG with same level IE of additional path list. The paths in a path list/group are measured based on the same PRS resource with the same Rx TEG (e.g. Rx panel) and derived based on same CIR.  For the case where UE measures one PRS resource with different Rx TEG, the report overhead can be reduced, since the duplicate bit overhead such as TRP/PRS resource set/PRS resource ID, time stamp etc. for the same PRS resource is saved.  An example for ‘associate Rx TEG with same level IE of additional path list’ is below.   |  | | --- | | NR-DL-TDOA-MeasElement-r16 ::= SEQUENCE {  dl-PRS-ID-r16 INTEGER (0..255),  nr-PhysCellID-r16 NR-PhysCellID-r16 OPTIONAL,  nr-CellGlobalID-r16 NCGI-r15 OPTIONAL,  nr-ARFCN-r16 ARFCN-ValueNR-r15 OPTIONAL,  nr-DL-PRS-ResourceID-r16 NR-DL-PRS-ResourceID-r16 OPTIONAL,  nr-DL-PRS-ResourceSetID-r16 NR-DL-PRS-ResourceSetID-r16 OPTIONAL,  nr-TimeStamp-r16 NR-TimeStamp-r16,  nr-RSTD-r16 CHOICE {  k0-r16 INTEGER (0..1970049),  k1-r16 INTEGER (0..985025),  k2-r16 INTEGER (0..492513),  k3-r16 INTEGER (0..246257),  k4-r16 INTEGER (0..123129),  k5-r16 INTEGER (0..61565),  ...  },  nr-RxTEGID NR-RxTEGID OPTIONAL  nr-AdditionalPathList-r16 NR-AdditionalPathList-r16 OPTIONAL,  nr-AdditionalRxTegMeasurementList NR-AdditionalRxTegMeasurement OPTIONAL  nr-TimingQuality-r16 NR-TimingQuality-r16,  nr-DL-PRS-RSRP-Result-r16 INTEGER (0..126) OPTIONAL,  nr-DL-TDOA-AdditionalMeasurements-r16  NR-DL-TDOA-AdditionalMeasurements-r16 OPTIONAL,  ...  }  NR-AdditionalRxTegMeasurementList -r17 ::= SEQUENCE {  nr-RxTEGID NR-RxTEGID OPTIONAL  NR-AdditionalPathList-r16 SEQUENCE (SIZE(1..3)) OF NR-AdditionalPath-r16  ...  } | |
| OPPO | We are fine with the proposal. |
| CMCC | We are general fine with the proposal, with one further comment. In the last meeting, some companies raised the point which was also the common understanding among most companies that, the DL measurement from the reference TRP is also carried in the DL-TDOA-MeasElement list, of which the value equals zero. In this sense, the UE Rx TEG ID of the reference time is either reported under the first highlight part shown in the above IE, or under the second highlight part, and will not be reported redundently, am I understanding correctly? |
| ZTE | Support. We should remove FFS since additional paths and TOA are from the same delay profile. Therefore, additional paths and TOA should of course be associated with the same TEG. |
| LG | We generally agree with the motivation of the proposal. But, before we discuss it, we think some clarification is needed first. We want to clarify whether the single PRS resource can be associated with multiple Rx TEG IDs or not?. If it is right, we have to consider how LMF can distinguish the specific Rx TEG which has a larger margin of error than the other Rx TEG that has a smaller margin of error. For example, UE has two Rx TEGs that are associated with a single PRS resource. And then, the one has larger values of margin of error than the other. There are some ambiguity problems when LMF receives the Rx TEG ID since the Rx TEG ID with larger value of error already covers the smaller value of error. |

Agreement:

* Subject to UE capability, support a UE to include one UE Rx TEG ID for the RSTD reference time and one UE Rx TEG ID for each DL RSTD measurement (including each additional DL RSTD measurement), in a DL TDOA measurement report. These UE Rx TEG IDs can be the same or different.
* Note: RSTD reference time is related to the DL\_PRS\_Reference\_Info IE

## RSTD measurement enhancements

FL Comments

|  |
| --- |
| (RAN1#105e) Proposal 3.1-3 (Revision 4)(H)  * Subject to UE’s capability, support a UE to   + **measure *the same* DL PRS resource from a TRP *with different UE Rx TEGs*, and report corresponding RSTD measurements.**   + measure different DL PRS resources from a TRP with the same UE RX TEG, and report corresponding RSTD measurements.   + measure *different* DL PRS resources from a TRP *with different UE Rx TEGs*, and report corresponding RSTD measurements.   + FFS: indicate whether the measured RX TEG timing error difference has been compensated at UE side. * Note: All RSTD measurements are relative to a single reference timing * FFS: Whether the TRP can be both “RSTD” reference TRP and neighbor TRP * FFS: details of the Signaling, procedures, and UE capability |

In RAN#105e, the proposal of UE measuring the same or different DL PRS resources from a TRP with the same or different UE Rx TEGs to obtain RSTD measurements was discussed without conclusion [21]. In this meeting, multiple companies propose to support measuring the same DL PRS resource from a TRP with different UE Rx TEGs, and report corresponding RSTD measurements (e.g., [2][3][5][9][10][15][19]). However, one company proposes not to support it [8]. The main purpose of measuring the same DL PRS resource from a TRP with different UE Rx TEGs is to obtain information of time difference of the different UE Rx TEGs. Some companies also propose to support measuring different DL PRS resources from a TRP with the same UE Rx TEGs, and report corresponding RSTD measurements (e.g., [15][19]), which may potentially allow the LMF to obtain the time difference of the different TRP Tx TEGs.UE reporting rule (e.g., whether UE should guarantee the RSTD measurements for more than one UE Rx TEGs or up to UE implementation to provide the RSTD measurements for more than one UE Rx TEGs) can be decided by RAN4 in my view.

Proposal 3.1-2a (H)

* *Subject to UE capability, support LMF to* ***request*** *a UE to measure and report multiple RSTD measurements from* ***the same*** *DL PRS resource of a TRP with* ***different*** *UE Rx TEGs.*
* *Support one [or both] of the following options for the reporting of the RSTD measurements:*
  + *Option 1: RSTD measurements are reported without compensation of the timing error difference between Rx TEGs*
  + *Option 2: RSTD measurements are reported with an indication that the timing difference between the TEGs are compensated.*
* *FFS: Whether the TRP can be both “RSTD” reference TRP and neighbor TRP*
* *FFS: details of the signalling, procedures, and UE capability*
* *Note: All RSTD measurements are relative to a single reference timing*

Comments

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | In our views, if UE has at least 2 RX TEGs, UE can actually measure a same DL PRS resource of a TRP with different RX TEGs, making them loke a single TEG. And this TRP could be set as reference TRP by UE. So, UE can perform the **measurement** but doesn't need to **report** it.  For the 2 options listed by FL, we think it can also be done during UE capability reporting. So, to FL, before having agreement on this proposal , we would like to clarify the UE capability. Whether the UE capability supports the following cases  1, UE reports itself to have single RX TEG. Then UE doesn't need to do such measurement and reporting  2, UE reports itself to have multiple RX TEGs. UE will do on-the-fly measurement to fill the difference between RX TEGs to make them like a single RX TEG  3, UE reports itself to have multiple RX TEGs. UE will do on-the-fly measurement for the difference between RX TEGs, and UE expects LMF to deal with the DL-RSTD measurement related to multiple RX TEGs  Or when doing the capability reporting, for the above 2), UE simply reports single RX TEG who will do on-the-fly measurement to fill the difference between RX TEGs to make them like a single RX TEG  Either way is fine for us for the case of performing the measurement without reporting for mitigating RX TEG difference. But we think we need consensus/agreement here |
| Qualcomm | We are supportive of the first bullet, but we do think that It will be useful to acknowledge that a UE will “optionally” report, even if it supports this feature (similar to RSRP reporting), that is change the firs bullet to:   * *Subject to UE capability, support LMF to* ***request*** *a UE to measure and optionally report multiple RSTD measurements from* ***the same*** *DL PRS resource of a TRP with* ***different*** *UE Rx TEGs.*   To explain the reasoning: Even though we acknowledge that most (if not all) positioning reports are optional, if the UE gets a request to measure the same PRS resource with multiple Rx TEGs, it may mean that the UE might have to do measurements with 2 panels simultaneously (or more antennas than what it was initially planning to do). That UE might not be capable of doing simultaneous processing/reception from both Rx TEGs, or might have other constraints that don’t allow the UE to do measurements from multiple Rx TEGs concurrently. Therefore, the measurement period might increase, or the UE might not be able to do the reporting.  We also think that RAN4 will need to know about this agreement:   * Up to RAN4 to study further any measurement requirements may be needed for this feature   We don’t really understand the 2nd bullet, and how it is related to the first bullet. It seems to us a UE capability disucsion or a separate topic. |
| Huawei, HiSilicon | Regarding the reporting options, we do not see the need to explicitly mention whether it is compsenstated. How could LMF utilize such information? |
| Apple | We share similar view as QC. In addition, the request for report subject to UE capability may be endorsed by UE “optionally, for UE assisted positioning, if UE indicates to have more than 2 RX TEG.” |
| CATT | Support the first bullet and both the two Options.  For the UE measure multiple RSTD measurements from the same DL PRS resource of a TRP with different UE Rx TEGs, UE may or may not compensate the timing error difference between the Rx TEGs. About the reason why UE cannot compensate it, it is because UE is lack of enough information(such as TRP location information), the UE may not finish accurate Rx timing error difference estimation. Therefore, in this case, UE can report the RSTD measurements without compensation of the timing error difference between Rx TEGs. |
| **vivo** | We prefer to discuss 1st bullet and 2nd bullet separately  Support the first bullet firstly.  For the 2nd bullet, we would like to understand whether the TEGs error can be seen as zero if an indication of TEGs are compensated is reported. If it is, RAN4 can guarantee this? If not, which may introduce new errors caused by unreasonable Rx timing error difference estimation after compensation in RSTD measurements. In addition, according to the evaluation result in our contribution, the performance of Rx timing error difference estimated and compensated by the LMF is better than the performance of Rx timing error difference estimated and compensated by the UE. |
| OPPO | In our understanding, this feature is not very usefull based on the following reasons:  1. there are less chance for a UE to measure the same PRS with different Rx TEGs with satisfied quality, especially considering that different panels of a UE are targeting different directions. In other words, it is likely that UE cannot report the measurement with different Rx TEGs  2. UE can companensate the difference itself and no need to report additional reporting.  The counterpart proposal of gNB to measure the same SRS resource with multiple Rx TEGs should also be considered together. |
| CMCC | Support the 1st main bullet.  Regarding the two options of the 2nd bullet, we think that it is either up to UE capability, or up to UE implementation, and we don’t see the benefits of the two options. |
| ZTE | * For the first bullet, we don’t need the request from LMF. If UE has such capability, it’s up to UE to decide whether to report measurements from multiple RX TEGs based on the same DL PRS. * We should assume that different UE Rx TEGs receive the same DL PRS simultaneously. Therefore, we would like to add another FFS: The multiple RSTD measurements share the same time stamp * Regarding the two options, it relies on whether UE has the capability to compensate locally so that only one TEG is assumed. We should confirm with RAN4 on the feasibility before any progress made by RAN1. |
| LG | * From our perspective, we are not sure the benetifs of supporting the proposal by restricting UE’s behaviour.. |
| Intel | We are OK with the first subbulet. Prefer to discuss separately the second subbulet. |
| InterDigital | We support the proposal.  For the first bullet, requesting the UE to use different Rx TEGs in one DL PRS resources can help the network aware of the TEG differences among Rx TEGs.  For the second bullet, two options should be supported. Option 1 can be used for the UE without Rx TEG compensation capability and Option 2 can be used otherwise. |
| Ericsson | We are supportive of the proposal except for the second bullet.  In particular, we are not supportive of Option 2 in the second subbullet. In fact, if the UE compensates for the measured timing error differences, then the reported RSTD measurements towards the same TRP using different UE Rx TEGs will be identical and thus redundant. Such a case effectively corresponds to a single UE Rx TEG.  The first bullet in the proposal allows for full mitigation of UE Rx-Tx timing errors as shown e.g. in section 2.2 in R1- 2108164 or in the figure below and is thus of top priority.  Chart  Description automatically generated  @ZTE: We think the part with ‘LMF to request’ is important to keep. This way, the UE that has this capability gets the particular request from the LMF to perform measurement of the same DL PRS resource with different UE Rx TEGs. |
| NTT DOCOMO | We are supportive of the 1st bullet. Regarding 2nd bullet, it can be handled in UE capability discussion. |
| ZTE2 | @Ericsson, We think we should allow more flexibility for UE decide whether to switch on or off more than one TEG for a single DL PRS resource measurement without mandatory request from LMF. |
| **FL** | Based on the comments, it seems most of the companies are supportive to the 1st bullet, except OPPO.  For the 2nd bullet, I assume there can be at least three different scenarios, as MTK lists. I assume the scenario that the UE simply reports what it has measured without internal compensations is in the mind of most companies for supporting 1st bullet. In this case, one way forward is simply list the reporting for other two scenarios as FFS.  To Qualcomm’s comments: It is unclear to me why there is a need to add “Optionally”. It seems “*optionally” is redundant.* If “*UE might not be capable of doing simultaneous processing/reception from both Rx TEGs, or might have other constraints that don’t allow the UE to do measurements from multiple Rx TEGs concurrently”,* then UE should not claim it has the capability to support it. In this case, the LMF will not make such request.  To Apple’s comments: Maybe we can add “for UE-assisted DL-TDOA” to address the concern.  For OPPO’s comments: I assume whether “ UE to measure the same PRS with different Rx TEGs with satisfied quality” is highly scenario dependent. It will be up to LMF on how to use the information. For UE that can companensate the difference itself, I assume the UE can simply let LMF know it does not support the capability.  I don’t see any comments on the “• FFS: Whether the TRP can be both “RSTD” reference TRP and neighbor TRP”. About the counterpart proposal of gNB to measure the same SRS resource with multiple Rx TEGs, I assume we can add it in once we have the agreement in UE side.  Also, it seems we may need to have a consideration on how many ***different*** *UE Rx TEGs* is supported by the UE to make the measurement. It should also be related to UE capability in my view. |

* *Subject to UE capability, support a LMF to* ***request*** *a UE to measure* ***different*** *DL PRS resources from a TRP with* ***the same*** *UE Rx TEG, and report corresponding RSTD measurements*

(Round 2) Proposal 3.1-2a (H)

* *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 without the compensation of the timing error difference between the Rx TEGs.*
  + *FFS: N=[2, 3, 4], the value N depends on UE capability.*
  + *FFS: whether to support reporting the corresponding multiple RSTD measurements after the compensation of the timing error difference between the Rx TEGs.*
* *Note: The TRP can be either a “RSTD” reference TRP or a neighbor TRP*
* *FFS: details of the signalling, procedures, and UE capability*
* *Note: All RSTD measurements are relative to a single reference timing*

Comments

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia/NSB | We support the main bullet. We think we can just remove the 2nd FFS. |
| Qualcomm | We support the main bullet but some comments so that our reasoning is clear:   * Why we think keeping the word “optionally” is important:   + To FL’s comment: If “*UE might not be capable of doing simultaneous processing/reception from both Rx TEGs, or might have other constraints that don’t allow the UE to do measurements from multiple Rx TEGs concurrently”,* then UE should not claim it has the capability to support it. In this case, the LMF will not make such request.   + Capabilities are reported relatively statically, even though they can change, they cannot be reported in a dynamic fashion. A UE may turn on/off panels, antennas, repurpose antennas for other technologies, in a dynamic fashion, which are basic functionalities already existing. It is rather unfortunate to think that, when this request is received, a UE must keep both panels ON, or antennas, no matter what, in order to satisfy this secondary information reporting; it should be understood that these are secondary optimization features, and are more best-effort features. As is the case of RSRP reporting for TDOA/MRTT: The UE reports capability, and the LMF may receive a request, but the UE may not report RSRP at all.   + Also, if the UE is requested to measure with multiple Rx TEGs, the UE may NOT be able to do those measurements simultaneously, so the UE would take double the time (assuming 2 TEGs), and we don’t know whether RAN4 will adjust the measurement period accordingly (these discussions have not started yet). So overall, the word “optionally” is key here for us, and should be kept in the proposal. * I still don’t understand what the “*FFS: whether to support reporting the corresponding multiple RSTD measurements after the compensation of the timing error difference between the Rx TEGs.”* We prefer to remove it. * With regards to the “*Note: The TRP can be either a “RSTD” reference TRP or a neighbor TRP*”   + We preferred the previous “whether” option. We could finalize it next meeting. |
| Huawei, HiSilicon | Same view as Nokia and QC on removing the second FFS.   * + *FFS: whether to support reporting the corresponding multiple RSTD measurements after the compensation of the timing error difference between the Rx TEGs.* |
| vivo | Support the main bullet, and we also think the second FFS is not needed.  We discuss ‘the second FFS’ for many times, and companies state that it is difficult to guarantee accuracy by UE compensating. In addition, evaluations show that the performance of Rx timing error difference estimated and compensated by the LMF is better than the performance of Rx timing error difference estimated and compensated by the UE. |
| ZTE | We’re generally fine with this proposal.   * ZTE’s comment in first round was not addressed. We should assume that different UE Rx TEGs receive the same DL PRS simultaneously, we would like to add another FFS,   *FFS: The multiple RSTD measurements share the same time stamp* |
| OPPO | We are fine with the main bullet. We also share the simiar view as other companies that the second FFS should be removed  Moreover, we should agree the counterpart for NW together the proposal, e.g.,   * *support the LMF to* ***request*** *a TRP to* ***optionally*** *measure* ***the same*** *SRS resource for positioning of a UE with N* ***different*** *TRP Rx TEGs and report the corresponding multiple RSTD measurements without the compensation of the timing error difference between the Rx TEGs.*   + *FFS: details* |
| LG | We try to understand the intention of the proposal. In this perspective, we have a question to make sure that our understanding is right. In our understanding, the proposal assumes that UE can measure single PRS resource with different Rx TEG at the same time and UE can report each measurements in the single measurement report. If is is right, we are okay with the proposal. |
| Intel | Support main bullet. The second FFS is not needed. |
| CATT | We Support the proposal and we are also fine with the proposal if without the second FFS. |
| FL | Based on the feedback, it seems all companies are supportive to the main bullet; most, if not all, are fine to remove the 2nd “FFS”.  Qualcomm’s want to keep: FFS for whether TRP can be either a “RSTD” reference TRP or a neighbor;  ZTE wants to add :FFS: The multiple RSTD measurements share the same time stamp”  OPPO suggests to add the corresponding one for TRP (Round 2) Proposal 3.1-2a (H)  * *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 without the compensation of the timing error difference between the Rx TEGs.*   + *FFS: N=[2, 3, 4], the value N depends on UE capability.*   + *~~FFS: whether to support reporting the corresponding multiple RSTD measurements after the compensation of the timing error difference between the Rx TEGs.~~*   *FFS:: whether the TRP can be either a “RSTD” reference TRP or a neighbor TRP*   * + *FFS: details of the signalling, procedures, and UE capability*   + *FFS: The multiple RSTD measurements 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 N* ***different*** *TRP Rx TEGs and report the corresponding multiple RTOA measurements without the compensation of the timing error difference between the Rx TEGs.*   + *FFS: details of the signalling, procedures, and UE capability* |

### (Closed) Proposal 3.1-2a (H)

* *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 ~~without the compensation of the timing error difference between the Rx TEGs.~~*
  + *FFS: N=[2, 3, 4], the value N depends on UE capability.*
  + *FFS: whether the TRP can be either a “RSTD” reference TRP or a neighbor TRP*
  + *FFS: details of the signalling, procedures, and UE capability*
  + *FFS: The multiple RSTD measurements 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 ~~without the compensation of the timing error difference between the Rx TEGs~~.*
  + *FFS: M=[2, 3, 4]*
  + *FFS: details of the signalling, procedures, and UE capability*

Comments

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| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Sorry, seems our comment was not clear: Anything related to “compensation” does not seem to be needed to be included. If the UE can successfully and fully compensates the measurements, these measurements are exactly the same, why would it report multiple? A UE may still try to compensate, but it may not be fully accurate, so it will report different measurements.   * *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 ~~without the compensation of the timing error difference between the Rx TEGs~~.*   + *FFS: N=[2, 3, 4], the value N depends on UE capability.*   + *FFS:: whether the TRP can be either a “RSTD” reference TRP or a neighbor TRP*   + *FFS: details of the signalling, procedures, and UE capability*   + *FFS: The multiple RSTD measurements share the same time stamp*   + *Note: All RSTD measurements are relative to a single reference timing* |
| CATT | Support.  For Qualcomm’s comments, we are also fine with don’t mention the wording of “without the compensation of the timing error difference between the Rx TEGs”, and left it for UE implementation. |
| Apple | First, we share exactly same view on removing “compensation”. I think the purpose of this proposal is to give an idea to LMF about the “delta” of different RX TEGs at UE. To achieve that (example for 2 RX TEGs): all the other players within the two RSTDs should be fixed, i.e. RX TEG on reference PRS is unchanged within RSTD1 & RSTD2. In our view, different RX TEGs over a single PRS is made on different time occasions, but it seems we are not all on the same page. |
|  |  |

Proposal 3.1-2b

* *Subject to UE capability, support a LMF to* ***request*** *a UE to measure* ***different*** *DL PRS resources from a TRP with* ***the same*** *UE Rx TEG, and report corresponding RSTD measurements*
* *FFS: Whether the TRP can be both “RSTD” reference TRP and neighbor TRP*
* *FFS: details of the Signaling, procedures, and UE capability*
* *Note: All RSTD measurements are relative to a single reference timing*

Comments

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | This reporting is more important than 3.1-2a, because this reporting may help to mitigate the TRP-specific impairment  3.1-2a is UE-specific impairment. UE can actually fix it through on-the-fly measurement. So the reporting is less critical than 3.1-2b |
| Qualcomm | We are OK to add this in 3.1-2a together. Also, we think the clarification that “and optionally report” will be useful to avoid any misunderstandings. |
| OPPO | Share the same view as MTK |
| **InterDigital** | We support the proposal. This feature is essential to allow the network to aware of its Tx TEGs. |
| Ericsson | We think this proposal follows from 3.1-2a and thus is superfluous. Possibly one could modify the wording in proposal 3.1-2a in the following way to make it more clear   * *Subject to UE capability, support LMF to* ***request*** *a UE to measure and report multiple RSTD measurements from* ***the same*** *DL PRS resource of a TRP with* ***~~different~~ all*** *UE Rx TEGs.*   Note that the UE will not always succeed in doing measurements with all TEGs due to signalstrength, noise and interference or inappropriately configured DL PRS. However, under conditions to be specified by RAN4, the UE will succeed**.** |
| CATT | Support. We think UE measures different DL PRS resources from a TRP with the same UE Rx TEG can let LMF to obtain the time difference of the different TRP Tx TEGs associated with mentioned different DL PRS resources from the TRP, then calibrate the Tx TEGs in TRP side. |
| ZTE | We think this proposal is whatever supported if Rel-17 supports the feature of TEG. Maybe what we need to discuss is to extend the maximum number of DL RSTD per pair of TRPs so that UE can report DL RSTD as many as possible. |
| FL | It seems many companies consider the proposal is, at least, as important as at least Proposal 3.1-2a. Thus, I would change its priority to high.  For Ericsson’s proposal: The “***~~different~~ all*** *UE Rx TEGs”* may have very significant impact on UE side. For example, if the UE has to use all 4 Rx TEGx.DL PRS. However, under conditions to be specified by RAN4, the UE will succeed**. How about we change it “N” Rx TEGs, where N is UE’s capability.** |

### (Round 2) Proposal 3.1-2b

* *Subject to UE capability, support a LMF to* ***request*** *a UE to* ***optionally*** *measure* ***different*** *DL PRS resources from a TRP with* ***the same*** *UE Rx TEG, and report the corresponding RSTD measurements*
* *Note: The TRP can be either a “RSTD” reference TRP or a neighbor TRP*
* *FFS: details of the Signaling, procedures, and UE capability*
* *Note: All RSTD measurements are relative to a single reference timing*

Comments

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia/NSB | Don’t feel this proposal is needed. Should be up to the UE. |
| Qualcomm | We could accept to have this request from LMF; UE could try to accommodate it, but clearly it may not be possible, so it will eventually be up to the UE.   * Again, the “*Note: The TRP can be either a “RSTD” reference TRP or a neighbor TRP*“, we would prefer to keep it “Whether” for now and come back next meeting. |
| Huawei, HiSilicon | We do not think this request, if explicity, is necessary, since this should be default request type. |
| vivo | We also have some concerns about this proposal.  Based on the feature of TEG, without any request, it is natural for UE to measure different DL PRS resources from a TRP with the same UE Rx TEG.  In addition, based on current wording, if UE receives such a request, whether the UE is required to use only 1 Rx TEG to receive PRS resources as much as possible? If it is, the UE behavior is greatly restricted.  Besides, we believe the motivation is to mitigate TRP Tx timing error difference. However, the UE has no information of TRP Tx TEG.  Unless the TRP Tx TEG information is transmitted to the UE, otherwise it is difficult to require UE to measure suitable DL PRS resources (PRS resources from different TRP Tx TEG) with the same UE Rx TEG. |
| ZTE | Not necessary to have this proposal. Repeat our comments in last round:  *We think this proposal is whatever supported if Rel-17 supports the feature of TEG. Maybe what we need to discuss is to extend the maximum number of DL RSTD per pair of TRPs so that UE can report DL RSTD as many as possible.* |
| OPPO | Thanks for the discussion. We tend to agree that as the default behavior, UE usually tries to use a Rx TEG to receive different DL PRS |
| LG | We also think the proposal is not necessary. |
| Intel | Support the proposal. |
| CATT | We are fine with this proposal. |
| **FL** | Based on the feedback, at least 5 companies either do not support it , or have concerns on it. Thus, suggest lowering the priority for further email discussion. |

## Parameters related to the maximum numbers

Submitted proposals

* *ZTE,* [*R1-2106549*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106549.doc)*[2]) Proposal 3: For DL-TDOA, increase the maximum number of measured and reported RSTD measurements per TRP pair, e.g. 8.*
* *(Qualcomm,* [*R1-2107345*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107345.doc)*[9]) Proposal 4: 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.*

FL Comments

Currently, the maximum number of measured and reported RSTD measurements per TRP pair is 4. It seems we may at least increase it to 8 if **measuring *the same* DL PRS resource from a TRP *with different UE Rx TEGs is agreed.***

In addition to the the maximum number of RxTEGs, proposed in [9], we will also need to decide the maximum numbers of UE/TRP Rx/Tx/RxTx TEGs for DL-TDOA, UL-TDOA and DL+UL, and consider to support UE capabilities on the maximum number of Rx TEGs/Tx TEGs/RxTx TEGs the UE can support.

### Proposal 3.1-3

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

Comments

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| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We suggest to agree first on the maximum number of Rx-TEGs, before discussing the maximum number of RSTDs (since this will come naturally as an outcome of a few agreements). |
| OPPO | Prefer to discuss all TEGs together, e.g., Tx TEG at UE side, Rx TEGs at UE side, Tx TEG at gNB side, Rx TEGs at gNB side, and TxRx TEG if agreeded. In this way, we can have a cleaer whole picture on this feture |
| CATT | Support. It will benefit the mitigation and calibration of timing errors if the maximum number of reported RSTD measurements per TRP pair is extended from 4 to a larger number, considering the requirements from Proposal 3.1-2a and Proposal 3.1-2b. |
| ZTE | Although we think it’s necessary to discuss these issues, we should de-prioritize over other important issues since it’s more like UE capability discussion. |
| **FL** | Let us wait for the comments from other companies to see if we want to continue the discussion in this meeting or until the next meeting. |
| Nokia/NSB | The maximum number could be per Rx-TEG and otherwise we don’t need to increase the number. |
| LG | We think that the maximum nuber of RSTD measuremnets can vary depending the maximum neber of RxTEG. For our view, if we suppose the maximum number of RX TEGs is M, we think that the maximum number of reported RSTD measurements per TRP needs to be extended for 4 by M since curruent ‘4’ is based on single Rx TEG assumption. |

## Timing reference for RSTD measurement

Submitted Proposals

* *(Samsung,* [*R1-2106888*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106888.doc)*[5])Proposal 2: For the indication of TEG in DL-TDOA method, one single reference TEG plus the TEG differences (in case of multiple different TEGs) can be considered.*
* *(MediaTek,* [*R1-2107822*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107822.doc)*[15]) Proposal 4-5: The definition of DL-RSTD measurement could be further extended for different types. The concept of “reference” could still be applied, but not limited to “reference TRP”. We may define the reference RX TEG, and the reference DL-PRS resource within a same TRP*

FL Comments

About the proposal in [5] to consider “*one single reference TEG plus the TEG differences (in case of multiple different TEGs*)”, it is unclear to me how it work, since the UE/gNB may not know the time difference between TEGs.

About the proposal in [15] to extend the concept of RSTD “reference” beyond reference TRP”, e.g., including reference RX TEG, and the reference DL-PRS resource within the same TRP, we may further discuss if it is necessary.

### (Closed) Proposal 3.1-4

* *The definition of DL-RSTD measurement could be further extended for different types. The concept of “reference” could still be applied, but not limited to “reference TRP”. We may define the reference RX TEG, and the reference DL-PRS resource withithe a same TRP*

Comments

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We do not support the current formulation. It should be clear that there should be only one reference time for each DL TDOA measurement report. That unique reference time can be associated with one unique reference TRP, one unique reference RX TEG and one unique reference DL-PRS resource. |
| ZTE | We think all DL RSTD measurements should be relative to the same reference timing. Meanwhile, we should allow UE to report multiple RSTD values (i.e. not limited to zero value) for “RSTD” reference TRP. |
| **FL** | It seems it is lack of the support for the proppsal. Suggest further email discussion. |
| Nokia/NSB | Unclear. Low priority. |
| **FL** | It seems no supporter for the proposal. Suggest closing the discussion. |

## 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.

|  |
| --- |
| Conclusion (RAN1#104e):  Study the following option(s) for mitigating UE Tx and TRP Rx timing errors for UL TDOA:   * Option 1:   + Support a TRP to provide the association information of RTOA measurements with Rx TEGs to LMF when the TRP reports the RTOA measurements * Option 2:   + Support a UE to provide the association information of SRS resources for positioning with UE Tx TEG(s) to LMF for UL TDOA positioning. * Option 3:   + Support a UE to provide Tx timing errors per Tx TEG to LMF for UL TDOA positioning. * Option 4:   + Support a UE to provide Tx timing error differences between Tx TEGs to LMF for UL TDOA positioning. * FFS: the details of the ignaling, procedures, and UE capability * FFS: How the TEGs are determined by the UE or TRP (could be by implementation, i.e., no specification impact) * Note: Other options are not precluded. * Note: Depending on the discussion results, none/one/multiple of the above options may be adopted in Rel-17.   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   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 |

Submitted Proposals and FL comments

* *(Huawei,* [*R1-2106449*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106449.doc)*[1])Proposal 2: Support UE to provide the SRS-TEG association to gNB and gNB forward the association to LMF if the association is static.*
  + *The RRC message can be RRCReconfigurationComplete.*

**FL:** Further discussion in Proposal 3-2.1. Which RRC message to use may be decided by RAN2.

* *(Huawei,* [*R1-2106449*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106449.doc)*[1])Proposal 3: Support UE to provide the SRS-TEG association directly to LMF per LMF request if the association is dynamic.*
  + *In this case, UE should indicate to gNB that the SRS-TEG association can be dynamic in the RRCReconfigurationComplete message.*

**FL:** Further discussion in Proposal 3-2.1. May need further discussion of the benefits of defining static and dynamic SRS-TEG association.

* *(ZTE,* [*R1-2106549*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106549.doc)*[2]) Proposal 1: For mitigating UE Tx timing errors for UL TDOA, support option 2, i.e., UE sends the association relationship firstly to the serving gNB, then serving gNB forwards it to LMF.*

**FL:** Further discussion in Proposal 3-2.1.

* *(vivo,* [*R1-2106595*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106595.doc)*[3]) Proposal 5:* 
  + *The UE can be requested to provide the association information of SRS resources for positioning with UE Tx TEG(s) to LMF when the UE supports more than 1 UE Tx TEG.*

**FL:** Further discussion in Proposal 3-2.1.

* *(vivo,* [*R1-2106595*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106595.doc)*[3]) Proposal 6:* 
  + *Support the UE to directly provide the association information of SRS resources for positioning with UE Tx TEG(s) to LMF via LPP message.*
  + *Note: The way the UE provides Tx TEG association information to the LMF should be consistent with the way the LMF requests UE Tx TEG association information.*

**FL:** Further discussion in Proposal 3-2.1.

* *(vivo,* [*R1-2106595*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106595.doc)*[3]) Proposal 8:* 
  + *Support LMF to forward the UE Tx TEG information associated with SRS resource(s) provided by the UE to the serving and neighboring gNBs.*

**FL:** Further discussion in Proposal 3-2.1.

* (Sony, [R1-2106809](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106809.doc)[4])Proposal 1: For UL positioning, support UE to send association information directly to LMF.

**FL:** Further discussion in Proposal 3-2.1.

* *(Samsung,* [*R1-2106888*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106888.doc)*[5])Proposal 3: The association information of UL SRS resources for positioning with Tx TEGs is sent directly from UE to LMF.*

**FL:** Further discussion in Proposal 3-2.1.

* *(CATT,* [*R1-2106971*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106971.doc)*[6])Proposal 1: For mitigating UE Tx timing errors for UL TDOA, support the following option1:* 
  + *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.*

**FL:** Further discussion in Proposal 3-2.1.

* *(CATT,* [*R1-2106971*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106971.doc)*[6])Proposal 2: Don’t 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.*

**FL:** Further discussion in Proposal 3-2.1.

* *(Nokia, R1- 2107057[7]) Proposal 8: Support option 2 from the prior agreement: UE reports Tx TEG IDs to the serving gNB and the serving gNB forwards to the LMF.*

**FL:** Further discussion in Proposal 3-2.1.

* *(OPPO,* [*R1-2107213*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107213.doc)*[8])Proposal 7: Rel-17 supports TRP/gNB to report a Rx TEG ID for each UL TROA measurement result.*

**FL:** It seems to me that the proposal is already covered by the previous agreement from RAN1’s perspective. How to associate Rx TEG ID for each UL TROA measurement result in NRPPa can be handled by RAN3

* *(OPPO,* [*R1-2107213*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107213.doc)*[8])Proposal 5: 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*

**FL:** Further discussion in Proposal 3-2.1.

* *(OPPO,* [*R1-2107213*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107213.doc)*[8])Proposal 6:* *R17 doesn’t support LMF to forward the association Tx TEG information of a UE from the serving gNB to the neighboring gNBs*

**FL:** Further discussion in Proposal 3-2.1.

* *(Qualcomm,* [*R1-2107345*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107345.doc)*[9]) Proposal 6: Support TxTEG-to-SRS association reporting as part of the LPP signaling framework (Option 1 in previous agreement).* 
  + *The reporting of the association is happening after the SRS is transmitted, together with an UL timestamp, and an associated UL Timing Error margin.*

**FL:** Further discussion in Proposal 3-2.1.

* *(CMCC,* [*R1-2107403*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107403.doc)*[10])Proposal 4: For mitigating UE Tx timing errors for UL TDOA, 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.*

**FL:** Further discussion in Proposal 3-2.1.

* *(LG,* [*R1-2107542*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107542.doc)*[11]) Proposal #1:* 
  + For providing association information related with UE Tx TEG, UE needs to provide gNB with the information first.

**FL:** Further discussion in Proposal 3-2.1.

* *(Intel,* [*R1-2107590*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107590.doc)*[12])* Proposal 2:
  + Support a UE providing the association information of the UL SRS resources for positioning with the 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.

**FL:** Further discussion in Proposal 3-2.1.

* *(InterDigital,* [*R1-2107643*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107643.doc)*[13]) Proposal 3: Support Option 1 (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)*

**FL:** Further discussion in Proposal 3-2.1.

* *(Apple,* [*R1-2107740*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107740.doc)*[14]) Proposal 5: For mitigating UE Tx timing errors for UL TDOA, 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.*

**FL:** Further discussion in Proposal 3-2.1.

* *(NTT DOCOMO,* [*R1-2107858*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107858.doc)*[16])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*

**FL:** Further discussion in Proposal 3-2.1.

* *(Ericsson,* [*R1-2108164*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)*[19])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.*

**FL:** Further discussion in Proposal 3-2.1.

* *(Ericsson,* [*R1-2108164*](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)*[19])Proposal 23 The TEG association is reported independently for each measurement instance in a measurement report.*

**FL:** Further discussion in Proposal 3-2.1.

## Association information of SRS resources and UE Tx TEGs

FL Comments

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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 |

About the two options in above agreement, it seems we have a diverged views according to the contributions to this meeting. Option 1 is supported by about 10 companies (Huawei (if the association is static)[1], vivo[3], Sony[4], Samsung[5], CATT[6], Qualcomm[9], CMCC[10], Intel[12], InterDigital[13], Apple[14]), while Option 2 are supported by Huawei (if the association is dynamic)[1], ZTE[2], Nokia[7], OPPO[8], LG[11], DCM[16], Ericsson[19]).

It seems we may need to have a further discussion in this meeting to see if we can have a compromised solution, e.g., supporting both options. Also, one of the main arguments for either side is related to the signalling efficiency for the request and the response of the association information of SRS resources and UE Tx TEGs. Thus, we may also consider getting the inputs from RAN2 if it is necessary.

In addition, once we have decided which of the option(s) are supported, we may need to consider more details on the signalling and procedure, such as when/how the association information is requested from LMF or from serving gNB, as discussed in [3], and when the association is reported ( e.g.,  *The reporting of the association is happening after the SRS is transmitted, together with an UL timestamp, and an associated UL Timing Error margin[9]).*

Another issue is whether *LMF to forward the association information to neighboring gNBs, which is supported at least by N companies (e.g., [3][11]) and objected at least by (e.g., [6][8])*

Proposal 3.2-1 (H)

* *For mitigating UE Tx timing errors for UL TDOA,* *support one* ***or both*** *of the following options:*
  + *Option 1:* 
    - *Subject to UE’s capability, support* ***LMF to request and*** *a UE to provide 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* ***serving gNB to request*** *and 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 signalling*
* *FFS: the need or the benefits of defining static and dynamic association information of UL SRS resources for positioning with Tx TEGs*
* *FFS: The details of the signalling and the procedures*

Comments

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| **Company** | **Comments** |
| Qualcomm | We support option 1. |
| Huawei, HiSilicon | In our view, we think that both options would useful, for different UEs and for different use cases.  We support both options. |
| CATT | Support Option 1.  In our point of view, since there are LPP signalling between UE and LMF, and LMF is responsible for the calculation of UE position, it is reasonable for UE to provide the association information of SRS-Pos with Tx TEGs directly to the LMF, so that LMF can use such association information to calculate the UE position. In addition, such direct provision to LMF can reuse current LPP signallings and introduce less standardization impacts. Therefore, we support Option 1 as the method of UE providing the association information to LMF.  About the FFS: Support LMF to forward the association information provided by the UE to the serving and neighboring gNBs, we don’t 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. In our point of view, since LMF is responsible for the calculation of UE position, the serving and neighboring gNBs don’t need such association information, and the gNBs will report the associated SRS-Pos resource ID/resource set ID of the RTOA measurement to LMF, then LMF will know the Tx TEGs of the RTOA measurement after UE providing the association information of SRS-Pos with Tx TEGs to the LMF. |
| vivo | Support option1 |
| OPPO | In the main bullet, prefer to remove “or both” since it is not benefical to support the same functionality with two different signalling mechanism |
| CMCC | We don’t see the need to support both options, and we support Option 1. |
| ZTE | We prefer Option 2 since there is no such LPP reporting procedure for UL-TDOA in Rel-16. Option 1 is more proper for M-RTT.  We can accept that Option 2 is only used for UL-TDOA and Option 1 can be used for both UL-TDOA and M-RTT. |
| InterDigital | Support option 1 |
| LG | We are on the same page with OPPO. |
| Huawei, HiSilicon2 | We drew the following figure to show the difference between Option 1 and Option 2.  UE  gNB/TRP  gNB/TRP  gNB/TRP  gNB/TRP  LMF  Serving  Neighbour  0. NRPPaTRP Configuration Information Exchange  1. LPP capability Transfer  2. NRPPa POSITIONING INFORMATION REQUEST (TEG)  3. gNB determines UL SRS resources  3a. UE SRS configuration  3b.Reconfiguration Complete (TEG)  4. NRPPa POSITIONING INFORMATION RESPONSE (TEG)  5. LPP RequestLocationInformation (TEG)  9. LPP ProvideLocationInformation (TEG)  6. NRPPa MEASUREMENT REQUEST  7. UL SRS Measurements  8. NRPPa MEASUREMENT RESPONSE  For Option 1, it goes presumably with LPP RequestLocationInformation and LPP ProvideLocationInformation messages. We believe that it can only be reported after SRS transmission. It means that LMF has no knowledge on the SRS-TEG association when sending the SRS configuration to the TRPs.  For Option 2, it goes presumably with RRCReconfigurationComplete message and NRPPa POSITIONING INFORMATION REPONSE messages. We believe in this case, it is reported prior to SRS transmission. This would help LMF make the decision on the measurement request to the TRP, e.g. whether each TRP should receive SRS from moe than one TEGs or from a single TEG.  In addition, it could also help LMF to selectively activate the SRS based on the TEG association for e.g. SP-SRS or AP-SRS.  So among the two options, we think that Option 2 should at least be supported. We can be open to generalize gNB/LMF to network as Siva proposed and let RAN2 and RAN3 to work out which option is needed. |
| Intel | Support option 1 |
| **FL** | **To Huawei’s comments:** Based on Huawei’s comment, it seems the main motivation for Huawei to support Option 2 is that LMF can provide the UE Tx TEG information to TRPs before Step 6. In order to do that, it requires the UE to provide the information to the LMF after Step 3a as soon as possible. Then, the issue comes down which options has the shorter messaging delays for UE to provide the UE Tx TEG information to LMF after Step 3a. If this understand is correct, may be we can simply ask RAN2/RAN3 that: “RAN1 consider it is beneficial for the LMF to obtain the UE Tx TEG information after Step 3a and before Step 6 in above figure, and ask RAN2/3 which of the options is better from LPP/NRPPa signalling point of view. |
| Ericsson | As this is related to signaling, instead of agreeing to both options, one possibility is to send an LS to RAN2 and ask for input from RAN2. Then, based on RAN2’s input, we can downselect one of the options. Alternatively RAN1 could agree to the following high level proposal:   * + - *Subject to UE’s capability, support* ***the network to request*** *and a UE providing the association information of UL SRS resources for positioning with Tx TEGs to the* ***the network*** *if the UE has multiple Tx TEGs.*     - *For RAN2 and RAN3 to decide whether to use LPP or RRC signalling and what signalling is needed between network nodes (i.e. serving gNB, neigboring gNBs, LMF) .*   Supporting both options seems like an overkill to us. |
| NTT DOCOMO | We share the similar view with Ericsson. |
| ZTE2 | We support Option 2.As we mentioned, LPP protocol is not mandatory UE feature for UL-TDOA in Rel-16. If we can’t get consensus, we prefer to send an LS as Ericsson suggested. |
| **FL** |  |

FL Comments

Based on the comments in online discussion and offline email feedbacks, it seems it would be difficult for RAN1 to decide whether to use LPP or RRC/NRPPa to send the association information of UL SRS resources for positioning with Tx TEGs. In order tof RAN2/RAN3 to decide which option to take, I think RAN1 needs to clearly state what is the purpose/intention of each option and why RAN1 cannot make the decision, and what kind of help we need from RAN2/RAN3.Since we already have the agreement to support one of the options. We can simply send the agreement to RAN2/RAN3, and asking for their inputs.

(Round 2) Proposal 3.2-1 (H)

*Send an LS to RAN2/RAN3 with the following text content:*

For mitigating UE Tx timing errors for UL TDOA, RAN1 has made the following agreement in RAN1#105e:

|  |
| --- |
| 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 |

In above agreement, RAN1 considers selecting one of the options for the UE to provide the association information of UL SRS resources for positioning with Tx TEGs to the LMF. But, RAN1 cannot reach the consensus on which of options to support because the companies have different views on which of the options has less impact on the high signalling (i.e., LPP, *NRPPa or RRC signalling*).

From RAN1’s perspective,

* The UE is expected to send the association information of UL SRS resources for positioning with Tx TEGs after UE receives the *UE SRS configuration* from the serving gNB (Step 3a);
* It is desirable for the association information to reach the LMF before the LMF sends the *NRPPa MEASUEMENT REQUEST* to the serving and neighboring gNB/TRPs ((Step 6), so that the information may be used by the LMF for optimizing the parameters for the *NRPPa MEASUEMENT REQUEST.*
* The association information needs to be availableat the LMF before, or at the same time, when the LMF receives the LPP ProvideLocationInformation (Step 9) for the positioning calculation.

**Action Items to** RAN2/RAN3**:** RAN1 kindly request RAN2/RAN3 to let RAN1 know which of the option is preferred by RAN2/RAN3 based on the consideration of the message efficiency and the impact on the high signalling.

UE

gNB/TRP

gNB/TRP

gNB/TRP

gNB/TRP

LMF

Serving

Neighbour

0. NRPPaTRP Configuration Information Exchange

1. LPP capability Transfer

2. NRPPa POSITIONING INFORMATION REQUEST (TEG)

3. gNB determines UL SRS resources

3a. UE SRS configuration

3b.Reconfiguration Complete (TEG)

4. NRPPa POSITIONING INFORMATION RESPONSE (TEG)

5. LPP RequestLocationInformation (TEG)

9. LPP ProvideLocationInformation (TEG)

6. NRPPa MEASUREMENT REQUEST

7. UL SRS Measurements

8. NRPPa MEASUREMENT RESPONSE

Comments

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| **Company** | **Comments** |
| Nokia/NSB | We support Option 2. We don’t think we should push this issue to RAN2/3. How will they make the decision? The metrics and feature are better evaluated in RAN1 in our view. |
| Qualcomm | Option 1. We think RAN1 should make an agreement, and send an LS to if RAN2/3 have concerns. |
| Huawei, HiSilicon | If there is need for down-selection in RAN1, we support Option 2.  Yet we are fine to let RAN2/RAN3 figure out the signaling, since it was RAN2 that made the decision that positioning SRS is configured in RRC instead of LPP in Rel-16. |
| vivo | Option1 is preferred.  In Multi-RTT positioning, uplink related parameters e.g. NTA-offset has been supported to report by UE via LPP. Therefore, in Multi-RTT positioning, we have no reason to support the similar uplink parameter UE Tx TEG to be reported through RRC+NRPPa instead of LPP.  Correspondingly, to align with the mechanism of Multi-RTT, UE report Tx TEG via LPP in UL-TDOA positioning is preferred. |
| ZTE | Share the same view with Huawei. |
| OPPO | We prefer Option 2. If Ran1 cannot achieve concerns, we are ok to send LS to RAN2/3 |
| Intel | Support Option 1. Agree to send the LS |
| CATT | Support to send the above LS to RAN2/3, since we cannot reach the consensus on which option should be selected. |
| Ericsson | Suggest to send the LS to RAN2/RAN3. But in the LS we don’t need the following sentence:  “But, RAN1 cannot reach the consensus on which of options to support because the companies have different views on which of the options has less impact on the high signalling (i.e., LPP, *NRPPa or RRC signalling*). ” |
| **FL** | Based on the feedbacks, we have:  Option 1: Qualcomm, vivo, Intel  Option 2: Nokia, Huawei, ZTE, OPPO  Not send LS to RAN2/RAN3: Nokia, Qualcomm  Fine to send LS to RAN2/RAN3 if the issue cannot be resoved in RAN1: Huawei, ZTE, OPPO, Intel, CATT, Ericsson.  To Nokia and Qualcomm: The main motivation for sending LS to RAN2/RAN3 is that the main arguments from supporting Optino 1 or Option 2 is related to the efficiency of the high signalling. RAN2/RAN3 seems to be the right WG to decide which is the best way to send a message from one entity (UE) to another entity (LMF and/or gNB). Will it be acceptable for Nokia/Qualcomm that we simply as RAN2/RAN3’s preference to help RAN1 to make the final decision.  To Ericsson’s comment: How about we say:  Before making the decision on which of options to support, RAN1 would like to get the inputs from RAN2/RAN3 on which of the options has less impact on the high signalling (i.e., LPP, *NRPPa or RRC signalling*).  The draft LS conte |

(Round 3) Proposal 3.2-1 (H)

*Send an LS to RAN2/RAN3 with the following text content:*

For mitigating UE Tx timing errors for UL TDOA, RAN1 has made the following agreement in RAN1#105e:

|  |
| --- |
| 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 |

In above agreement, RAN1 considers selecting one of the options for the UE to provide the association information of UL SRS resources for positioning with Tx TEGs to the LMF. Before making the decision on which of options to support, RAN1 would like to ask RAN2/RAN3 on which of the options is preferred from the RAN2/RAN3’s perspectives (e.g., the efficiency and latency of LPP, NRPPa or RRC signalling).

From RAN1’s perspective,

* The UE is expected to send the association information of UL SRS resources for positioning with Tx TEGs after UE receives the *UE SRS configuration* from the serving gNB
* It is desirable for the association information to reach the LMF before the LMF sends the *NRPPa MEASUEMENT REQUEST* to the serving and neighboring gNB/TRPs, so that the information may be used by the LMF for optimizing the parameters for the *NRPPa MEASUEMENT REQUEST.*
* The association information needs to be availableat the LMF before, or at the same time, when the LMF receives the LPP ProvideLocationInformation for the positioning calculation.

**Action Items to** RAN2/RAN3**:** RAN1 kindly request RAN2/RAN3 to let RAN1 know which of the option is preferred by RAN2/RAN3 based on the consideration of the message efficiency and the impact on the high signalling.

Comments

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| **Company** | **Comments** |
| Huawei, HiSilicon | We are fine with the LS if RAN1 cannot make the decision.  Regarding the three bullets, we wonder whether the step number should be removed   * The UE is expected to send the association information of UL SRS resources for positioning with Tx TEGs after UE receives the *UE SRS configuration* from the serving gNB (Step 3a); * It is desirable for the association information to reach the LMF before the LMF sends the *NRPPa MEASUEMENT REQUEST* to the serving and neighboring gNB/TRPs ((Step 6), so that the information may be used by the LMF for optimizing the parameters for the *NRPPa MEASUEMENT REQUEST.* * The association information needs to be availableat the LMF before, or at the same time, when the LMF receives the LPP ProvideLocationInformation (Step 9) for the positioning calculation. |
| Qualcomm | Not sure if the criteria “which option has the less impact to the signaling” should be the only factor to consider here. |
| CATT | Support the LS to RAN2/RAN3. And we are also fine to remove the step numbers as Huawei’s comments.  About the criteria” which option has the less impact to the signaling” should be the only factor to consider here.”, we think it try to ask the opnions of RAN2/RAN3 about the signaling impact of Option1 and Option2, it will be one of the factors to select which option should be adopted, but not the only one. |
| FL | **To Huawei**: Yes, I assume the step numbers can be removed. RAN2/3 should be more familiar than RAN1 with the message calls and steps.  **To Qualcomm/CATT**: I assme RAN2/RAN3 may consider the additional factors from their perspectives. Maybe we can say “RAN1 would like to ask RAN2/RAN3 on which of the options is preferred from the RAN2/RAN3’s perspectives (e.g., the efficiency and latency of LPP, NRPPa or RRC signalling). |
| LG | We are fine with principle. But, regarding overall of RAN1 perspective, we think the motivation of option 2 is not reflected enoughly. We prefer to add some details of intention about option2 and we also think it will be helpful if the reason why do we consider both options is added. |
| CATT | We are fine with current version. |
| OPPO | We are supportive of this proposal in principle. We can two comment   * One minor suggestion is to remove “Before making the decision on which of options to support”. In our understanding, If RAN2/RAN3 prefer a given option, then RAN1 will follow them. However, the sentence “before …” seems to indidate that RAN1 will also make an explicit decision on the down-selection based on the reply of RAN2/RAN3 * What’s the consequence if RAN2 and RAN3 prefer different options in their LS reply? What should RAN1 do then? We only have two remaining meetings. Thus, is it better for RAN1 to send LS to RAN2 and cc RAN3? In this case, we can just follow RAN2 decsion. |
| vivo | We are fine to send an LS to RAN2/RAN3. |
| SONY | It is unclear who should make the final decision. If RAN1 is the one that make the decision, it is better to remove this words “Before making the decision on which of options to support,” Hence, we basically ask RAN2/3 their opinion as an input to RAN1.  If we let RAN2 to decide, RAN1 observes the two following options (as written above). Furtnermore, we need to explicitly say RAN2 to decide. |
| ZTE | Agree with Sony. Obviously, RAN1 cannot make the decision. RAN2/RAN3 can make their decision and inform RAN1. |
| **FL** | **To LG**: My thinking of the main purpose of the LS to get a quick response from TAN2/RAN3 on which option they prefer from the singalling point of view to help RAN1 make the final decision. It is unclelar to me how RAN2/RAN3 to evaluate the importance of the usage of the Tx TEX information for each options.  **To OPPO**: Yes, RAN2 and RAN3 may prefer different options. RAN1 should make the final decision once RAN1 obtains the feedbacks from RAN2/RAN3 after RAN1 has a full picture of the benefits and impacts of both options.  **To SONY/ZTE**: In my view, RAN1 should make the final decision after RAN1 has a full picture of the benefits and impacts of both options.  It seems the change marks were accepted by someone when providing the comments. To avoid this to happen, I will only use ‘red’ color to mark the changes from now now. |
| **Ericsson** | We are supportive of sending an LS but we think the wording of the action items should be the same as in the LS text, ie.  **Action Items to** RAN2/RAN3**:** RAN1 kindly request RAN2/RAN3 to let RAN1 know which of the option is preferred by RAN2/RAN3 based on RAN2/RAN3’s perspectives (e.g., the efficiency and latency of LPP, NRPPa or RRC signalling) ~~the consideration of the message efficiency and the impact on the high signalling~~. |
| **Apple** | Agree with SONY and in our view we can leave it to RAN2/3. We also agree with changes suggested by Ericsson. |
| **FL** | Based on the feedbacks so far, there was no objection to send the LS to RAN2/RAN3. One of the main issues is which WG should make the final decision. At least the following companies consider we can let RAN2/RAN3 to make the decision: OPPO, SONY, ZTE, Apple. In my iew, the potential issues to leave RAN2/RAN3 to make the final decision:   1. What should we do if RAN2/RAN3 have different preferenes? 2. What should we do RAN2/RAN3 say they also cannot make the decision or cannot decide their preference because there are more factors that need to be considered than the impact on the signaling?   Thus, my thinking is still that RAN1 should make the final decision after RAN1 has a full picture of the benefits and impacts of both options. Otherwise, we may have the risk that we cannot make the final decision before or at the November meeting. |

(Round 4) Proposal 3.2-1 (H)

*Send an LS to RAN2/RAN3 with the following text content:*

For mitigating UE Tx timing errors for UL TDOA, RAN1 has made the following agreement in RAN1#105e:

|  |
| --- |
| 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 |

In above agreement, RAN1 considers selecting one of the options for the UE to provide the association information of UL SRS resources for positioning with Tx TEGs to the LMF. Before making the decision on which of options to support, RAN1 would like to ask RAN2/RAN3 on which of the options is preferred from the RAN2/RAN3’s perspectives (e.g., the efficiency and latency of LPP, NRPPa or RRC signalling).

From RAN1’s perspective,

* The UE is expected to send the association information of UL SRS resources for positioning with Tx TEGs after UE receives the *UE SRS configuration* from the serving gNB
* It is desirable for the association information to reach the LMF before the LMF sends the *NRPPa MEASUEMENT REQUEST* to the serving and neighboring gNB/TRPs, so that the information may be used by the LMF for optimizing the parameters for the *NRPPa MEASUEMENT REQUEST.*
* The association information needs to be availableat the LMF before, or at the same time, when the LMF receives the LPP ProvideLocationInformation for the positioning calculation.

**Action Items to** RAN2/RAN3**:** RAN1 kindly request RAN2/RAN3 to let RAN1 know which of the option is preferred by RAN2/RAN3 from RAN2/RAN3’s perspectives (e.g., the efficiency and latency of LPP, NRPPa or RRC signalling).

Comments

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| --- | --- |
| **Company** | **Comments** |
| Nokia/NSB | Even though our preference is simply to make a decision in RAN1 we understand that the clear majority want to send an LS. However, the current Action to the other WGs is not acceptable to us. What we are saying is that RAN1 will still make the decision but we want RAN2/3’s input? This is not helpful at this stage in the work item in our view. How will RAN2/3 evaluate the different methods which may have different metrics (e.g., one option may have better latency but larger overhead)?  If we want them to make the decision we should say so, otherwise we don’t see any value in sending this LS. As stated before we feel that we should simply make a decision in RAN1. |
| Qualcomm | We do not agree with a few aspects in the above statement, especially the”From Ran1 perspective”   * “The UE is expected to send the association information of UL SRS resources for positioning with Tx TEGs after UE receives the UE SRS configuration from the serving gNB“   Qualcomm: We disagree. The UE will send the SRS<->TEG association after the SRS is transmitted. The association may change dynamically, and does not stay constant, so sending it before will not be useful. That’s the same with the RTT report and TxTEG reporting: UE sends the TxTEG together with all the measurements, after the measurements have been completed. For us, TEG<->SRS is a reporting of “what just happened” and not a reporting of “what will happen in the future” |
| ZTE | We think it’s better to decide by RAn2/RAN3. Otherwise, we just kick the ball back and forth.  As for the statement quoted by Quacomm, Option 2 doesn’t mean UE always has to report SRS-TEG association before the SRS is transmitted. The reason we prefer Option2 is that UL-TDOA doesn’t mandate UE to support LPP protocol. Maybe we can remove the first two sub-bullets and add other statement.  From RAN1’s perspective,   * ~~The UE is expected to send the association information of UL SRS resources for positioning with Tx TEGs after UE receives the~~ *~~UE SRS configuration~~* ~~from the serving gNB~~ * ~~It is desirable for the association information to reach the LMF before the LMF sends the~~ *~~NRPPa MEASUEMENT REQUEST~~* ~~to the serving and neighboring gNB/TRPs, so that the information may be used by the LMF for optimizing the parameters for the~~ *~~NRPPa MEASUEMENT REQUEST.~~* * UE is not mandatory to support LPP protocol for UL-TDOA based positioning solution. * The association information needs to be availableat the LMF before, or at the same time, when the LMF receives the LPP ProvideLocationInformation for the positioning calculation. |
| vivo | We are fine to send an LS to RAN2/3. However, the descriptions about ‘From RAN1’s perspective…’ seems not clear to us.  For the first bullet, we have the same understanding as Qualcomm.  For the second bullet, it is mentioned that the ‘the Tx TEG information may be used by the LMF for optimizing the parameters for the *NRPPa MEASUEMENT REQUEST*’, for example, it may help the LMF determine whether each TRP should receive SRS from more than one TEGs or from a single TEG . We think this issue is related to Proposal 3.2-2, however, companies make no conclusions. We are not sure whether LMF obtaining UE Tx TEG information before the LMF sends the *NRPPa MEASUEMENT REQUEST* is useful. Proposal 3.2-2  * *For UL-TDOA positioning, support a gNB to report RTOA measurements associated with different UE Tx TEGs from a UE.*   For the third bullet, from the perspective of RAN2/3, just looking at this sentence literally, maybe weird to include ‘the LPP ProvideLocationInformation for the positioning calculation’ in UL-TDOA positioning.  Therefore, we don’t think we have make a conclusion on the descriptions about ‘From RAN1’s perspective…’ and propose to delete related descriptions in the LS. |
| CATT | We are fine with the this version.  We think RAN1 should decide which option should be adopted. And the LS to RAN2/3 is needed, since RAN1 want to know the efficiency and latency aspects of the two options. |
| **OPPO** | It is obvious that RAN1 cannot make decision now. If we follow the current LS, RAN1 sends LS this meeting. RAN1 can only receive the LS in the Nov meeting or even later since RAN2/3 has only one remaining meeting this year. There may not be sufficient for RAN1. Therefore, we prefer to let RAN2 make the decision. |
| **FL** | Thanks for all of the comments. It seems most companies prefer RAN2 to make the decision if RAN1 cannot make the decision in this meeting.  For the 1st bullet under from RAN1’s perspective, my understanding it is obvious that the Tx TEG information cannot be sent before the UE receives the UE SRS configuration from the serving gNB. Thus, the UE can only send it after UE receives the UE SRS configuration from the serving gNB. I assume the comments from QC is that the UE may not need to send it *right* after UE receives the UE SRS configuration from the serving gNB, which I do share the similar view. However, to help RAN2/RAN3 to make the decision, in my view RAN1 needs at least provide the information on when the UE is expected to send it out. Sending it out together with the measurements is one of the options, which is Option 1.  For the last bullet under from RAN1’s perspective, I think it is obvious that the Tx TEG information is needed for positioning calculation.  In my view, if we want to let RAN2/RAN3 to make the decision, we would need to given them to a reason why RAN1 could not make a decision, and also provide some information to help them to make the decision.  **How about we say:**  *Send an LS to RAN2, cc to RAN3 with the following text content:*  For mitigating UE Tx timing errors for UL TDOA, RAN1 has made the following agreement in RAN1#105e:   |  | | --- | | Agreement: (RAN1#105e)   * For mitigating UE Tx timing errors for UL TDOA, support one of the following options:   + Option 1:     - …   + Option 2:     - … |   One of the options in above agreement needs to be selected for the UE to provide the association information of UL SRS resources for positioning with Tx TEGs to the LMF. *It is RAN1’s understanding that these two options have different impacts on the efficiency and latency of the high-layer signaliing, and thus it would be better for RAN2 to make the decision on which of the options is adopted.*  **Action Items to** RAN2**:** *RAN1 kindly request RAN2 to let RAN1 know which of the options should be adopted.* |
|  |  |

### (Round 5) Proposal 3.2-1 (H)

*Send an LS to RAN2/RAN3 with the following text content:*

For mitigating UE Tx timing errors for UL TDOA, RAN1 has made the following agreement in RAN1#105e:

|  |
| --- |
| 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 |

There is a need to decide which of the options in above agreement needs to be selected for the UE to provide the association information of UL SRS resources for positioning with Tx TEGs to the LMF. *It is RAN1’s understanding that these two options have different impacts on the efficiency and latency of the high-layer signaliing, and thus would like to request RAN2 to make the decision on which of the options should be adopted.*

**Action Items to** RAN2**:** *RAN1 kindly request RAN2 to let RAN1 know which of the options should be adopted.*

Comments

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| --- | --- |
| **Company** | **Comments** |
| ~~Qualcomm~~ | ~~OK~~ |
| Huawei, HiSilicon | We think the decision is up to RAN2/3. However, in case we do not kick balls between different WGs, e.g. RAN2 may also have different view towards dynamic change of TEG, that would further require RAN1 to clarify.  Given that RAN2/RAN3 does not have Oct. meeting, so the suggestion from our side is that let’s try to converge in Oct. meeting, and send the LS to RAN2 by that time. At least we think some clarification on whether Tx TEG associated with SRS can be dynamically changed, and what haviour can be treated as Tx TEG change needs to be resolved in RAN1 beforehand. |
| OPPO | Support |
| LG | We are fine with the current version of the proposal. |
| CATT | Support. |
| ZTE | OK with the current version. |
| vivo | Support  And we are okay to discuss what behavior can be treated as Tx TEG change and how to resolve it in RAN1 beforehand. |
| Ericsson | Support |
| **FL** | **To Huawei and all:**  Based the feedbacks, most companies are fine to send the LS to RAN2/3. On the other hand, given that RAN2/3 do not Oct. meeting, we could also take Huawei’s suggestion that we have a further discussion and try to converge in the next meting. The issue is that we may also do not have much time for the next meeting since there are many issues left. |
| **Qualcomm2** | Sorry, i need to update our previous response, which it was added **by mistake in the wrong window.**  We don’t agree sending this LS yet to RAN2 because it misses important aspects that need to be agreed in RAN1:   * Section 3.4.1 talks about “updating of TEGs” which is very important to be known to RAN2 to make a good solution. RAN2 should know that RAN1 considers TEGs not being static and that any solution should be able to handle the TEGs being changed.   So, instead of focusing on sending an LS with incomplete information/agreements, we want to focus on doing more agreements in RAN1 (Section 3.4.1, Section 3.3.1, Section 3.3.3) and include all of them in any LS sent to RAN2. |
| Apple | Support |
| Nokia/NSB | We still prefer to not send an LS and make a decision in RAN1. If we are the only company with this view we can compromise to send the LS. |
| NTT DOCOMO | Support |

## RTOA measurements with multiple TRP Rx TEG(s)

FL Comments

* ***(vivo,*** [***R1-2106595***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106595.doc)***[3]) Proposal 9:*** 
  + *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 needs to be guaranteed if the gNB is able to measure SRS resoures associated different UE Tx TEGs.*
    - *FFS the gNB reporting rules to guarantee the RTOA measurement report for more than one UE Tx TEGs.*
* ***(Ericsson,*** [***R1-2108164***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)***[19])Proposal 13*** *For UL-TDOA positioning, support a gNB to report RTOA measurements associated with different UE Tx TEGs from a UE*

FL Comments

It may be beneficial for a gNB to report RTOA measurements associated with different UE Tx TEGs from a UE, especially when the gNB uses the same Rx TEG to measure the RTOA measurements associated with different UE Tx TEGs. How to *guarantee* a gNB to report RTOA measurement for more than one UE Tx TEGs seems related to performance requirement that can be handled by RAN4.

### Proposal 3.2-2

* *For UL-TDOA positioning, support a gNB to report RTOA measurements associated with different UE Tx TEGs from a UE.*

Comments

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | OK |
| Huawei, HiSilicon | We do not think (neighbouring) gNB/TRP should be aware of the UE Tx TEG information, but rather perform measurement and report the results using SRS resource ID. |
| MTK | It seems to us that this proposal is in order to measure TX TEG difference of UE. gNB doesn't know SRS from which TX TEG. LMF knows. So we think gNB just report the RTOA measurement based on measurable SRS  Unless we define a calibration period, in which the UE may transmit SRS iteratively between different TX TEGs. Otherwise this proposal is sort of strange to us |
| CATT | Support. |
| vivo | Support. |
| OPPO | We are fine with the proposal |
| CMCC | As our comments above, we think that the association information of UL SRS resources and UE Tx TEGs should be reported to LMF by LPP signalling, and therefore we don’t think that a gNB has this information. |
| ZTE | Share similar view with Huawei and MTK. |
| LG | We have a similar view of CMCC and MTK, we need to discuss whether gNB knows the information of UE Tx TEG or not firstly. We think the proposal can be varied depending on the discussion of Proposal 3.2.1. |
| Intel | UE Tx TEG association information is available on LMF side not gNB side. In our understanding gNB can report several RTOA measruements from a UE, which are measured from different SRS resources for positioning. |
| Ericsson | Support |
| ZTE2 | Not support. What gNB can do is to provide SRS resource ID information for UL-AOA measurement to LMF. If LMF has the SRS-TEG association information ,LMF will know what UE Tx TEG has been used to transmit SRS. |
| **FL** | Based on the feedback so far, at least 3 companies are not supportive to the proposal. Suggest further email discussion. |
| Nokia/NSB | Unclear that this is needed. The gNB/TRP doesn’t necessarily know about UE Tx TEG and in addition our understanding is that the UE uses one TX TEG per SRS resource. Doesn’t the spec already supports reporting multiple RTOA values for a UE and therefore support this feature in some sense? |
| **FL** | The priority of the proposal is lowered for further discussion, since about half of the feedback do not support it.  By the way, it seems LMF should have the UE Tx TEG information based on the options discussed in Proposal 3.2-1. It seems no need for gNB to send the information to LMF with RTOA measurements. |

## Report of the SRS port IDs with the RTOA measurements

Submitted Proposals

* ***(Huawei,*** [***R1-2106449***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106449.doc)***[1]) Proposal 1:*** *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. Thus, we may consider whether to support gNB to report the associated SRS port ID of the RTOA measurement.

### 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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Huawei, HiSilicon | Support.  There is no UE requirement or impact. The spec change can be manageable in RAN3. |
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|  |  |
|  |  |

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

Submitted Proposals

* ***(OPPO,*** [***R1-2107213***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107213.doc)***[8])Proposal 1****: Rel-17 doesn’t support the association of TEG with MIMO SRS port(s).*
* *(****OPPO,*** [***R1-2107213***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107213.doc)***[8])Proposal 4****: Rel-17 doesn’t support the association of TEGs with MIMO SRS resources.*
* ***(Qualcomm,*** [***R1-2107345***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107345.doc)***[9]) Proposal 7****: Do not support Tx TEGs reporting for MIMO SRS.*
* ***(Ericsson,*** [***R1-2108164***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)***[19])Proposal 7****: The UE can be configured to send UE TX TEG association reports for all SRS types.*

FL Comments

In RAN1#104bis-e and RAN1#105e, 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.

### (Closed) Proposal 3.2-4

* *Study whether to support a UE to provide the association information of Tx TEGs with UL SRS resources for MIMO to the LMF for UL-TDOA if the UE has multiple Tx TEGs.*

Comments

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LG | Not support. |
| **FL** | There seems no support for the proposal. |
|  |  |
|  |  |

## Additional proposals for UL-TDOA enhancements

Submitted Proposals

* ***(Huawei,*** [***R1-2106449***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106449.doc)***[1])Proposal 4: Support positioning SRS with antenna switching.***
* ***(Ericsson,*** [***R1-2108164***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)***[19])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,*** [***R1-2108164***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)***[19])Proposal 11*** *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,*** [***R1-2108164***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)***[19])Proposal 12*** *The UE shall report the number of UE TX TEGs as part of UE capabilities.*
* ***(Ericsson,*** [***R1-2108164***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)***[19])Proposal 14*** *Support SRS with beam and UE TX TEG sweeping.*

FL Comments

Above are some proposals which are proposed, but not fully discussed in previous meetings. Companies are encouraged to take a look these proposals and provide their opinions.

### Proposal 3.2-5

* *Further study the following enhancements:*
  + *Support positioning SRS with antenna switching.*
  + *Support configuring a UE with a list of SRS resource sets for which UE TX TEG association reporting should be performed.*
  + *Support configuring a UE with an SRS with a restriction for the UE to utilize a certain UE TX TEG when transmitting the SRS.*
  + *Support a UE to report the number of UE TX TEGs as part of UE capabilities.*
  + *Support SRS with beam and UE TX TEG sweeping.*

Comments

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| --- | --- |
| **Company** | **Comments** |
| Huawei, HiSilicon | We believe it should be useful to indicate to the UE some degree of TEG/antenna sweeping is desired from network perspective. |
| **InterDigital** | We support the proposal. |
| Ericsson | The following two proposals are crucial to achieve full mitigation of the UE TX timing errors   * + *Support configuring a UE with an SRS with a restriction for the UE to utilize a certain UE TX TEG when transmitting the SRS.*   + *Support a UE to report the number of UE TX TEGs as part of UE capabilities.*   Under the timing error mitigation agenda we are currently discussing numerous proposals without any justification in terms of evaluated and verified gains. For the above proposals, however, very strong gains have been demonstrated (see e.g. section 3.2 in R1- 2108164 or the figure below). These proposals should be prioritized and agreed.    An alternative solution to ‘configuring a UE with an SRS with a restriction for the UE to utilize a certain UE TX TEG when transmitting the SRS’ is to   * + *Support SRS with beam and UE TX TEG sweeping.*   This could be discussed as an additional method to achieve the big gains demonstrated. |
| CATT | We support to further discuss these UL-TDOA enhancements. |
| Nokia/NSB | Low priority compared with other urgent issues to discuss at this meeting. |

## Mitigation of UE/gNB Rx/Tx timing errors for DL+UL positioning

Background

|  |
| --- |
| 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 |

Submitted Proposals

* ***(Huawei,*** [***R1-2106449***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106449.doc)***[1])Proposal 5: Update the agreement as below:***

|  |
| --- |
| * + **For mitigating UE Tx/Rx timing errors for DL+UL positioning, both the following options are supported subject to UE capability:**   + **Option 1: Reporting of UE RxTx TEG ID 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 Rx TEG ID and Tx TEG ID** |

**FL:** The suggestion to remove the “Reporting of UE RxTx TEG ID is not supported by the UE” from Option 2 makes sense in logic, since the main bullet says “a UE may support, up to UE capability, one or both of the following options”. Further discussion in Proposal 3-3.1a.

* ***(Huawei,*** [***R1-2106449***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106449.doc)***[1])Proposal 6: Support Tx TEG association with positioning SRS resource reported as part of non-TRP associated information, and Tx TEG association with UE Rx – Tx time difference measurement reported as part of TRP associated information.*** 
  + ***Note that the same Tx TEG ID is used to link the measurement Tx time and the corresponding positioning SRS resource(s).***

**FL:** Further discussion in Proposal 3-3.1a.

* ***(Huawei,*** [***R1-2106449***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106449.doc)***[1])Proposal 7: Adopt the signaling structure for NR-Multi-RTT-SignalMeasurementInformation IE to include both non-TRP associated information and TRP associated information, where Tx TEG ID is used to link the measurement timing to the SRS resources.***

**FL:** The details of signalling structure may be handled by RAN2/RAN3.

* ***(ZTE,*** [***R1-2106549***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106549.doc)***[2]) Proposal 4: For mitigating UE Tx/Rx timing errors for DL+UL positioning, a UE may support, up to UE capability, 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.***

**FL:** Further discussion in Proposal 3-3.1a.

* ***(ZTE,*** [***R1-2106549***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106549.doc)***[2]) Proposal 5: For Tx timing decision, support alt 3, i.e. a Tx TEG ID is associated with one or more UL SRS resources for positioning.***

**FL:** Further discussion in Proposal 3-3.1a.

* ***(vivo,*** [***R1-2106595***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106595.doc)***[3]) Proposal 10:*** 
  + ***For mitigating UE Rx/Tx timing errors for DL+UL positioning, up to UE capability, both of the following options can be supported.***
    - ***Option 1: Reporting of UE RxTx TEG ID is supported by the UE.***
    - ***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.***

**FL:** Further discussion in Proposal 3-3.1a.

* ***(vivo,*** [***R1-2106595***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106595.doc)***[3]) Proposal 11:*** 
  + ***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 3-3.1a.

* ***(vivo,*** [***R1-2106595***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106595.doc)***[3]) Proposal 12:*** 
  + ***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 (similar to DL-TDOA).***
    - ***UE providing the association information of UE Tx TEG(s) with all UL Positioning SRS resources to LMF (similar to UL-TDOA).***
    - ***UE providing the mapping information of UE {Rx TEG ID, Tx TEG ID} to UE RxTx TEG IDs to LMF.***

**FL:** Further discussion in Proposal 3-3.1a.

* **(Sony,** [**R1-2106809**](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106809.doc)**[4])Proposal 2: For DL+UL positioning, support UE to send UE RxTx TEG ID to the LMF,**

**FL:** Further discussion in Proposal 3-3.1a.

* **(Sony,** [**R1-2106809**](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106809.doc)**[4])Proposal 3: The UE RxTx TEG ID is associated with a pair of Tx TEG and Rx TEG. One Rx TEG is associated with one or more DL PRS resources. One Tx TEG is associated with one or more UL SRS resources.**

**FL:** Further discussion in Proposal 3-3.1a.

* ***(Samsung,*** [***R1-2106888***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106888.doc)***[5])Proposal 4: Both options for reporting the TEG (i.e., reporting the RxTx TEG ID or reporting both Rx TEG ID and Tx TEG ID) are supported for DL+UL positioning subject to UE capability.***
* **FL:** Further discussion in Proposal 3-3.1a.
* ***(Samsung,*** [***R1-2106888***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106888.doc)***[5])Proposal 5: 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 3-3.1a.

* ***(CATT,*** [***R1-2106971***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106971.doc)***[6])Proposal 3: For mitigating UE Tx/Rx timing errors for DL+UL positioning, a UE may support, up to UE capability, the following option 2 in the previous agreement of RAN1#105-e:***
  + ***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.***

**FL:** Further discussion in Proposal 3-3.1a.

* ***(CATT,*** [***R1-2106971***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106971.doc)***[6])Proposal 4: A Tx TEG ID should be associated with one or more UL SRS resources for positioning and decoupled with the Tx timing of the Rx-Tx measurement.***

**FL:** Further discussion in Proposal 3-3.1a.

* ***(Nokia, R1- 2107057[7]) Proposal 4: Support Alt. 2, Option 1 in the prior agreement from RAN1#104-bis on UE Rx-Tx time difference measurements.***

**FL:** Further discussion in Proposal 3-3.1a.

* ***(Nokia, R1- 2107057[7]) Proposal 5: Don’t support UE providing association of PRS resources and Rx TEG to LMF for UE Rx-Tx measurements.***

**FL:** UE Rx-Tx measurement is impacted by both Rx and Tx timing errors**.** If UE does not report RxTx TEG, but Tx TEG, theRx TEG information should be useful for LMF in my view. Further discussion in Proposal 3-3.1a.

* ***(Nokia, R1- 2107057[7]) Proposal 6: Support Alt. 2, Option 1 in the prior agreement from RAN1#104-bis on gNB Rx-Tx time difference measurements.***

**FL:** Further discussion in Proposal 3-3.1b.

* ***(Nokia, R1- 2107057[7]) Proposal 7: Don’t support TRP reporting the association information of SRS resource to TRP Rx TEG for gNB Rx-Tx measurements.***

**FL:** Similar comment to UE side, if gNB does not report TRP RxTx TEG, but Tx TEG, theRx TEG information should be useful for LMF. Further discussion in Proposal 3-3.1b.

* ***(OPPO,*** [***R1-2107213***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107213.doc)***[8])Proposal 8: For mitigating UE/TRP Tx/Rx timing errors for DL+UL positioning, Rel-17 NR support Option 2, i.e.,***
  + ***UE provides the association information of a UE Rx-Tx time difference measurement with a pair of {Rx TEG ID, Tx TEG ID} 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***

**FL:** Further discussion in Proposal 3-3.1a/b.

* ***(OPPO,*** [***R1-2107213***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107213.doc)***[8])Proposal 9: For mitigating UE/TRP Tx/Rx timing errors for DL+UL positioning, a Tx TEG ID is associated with the Tx timing of the Rx-Tx measurement if there is no modification on the definition of Rx-Tx time difference measurements (Alt.2).***

**FL:** Further discussion in Proposal 3-3.1a/b.

* ***(OPPO,*** [***R1-2107213***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107213.doc)***[8])Proposal 10: For mitigating UE/TRP Tx/Rx timing errors for DL+UL positioning, Rel-17 NR support Alt.1, i.e.,***
  + ***gNB to provide the association information of a gNB Rx-Tx time difference measurement with a pair of {Rx TEG ID, Tx TEG ID } to LMF***

**FL:** Further discussion in Proposal 3-3.1a/b.

* ***(Qualcomm,*** [***R1-2107345***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107345.doc)***[9]) Proposal 8: For either UE capability (option 1 or Option 2):*** 
  + ***Support a UE to report the Tx TEG ID to SRS resource ID association in a separate report from the measurement report***
    - ***Use the same report also used for UL-TDOA.***
  + ***Support a UE to optionally report an SRS resource ID associated with an Rx-Tx measurement in the Rx-Tx measurement report.***
    - ***The associated SRS resource was transmitted with the Tx timing also used in the Rx-Tx measurement.***
  + ***Support a UE to optionally report an Rx TEG ID associated with an Rx-Tx measurement in the Rx-Tx measurement report.***

**FL:** Further discussion in Proposal 3-3.1a and Proposal 3-3.1c.

* ***(CMCC,*** [***R1-2107403***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107403.doc)***[10])Proposal 6: For mitigating UE Tx/Rx timing errors for DL+UL positioning, up to UE capability, a UE may support reporting of UE RxTx TEG ID.***

**FL:** Further discussion in Proposal 3-3.1a.

* ***(CMCC,*** [***R1-2107403***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107403.doc)***[10])Proposal 7: The UE RxTx TEG is associated with one or more {Rx TEG, Tx TEG} pairs, where the Rx TEG ID is associated with the Rx timing to receive the DL PRS, and the Tx TEG ID is associated with the Tx timing of the UE Rx-Tx measurement.***

**FL:** Further discussion in Proposal 3-3.1a.

* ***(CMCC,*** [***R1-2107403***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107403.doc)***[10])Proposal 8: For mitigating UE/TRP Tx/Rx timing errors for DL+UL positioning, 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 TEG.***

**FL:** Further discussion in Proposal 3-3.1b.

* ***(CMCC,*** [***R1-2107403***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107403.doc)***[10])Proposal 9: The TRP RxTx TEG is associated with one or more {Rx TEG, Tx TEG} pairs, where the Rx TEG ID is associated with the Rx timing to receive the UL SRS pos, and the Tx TEG ID is associated with the Tx timing of the gNB Rx-Tx measurement.***

**FL:** Further discussion in Proposal 3-3.1b.

* ***(LG,*** [***R1-2107542***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107542.doc)***[11]) Proposal #2:*** 
  + ***Support 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.’) and Alt.#1 (‘an UL SRS resource for positioning corresponding to the Tx timing of the Rx-Tx measurement’)***
* **FL:** Further discussion in Proposal 3-3.1a.
* ***(Intel,*** [***R1-2107590***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107590.doc)***[12])* Proposal 3:**
  + **Support UE to include (TX TEG ID, RX TEG ID) and RxTx TEG ID for each UE Rx-Tx time difference measurement in a Multi-RTT measurement report.** 
    - **The TX TEG ID is associated with the UL SRS Resource for positioning corresponding to the TX timing of the Rx-Tx time difference measurement.**
    - **The RX TEG ID is associated with the DL PRS Resource for positioning corresponding to the RX timing of the Rx-Tx time difference measurement.**

**FL:** Further discussion in Proposal 3-3.1a.

* ***(Intel,*** [***R1-2107590***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107590.doc)***[12])* Proposal 4:**
  + **Support gNB to include (TX TEG ID, RX TEG ID) and RxTx TEG ID for each gNB Rx-Tx time difference measurement in a Multi-RTT measurement report.** 
    - **The TX TEG ID is associated with the DL PRS Resource for positioning corresponding to the TX timing of the Rx-Tx time difference measurement.**
    - **The RX TEG ID is associated with the UL SRS Resource for positioning corresponding to the RX timing of the Rx-Tx time difference measurement.**
* **FL:** Further discussion in Proposal 3-3.1b.
* ***(InterDigital,*** [***R1-2107643***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107643.doc)***[13]) 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:** Further discussion in Proposal 3-3.1a.

* ***(InterDigital,*** [***R1-2107643***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107643.doc)***[13]) Proposal 2: Tx TEG is associated with an UL SRS resource for positioning corresponding to the Tx timing of the Rx-Tx measurement (i.e., support Alt. 1).***

**FL:** Further discussion in Proposal 3-3.1a.

* ***(Apple,*** [***R1-2107740***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107740.doc)***[14]) Proposal 4: For mitigating UE/TRP Tx/Rx timing errors for DL+UL positioning, “subject to UE capability” support the following***
  + ***Reporting of UE RxTx TEG ID is supported where the UE RxTx TEG is associated with the cumulative TEG for DL PRS resource Rx and UL Positioning SRS Tx***
  + ***the association information is sent from UE to LMF on LPP message***
  + ***UE is not expected to additionally provide the association information of Rx/Tx TEG IDs***

**FL:** Further discussion in Proposal 3-3.1a.

* ***(MediaTek,*** [***R1-2107822***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107822.doc)***[15]) Proposal 3-1: For a UE measurement report when a RXTX TEG ID is attached, a TX TEG ID needs to be attached together***

**FL:** Further discussion in Proposal 3-3.1a.

* ***(MediaTek,*** [***R1-2107822***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107822.doc)***[15]) Proposal 3-3: A TX TEG ID of UE is associated with SRS resource IDs. It is Alt. 3***
* **FL:** Further discussion in Proposal 3-3.1a.
* ***(Ericsson,*** [***R1-2108164***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)***[19])Proposal 17 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 3-3.1a.

* ***(Ericsson,*** [***R1-2108164***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)***[19])Proposal 23 The TEG association is reported independently for each measurement instance in a measurement report.***
* **FL:** Further discussion in Proposal 3-3.1a.

## Reporting of UE Rx/Tx/RxTx TEG IDs with Rx-Tx time difference measurements

FL Comments

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| 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 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 |

In previous meeting, it was agreed to consider above two options for reporting of UE Rx/Tx/RxTx TEG IDs mitigating UE Tx/Rx timing errors for DL+UL positioning. Based on the feedbacks in this meeting[1-19], it seems there are still diverse opinions on which of the options should be supported. Among them, at least 5 companies propose to support both of the options.

* Option 1: Reporting of UE RxTx TEG ID is supported by the UE

**Supported by**: *Huawei, ZTE, vivo, Sony, Samsung, Nokia, Qualcomm, CMCC, Intel, InterDigital, Apple, MTK,*

* 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.

**Supported by**: *Huawei, ZTE, vivo, Samsung, CATT, OPPO, Qualcomm, LG, Intel, InterDigital*

**Not Supported by**:

About the “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”, it was proposed in [3][4][10] for ***UE providing the mapping information of UE {Rx TEG ID, Tx TEG ID} to UE RxTx TEG IDs to LMF. However, somce companies (e.g., [14]) proposes “UE is not expected to additionally provide the association information of Rx/Tx TEG IDs”.***

About three alternatives on the Tx TEG ID association, the companies views may be summarized as follows:

* 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

**Supported by**: *Samsung, LG, Intel, InterDigital, Ericsson*

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

**Supported by**: *OPPO, CMCC*

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

**Supported by**: *ZTE, vivo, CATT, MTK*

To make the discussion easier, I draw the figure based on my understanding of the three alternatives:



In the figure, it is assumed that SRS1 and SRS2 are in the same Rx TEG, and both of them are transmitted in the same subframe from the BB.

For Alt.1, the Tx TEG ID in the Rx-Tx time difference is associated with *an UL SRS resource corresponding to the Tx timing of the Rx-Tx measurement*. Then, if the UL Tx time of SRS1 is used for the determination of the Rx-Tx time difference, the Tx TEG ID is associated with SRS1; and if the UL Tx time of SRS2 is used for the determination of the Rx-Tx time difference, the Tx TEG ID is associated with SRS2. Since SRS1 and SRS2 are in the same Tx TEG 1, the Tx TEG ID1 is included in the Rx-Tx time difference.

For Alt.2, I assume “the Tx timing of the Rx-Tx measurement” means the Tx timing used by the UE for the determination of the Rx-Tx measurement as shown in the figure. The Tx timing of the Rx-Tx measurement should be the same for the SRS in the same Tx TEG, i.e., Tx TEG1. Thus, the Tx TEG ID1 is included in the Rx-Tx time difference.

For Alt.3, the Tx TEG ID in the Rx-Tx time diffenrece is associated with one or more UL SRS resources for positioning. For the figure, the Tx TEG ID is associated with SRS1 and SRS2. The consideration for Alt.3 is that since the UE does not know the exact time of UL Tx for either SRS1 or SRS2, but with the margin of the Tx TEG. Thus, neither the Tx time of SRS1 nor the Tx of SRS2 is used for the determination of the reported Rx-Tx time difference, but the same Tx timing of Tx TEG1.

Therefore, in my view, regardless which of the alternative is adopted for the definition of the association of the Tx TEG ID in the Rx-Tx time difference measurement, the same Tx TEG ID is included the Rx-Tx time diffenrece measurement, and the UE needs to provide the association of the Tx TEG ID with SRS resources to the LMF.

As discussed in multiple companies (e.g., [1][3][4][5][6][9][10][12][13][15][19]), there is a need for UE to report the Tx TEG associate with SRS *SRS resources and Tx TEG association with UE Rx – Tx time difference measurement, i.e., the same Tx TEG ID is used to link the Tx time of UE Rx – Tx time difference measurement and the corresponding positioning SRS resource(s).*

Similarly, the Rx TEG, if included in the *UE Rx – Tx measurement, should be associated with* DL PRS r*esources [3][4][9][10][12][15]. However, one company proposes not to support UE providing association of PRS resources and Rx TEG to LMF for UE Rx-Tx measurements.*

In addition, the association of the Tx TEG ID with the SRS resources are expected to be the same for DL+UL positioning and UL-TDOA as previously discussed and also pointed out in some contributions (e.g., [3][9]).

In [9], it was proposed “Support a UE to optionally report an SRS resource ID associated with an Rx-Tx measurement in the Rx-Tx measurement report”, which may need to be further discussed.

Based on the above discussion, it is suggested to modify the previous meeting agreement as follows

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| --- |
| Modification of the previous the agreement of 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.   + ***UE providing the mapping information of UE {Rx TEG ID, Tx TEG ID} to UE RxTx TEG IDs to LMF.*** * Option 2: Reporting of UE Rx TEG ID and Tx TEG ID is supported by the UE. * If a Tx TEG ID is included with a Rx-Tx time difference measurement report, the UE should report the association of the Tx TEG ID to SRS 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 UL-TDOA and DL+UL positioning by default * If a Rx TEG ID is included with a Rx-Tx time difference measurement report, the UE should report the association of the Rx TEG ID to DL PRS resource(s) corresponding to the Rx 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: 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 |
|  |

The following is clean version of the proposal for UE side for further discussion. We can further discuss the corresponding requirements in TRP side once we reach the agreement for UE side.

Proposal 3.3-1a(H)

*Replacing the previous agreement of RAN1#105e as follows:*

* *For mitigating UE Tx/Rx timing errors for DL+UL positioning, subject to UE capability a UE should support one or both of the following options:*
  + *Option 1: Reporting of UE RxTx TEG ID*
    - *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 Rx TEG ID and Tx TEG ID*
* *If a Tx TEG ID is included with a Rx-Tx time difference measurement report, the UE should report the association of the Tx TEG ID to SRS resource(s) corresponding to the Tx time of the measurement*
  + *Note 1: The association can be reported separately from the Rx-Tx time difference measurement report.*
  + *Note 2: The association is the same for both UL-TDOA and DL+UL positioning by default*
* *If a Rx TEG ID is included with a Rx-Tx time difference measurement report, the UE should report the association of the Rx TEG ID to DL PRS resource(s) corresponding to the Rx time of the measurement*
  + *Note 1: The association can be reported separately 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: 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 UE Rx-Tx time difference measurements*

Comments

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| --- | --- |
| **Company** | **Comments** |
| Qualcomm | 1st comment: For us it was clear in the previous agreement that BOTH options are supported. There was no downselection in the previous agreement, and I remember clarifying this in the GTW online also. So, any discussion related to downselecting is not productive at this stage. What needs to be finalized is how the Tx-TEG is associated to the Rx-Tx measurement and/or the SRS resources.  So, with regards to this question, We are generally supportive of the first 2 bullets, even though the two “Notes” seem unclear.   * Does the first Note mean that we agree that the association of Tx-TEG to SRS is reported separately, or that we are going to discuss it in a separate proposal? We are OK to discuss it separately, but it needs to be clear in the Note. * Not sure what the 2nd Note means. The UE will report an SRS-resource-ID (likely with a timestamp) to an Tx-TEG. How could it be that the same SRS instance be associated with different TEGs for different methods? It looks to me that any SRS resource at a specific time, can only be associated with one Tx-TEGs, and the UE cannot say different TxTEGs for each method; to put it differently, there will not be a “method” (TDOA or RTT) in the report. It will be a generic Tx-TEG to SRS association reporting. Is that what the Note wants to say?   With regards to the Rx-TEG ID (3rd bullet), why would a separate report is needed? The UE includes a DL-PRS resource ID already in the measurement report! So, by adding a Rx-TEG ID, all the information is already available. |
| Huawei, HiSilicon | We may need some clarification first. The previous agreement reads  a UE may support, up to UE capability, one or both of the following options:  Whether an interpretation on this agreement as “spec supports both” and “UE supports either” is correct.  Then for the Tx TEG ID reporting, our view is that there should exist two types of information. One is common to all TRPs (TEG-ID and SRS association, which is applible also to UL-TDOA methods), and one is TRP specific (TEG-ID and UE measurement association, which is not applicable to UL-TDOA methods).  I think the interpretation may be implied in the following:   * *If a Tx TEG ID is included with a Rx-Tx time difference measurement report, the UE should report the association of the Tx TEG ID to SRS resource(s) corresponding to the Tx time of the measurement*   + *Note 1: The association can be reported separately from the Rx-Tx time difference measurement report.*   However, we think the wording may be improved, e.g.   * *If a Tx TEG ID is included with a Rx-Tx time difference measurement report, the UE should report the association of the Tx TEG ID to the Tx time of the measurement*   + *Note 1: The association between Tx TEG ID and SRS resource(s) can be reported separately from the Rx-Tx time difference measurement report.*   In addition, we are not sure whether Note 1 for the Rx TEG ID is needed, since we think that the Rx TEG ID, DL PRS resource, and DL TOA measurement should only be reported for each TRP, and thus would have the following suggestion.   * *If a Rx TEG ID is included with a Rx-Tx time difference measurement report, the UE should report the association of the Rx TEG ID to DL PRS resource(s) corresponding to the Rx time of the measurement*   + *Note 1: Void*   + *Note 2: The association is the same for both DL-TDOA and DL+UL positioning by default* |
| CATT | We share the same view with Huawei that we should clarify whether we still need to discuss the down-selection from option 1 and option 2, or we should support both options without any further discussion.  About the issue of the associated information of a UE Tx TEG ID, there are three alternatives in the previous agreement of RAN1#105-e for further down-selection:   * 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   We prefer Alt.3, i.e., a Tx TEG ID is associated with one or more UL SRS resources for positioning. In fact, we prefer UE Tx TEG ID to be decoupled with a particular UE Rx-Tx time difference measurement to avoid the issue of potential mismatch between UE and gNB Rx-Tx time difference measurements, i.e., the UE indicates the UE Rx-Tx time difference measurement associated with one UE TX TEG ID, but the gNB only receives the SRS-Pos associated with other UE Tx TEG ID and use this SRS-Pos to derive the gNB Rx-Tx time difference measurement. Therefore, LMF will use incorrect UE Tx TEG ID to mitigate the UE Tx/Rx timing errors for Multi-RTT positioning.  In a word, a Tx TEG ID should be associated with one or more UL SRS resources for positioning and decoupled with the Tx timing of the Rx-Tx measurement. No need to change the definition of UE Rx-Tx time difference measurement provided in Rel-16. |
| **vivo** | For the first bullet, we think both options can be supported subject to UE capability.  For the second bullet, we are not sure if it wants to express the meaning of ‘alt1+alt3’ based on the agreement of the last meeting? And does it restrict to the case where SRS(s) is transmitted in Tx time? if it is, we can not support this.   * 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   For the third bullet, we don’t think a separate report is needed as it is natural to include Rx TEG in Rx-Tx measurement report. And the association is clear when the DL PRS resource index is in Rx-Tx measurement report. |
| OPPO | Similar to Hua/CATT, we support to clarify whether down-selection is in the scope of discussion or not.  Regarding Note 1, we have similar feeling as QC. |
| CMCC | As clarified by QC, if it is the common understading, we are fine with the first bullet to support both options.  Regarding the 2nd bullet, share similar view with CATT that the associated information of a UE Tx TEG ID with one or more UL SRS resources is beneficial for further resolve the potential mismatch between UE and gNB Rx-Tx time difference (captured by FFS, and also by Proposal 3.3-2).  On the other hand, we are also confused by Note 1 under the 2nd and 3rd bullets. |
| ZTE | According to our understanding, the previous agreement means both options are supported, which is up to UE capability.  We prefer Huawei’s revisions on the Notes. How to report the association between the TEG and RS may be up to signaling design in RAN2. |
| LG | Regarding Rx TEG ID for UE Rx – Tx time difference, since there is description that “Multiple DL PRS resources can be used to determine the start of one subframe” in current specification (38.215) , we agree with third main bullet. However, for the decision on Tx timng for UE Rx – Tx time difference, there is no such descprition. So, considering it, we think it depends on the discussion on wheter the multiple SRS resources are used or not. From the perpective, we discuss it first. |
| Huawei, HiSilicon2 | In our view, the same discussion on SRS-TEG association by RRC+NRPPa or LPP should be expected.  For Multi-RTT, one is certain, that we may TEG ID reporting associated with UE Rx – Tx time difference for each TRP, which means that the Tx time in the measurement is associated with the TEG ID that is linked to the SRS resources further. TEG ID linkage to SRS resource is either RRC+NRPPa or LPP, subject to further discussion. |
| Intel | Support both options. Additionally, we support subbulets 2 and 3 except of the note 2. |
| InterDigital | We support the proposal. In addition, we support both options. |
| Ericsson | We are not pro to the current proposal.  The reason for the UE to transmit multiple SRSs for positioning is that they have different spatial relations and thus are transmitted in different directions. A TRP will only be able to hear the SRS transmitted in the direction of that TRP, i.e. the SRS with a spatial relation to the DL PRS/SSB of that TRP. The choice of which UL SRS to associate to a certain UE Rx-Tx time difference measurement can therefore not be left to UE implementation. Even if the association is signalled by the UE, it can’t be used unless it points to the SRS that is actually transmitted towards and heard by the TRP. Instead of UE signaling the SRS association, the SRS association has to be configured by the network as part of the UE Rx-Tx time difference measurement configuration (i.e. the multi-RTT measurement configuration in LPP).  To make timing error mitigation work for multi-RTT the following agreement is needed:   * *For mitigating UE Tx/Rx timing errors for DL+UL positioning, subject to UE capability a UE should support one or both of the following options:*   + *Option 1: Reporting of UE RxTx TEG ID*     - *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 Rx TEG ID and Tx TEG ID* * *In both options, the multi-RTT measurement configuration should include an association to a UL SRS for each TRP and the TX timing of the UE Rx-Tx time difference measurement for a TRP should be based on the UL SRS associated to that TRP.* * *For Option 1, the reported UE RxTx TEG ID should be based on the DL PRS RX and UL SRS TX associated to the given UE Rx-Tx time difference measurement.* * *For Option 2, the reported UE Tx TEG ID should be based on the UL SRS TX associated to the given UE Rx-Tx time difference measurement.* |
| ZTE2 | Seems it’s diverse on how to associate Tx TEG ID with SRS (or Tx timing). We suggest to agree both Option1 and Option 2 first.  Regarding the SRS-TEG association, it can be discussed together with UL-TDOA. |
| **FL** | 1. About whether to suppot both options, I think the previous agreement says clearly “a UE may support, *up* ***to UE capability, one or both of the following options***:” My interpretation is: depending on UE ***capability***, a UE may support Option 1, or Option 2, or both. So, I don’t see the confusion comes. If the common understanding is that UE needs to always support both options, then it should say: “a UE may support, *up* ***to UE capability, ~~one or~~ both of the following options***”. But, I am not sure if this is all companies want. 2. For the 2nd main bullet “Note 2: The association is the same for both UL-TDOA and DL+UL positioning by default”, my thinking was the same SRS resources can be used for RTOA measurements and/or gNB Rx-Tx measurement to supporting UL-TDOA and DL+UL positioning. In this case, the *association between Tx TEG IDs and SRS resource(s) should be the same for both* UL-TDOA and DL+UL positioning, and UE does not need to report separate reports for the *association between Tx TEG IDs and SRS resource(s).* If it causes any confusion, we can remove it for now. 3. For the 3rd main bullet, “Note 1: *The association can be reported separately from the Rx-Tx time difference measurement report*”. I would agree that it can be removed, since the association of the Rx ID with DL PRS resource is always included with each *Rx-Tx time difference measurement report.*   To vivo’s comments: For “*the Tx TEG ID to SRS resource(s) corresponding to the Tx time of the measurement”,* my thinking is that this is a general statement, similar to: “*DL PRS resource(s) corresponding to the Rx time of the measurement”.* As I commented with the previous figure, UE may not know exactly the “*Tx time of the measurement”.*  To Huawei’s comment: Yes, we may have to discuss the transmission of SRS-TEG association by RRC+NRPPa or LPP. It might be easier after have a conclusion on Proposal 3.2-1(H).  To Ericsson’s comment: SRS configuration has included the QCL’ed DL PRS of a TRP. However, the UL beam may or may not be sent (only) to the TRP (e.g., UL antenna beam is much wider than the DL beam). Thus, it is unclear to me how the UE to report “the *multi-RTT measurement configuration* to include *an association to a UL SRS for each TRP.* In either option, the Tx TEG ID included in a Rx-Tx time difference measurement report should be the SRS resource(s) corresponding to the Tx time of the measurement. |

(Round 2) Proposal 3.3-1(a1)(H)

Make the following modification of the previous agreement:

*For mitigating UE Tx/Rx timing errors for DL+UL positioning, a UE 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 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 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*

Comments

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| **Company** | **Comments** |
| MTK | SRS transmission has spatial relation with a SSB/PRS of a TRP. UE can know which panel as RX TEG could hear the SSB/PRS of a TRP, and then use a same panel as TX TEG to transmit SRS. So UE can determine using which TX TEG to transmit a SRS resource  A TX TEG could transmit multiple SRS resources. It is like UE to perform beam sweeping which has been supported in Rel-16. So a TX TEG is linked to multiple SRS resources. This one-to-many mapping table could be provided to LMF separately from the measurement report. This is why we support Alt. 3  There should be 2nd level details for the two options, which could be done next week or next meeting  For Option 1, the reporting of UE RXTX TEG ID has some meanings,  1, it is to indicate that UE has compensated RX+TX group delay in the UE measurement report. For original UE measurement at baseband, RX group delay is involved. So when UE compensate RX+TX group delay, it means RX group delay is cancelled but TX group delay is additionally added (subtracted with a mins sign). This added TX group delay will be cancelled when combining with a gNB measurement report, since the actual SRS transmission resulting in the TX group delay happens for gNB-side measurement. Therefore, TX TEG ID should be reported together within UE RX-TX time difference measurement report. It seems to us that TX TEG ID reporting within UE measurement report is more important than RXTX TEG ID because TX TEG ID is the key to pair UE-side and gNB-side measurement. And RXTX TEG ID is to indicate how well the compensation could be done  2, it is also to indicate the confidence how UE could compensate RX+TX group delay. So, a RXTX TEG ID should also be linked with a range of residual error. The range of residual error would be different for TDD, FDD or different bands. This requires careful test case design to check whether UE bluff its capability of controlling the residual within a certain range  For Option 2, it is to indicate that UE may not have RX+TX group delay compensation capability, since it consumes a certain implementation cost. Therefore UE expects LMF to do TDOA-like processing to cancel UE side group delay. Then for UE, where to transmit SRS, and where to receive DL-PRS needs to indicate to LMF so that LMF can pair the gNB-side and UE-side measurements to be like performing DL-TDOA+UL-TDOA. RX TEG ID is used to perform like DL-TDOA, and TX TEG IS is used to perform like UL-TDOA  We are also thinking that, for option 2, if the reported pair of RX TEG ID and TX TEG ID could be linked with a range of residual error |
| Huawei, HiSilicon | Agree with the generic intention from the FL. Perhaps we can make it more clear.  *For mitigating UE Tx/Rx timing errors for DL+UL positioning, a UE should support, up to UE capability, either one or both of the following options:*   * *Option 1: Reporting of UE RxTx TEG ID*    + *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.* * *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 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*   Note that in Option 1, my understanding is that Tx TEG ID is anyway reported along with RxTx TEG ID, so basically we are saying  Option 1: RxTx TEG ID + Tx TEG ID  Option 2: Rx TEG ID + Tx TEG ID |
| vivo | For Option 1 and Option 2, we share the same understanding with FL. Up to UE capability, either or both can be supported.  For Tx TEG ID, Alt3 is preferred. |
| ZTE | Support the revision from Huawei with some modifications to avoid ambiguity,  *For mitigating UE Tx/Rx timing errors for DL+UL positioning, a UE should support, up to UE capability, either one or both of the following options:*   * *Option 1: Reporting of UE RxTx TEG ID*    + *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.* * *In either option, an UE Tx TEG ID is associated with (downselection needed)*   + *Alt. 1: an UL SRS resource for positioning corresponding to the Tx timing of the UE Rx-Tx measurement*   + *Alt. 2: the Tx timing of the UE Rx-Tx measurement*   + *Alt. 3: one or more UL SRS resources for positioning* * *Note: An UE Rx TEG ID is associated with one DL PRS resource (or more DL PRS resources) corresponding to the Rx time of the measurement* * *FFS: How to resolve potential mismatch between UE and gNB Rx-Tx time difference measurements (e.g. UE provides the UE Rx-Tx measurements associated with a Tx TEG with SRS1, while gNB provides the gNB Rx-Tx measurements with a Rx TEG associated with SRS2).* * *FFS: The potential impact and modification on the definition of Rx-Tx time difference measurements* |
| OPPO | We are supportive of this proposal. One clarification question for Alt.3: Among one or more UL resource for positioning, does there a SRS resource corresponding to the Tx timing of UE Rx-Tx measurement or not?   * If the answer is yes, we should make it clear for Alt.3 * If the answer is no, what’s the relationship between the UE Tx TEG and the Rx-Tx measurement? |
| Intel | Support proposal. Agree with corrections from Huawei and ZTE |
| CATT | Support.  We are fine with FL’s interpretation “depending on UE capability, a UE may support Option 1, or Option 2, or both”.  We support Alt.3. The reason is that Alt.3 can avoid the issue of potential mismatch between UE and gNB Rx-Tx time difference measurements. Detailed explanation as follows,  If Alt.3 is adopted and the UE Tx TEG ID is associated with one or more UL SRS resources for positioning and decoupled with the Tx timing of the Rx-Tx measurement, then UE can provide a separate report of the association of the Tx TEG ID with the SRS-Pos resources. And the Tx time of UE Rx-Tx time difference measurement is determined by the closest UL subframe #j (as Rel-16 definition), but not by UL Tx time of the SRS-Pos resources. With Alt.3, the reporting of UE Rx-Tx time difference measurement is decoupled from the UE Tx TEG, UE derives Tx timing for the UE Rx-Tx time difference measurement report based on the expected UL Tx time. And the real UL Tx timing errors for transmission of the SRS-Pos resource will be provided by the UE through Tx TEG information. In this way, LMF can determine the UL Tx timing errors based on the received SRS-Pos resource ID to solve the issue of potential mismatch between UE and gNB Rx-Tx time difference measurements (will solve the 2nd FFS). No need to change the definition of UE Rx-Tx time difference measurement provided in Rel-16 (will solve the 3rd FFS). |
| Qualcomm | We are supportive of the intention, and updated version of ZTE (after HW’s revision). Even though, this was the understanding from our side, it may be useful to clarify it. |

### (Closed) Proposal 3.3-1(a1)(H)

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 Rx TEG ID is associated with one DL PRS resource (or more DL PRS resources) corresponding to the Rx time of the measurement*
* *FFS: How to resolve potential mismatch between UE and gNB Rx-Tx time difference measurements (e.g. UE provides the UE Rx-Tx measurements associated with a Tx TEG with SRS1, while gNB provides the gNB Rx-Tx measurements with a Rx TEG associated with SRS2).*
* *FFS: The potential impact and modification on the definition of Rx-Tx time difference measurements*

Comments

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| **Company** | **Comments** |
| Qualcomm | Support (we are just beautifying the previous agreement, but hopefully it will not take long online). |
| CATT | Support the proposal. |
| Apple | Not really needed, but ok |
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(Round 2) Proposal 3.3-1(a2)(H)

* *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), which are related to the Tx time of the UE Rx-Tx time measurement;*
  + *Note 1: The association of the Tx TEG ID to the UL SRS resource(s) can be reported separately from the Rx-Tx time difference measurement report.*

Comments

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| **Company** | **Comments** |
| MTK | Yes, we need a one-to-many table since a TX TEG ID is linked with multiple SRS resources. This table could be separately reported from the UE measurement reports. But a TX TEG ID should be within UE measurement reports |
| Huawei, HiSilicon | OK. By “reported separately”, our understanding is that it currently does not preclude any of the following case:   * Alt.1 RRC * Alt.2 The same LPP message as what contains the RTT measurement * Alt.3 A different LPP message from what contains the RTT measurement |
| vivo | We agree with the intention.  But we are confused about how to related to the Tx time of the UE Rx-Tx time measurement. That is, we are not in favor of establishing a mapping relationship by the definition modification which is listed in the current two options in proposal 3.3-3.  From our understanding, at least, the UL time stamp (transmitted SRS), Rx-Tx measurement time stamp, and some margin defined by RAN4 or the validity index also can be used to resolve the mismatch and establish a mapping relationship. |
| ZTE | Does this proposal try to downselect the three alternatives in proposal 3.3-1(a1)? If answer is yes, we think current wording is a bit unclear. Do you mean UE Tx TEG ID is associated with the Tx timing of the Rx-Tx measurement (i.e. Alt.2) or one or more UL SRS resources for positioning (i.e. Alt.3)? |
| OPPO | A bit confused with the proposal. According to Note 1, the association can be reported by other signalling. In this case, why we still need to report the association in the Rx-Tx time different measurement? Do the main bullet intend to report the UL RS resource(s) associated with the TEG ID? |
| Intel | Suport |
| CATT | Support.  In our point of view, the reporting of UE Rx-Tx time difference measurement is decoupled from the UE Tx TEG, UE should separately report the association of the Tx TEG ID to the UL SRS resource(s) from the Rx-Tx time difference measurement report, in order to solve the issue of potential mismatch between UE and gNB Rx-Tx time difference measurements. |
| Qualcomm | Support. |
| Ericsson | Do not support. As we commented in the previous round, the multi-RTT measurement configuration should include an association to a UL SRS for each TRP, and the TX timing of the UE Rx-Tx time difference measurement for a TRP should be based on the UL SRS associated to that TRP.   * *For Option 1 in Proposal 3.3-1(a1)(H), the reported UE RxTx TEG ID should be based on the DL PRS RX and UL SRS TX associated to the given UE Rx-Tx time difference measurement.* * *For Option 2 in the Proposal 3.3-1(a1)(H), the reported UE Tx TEG ID should be based on the UL SRS TX associated to the given UE Rx-Tx time difference measurement.* |
| Qualcomm2 | To Ericsson: It is still unclear to me what the concern proposal is. Can you please provide a concrete example? It seems you are saying that LMF provides SRS IDs in the Location Request (?), and the UE reports RxTx measurements for those SRS IDs? I thought we were debating in Rel-16, that SRS should be chosen by the LMF, and Ericsson was so against it.  Either way, how is that related here? Even if SRS ID is provided, even if the UE reports an RxTx measurement derived baased on that SRS ID (assuming that the RxTx definition changes), how is that related to the TxTEG or RxTxTEG discussion? For any PRS/SRS measured, the UE picks the TxTEG or RxTEG or RxTxTEG. So, the UE would have to report what TEG was used. The TEG association to SRS is NOT static, and its interpretation changes dynamic (e.g. UE changes BWP, goes to RRC Inactve, changes RRC config, turns off antennas, panels, etc).  Having said the above: Yes, the RxTxTEG is based on the Rx PRS and SRS Tx obviously, but this doesn’t say anything about what we report. The proposal from the FL is what the UE reports, and it says: When the UE adds TxTEG<-> RxTx measurement, also report TxTEG <-> SRS. |
| **FL** | **To Huawei**: I assume how the information is reported to LMF can be further discussed in next meeting once we have a conclusion on Proposal 3.2-1 (H). We could add: “*FFS: details of the signalling*”  **To vivo:** In my view,the definition of Tx information to the UE Rx-Tx time measurement can/should be handled in Proposal 3.3 in my view. Let us focus on the Tx TEG association first here.  **To ZTE:** Simialr to the response to vivo,I think how to/whether to downselect the three alternatives in proposal 3.3-1(a1) can be wait for the conclusion on Proposal 3.3. In my view, regardless which of the three alternatives in proposal 3.3-1(a1) is selected, there is a need to report the Tx TEG association with the SRS resources.  **To Ericsson:** It is also unclear to me what the conncer is. We have agreed that each UE Rx-Tx time difference measurement can be assoaited with an Tx TEG, and it is obviuous that the Tx TEG can be associated with one or more SRS resources. The proposal is just to say Tx TEG asscocistion needs to be reported to the LMF.  If seems most companies are |

(Round 3) Proposal 3.3-1(a2)(H)

* *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), which are related to the Tx time of the UE Rx-Tx time measurement;*
  + *Note 1: The association of the Tx TEG ID to the UL SRS resource(s) can be reported separately from the Rx-Tx time difference measurement report.*
  + *FFS: details of the signalling*

Comments

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| **Company** | **Comments** |
| Qualcomm | Support the proposal |
| MTK | We basically support the association. Just one small concern, do we really need the wording “*which are related to the Tx time of the UE Rx-Tx time measurement”?*  It seems to us that we just need a table providing the one-to-many mapping between TX TEG ID and SRS resources. And we already define what TX TEG is.  Can we just remove this sentence? |
| Huawei, HiSilicon | Support the proposal.  To MTK, we think that multiple SRS resources can share the same timing, and this one-to-many may be necessary. |
| LG | Agree with the proposal. |
| CATT | Support. |
| OPPO | We don’t fully understand this proposal. Could FL make some clarification for our question raised in Round 2?    A bit confused with the proposal. According to Note 1, the association can be reported by other signalling. In this case, why we still need to report the association in the Rx-Tx time different measurement? Do the main bullet intend to report the UL RS resource(s) associated with the TEG ID? |
| vivo | Generally supportive , but same view as MTK, we can remove “*which are related to the Tx time of the UE Rx-Tx time measurement”* and handle it in Proposal 3.3. |
| **FL** | **To OPPO:** Sorry for missing the comments in the Round 2 discussion. Yes, the intention of the intend to report the UL RS resource(s) associated with the TEG ID. When a UE reports a Rx-Tx measurement, it will report a Tx TEG ID with the measurement. The UE needs to let the LMF know the Tx TEG ID is associated with which SRS resources.  **To MTK/vivo:** I don’t have strong view on whether to keep or remove the wording “which are related to the Tx time of the UE Rx-Tx time measurement”. In my view, it would be better to keep it, since it is obvious the UE will not randomly include a Tx TEG ID with the UE Rx-Tx measurements. The Tx TEG ID should be associated SRS resources that *are related to* the Tx of the Rx-Tx measurement, regardless what conclusion we are going to make for Proposal 3.3. I on purposely use the vague wordking “**related to**”, but not “**determined by**”, to cover all of the options in Proposal 3.3. |
| ZTE | The same view with MTK and vivo. The sentence seems like we already decide that Alt.2 in Proposal 3.3-1(a2) is selected. |
| Ericsson | To respond to some questions in the previous round, our concern is that if it’s left to the UE to choose which SRS to use to define the TX timing of the UE Rx-Tx time difference measurement, then the UE may select an SRS which the TRP isn’t hearing or an SRS which the TRP isn’t even trying to receive, and thus that no RTT can be calculated.  Our preference is that the network signals to the UE which SRS to use for the TX timing for a certain UE Rx-Tx time difference measurement.  As a compromise, we could accept that the UE instead reports the SRS association if the UE behavior is specified in the following way:  **“If the UE has been configured with an SRS with a spatial relation towards a DL PRS or SSB from a TRP, then that SRS shall be used to define the TX timing of UE Rx-Tx time difference measurements towards that TRP.”**  Note 1 we find a bit confusing. It should be clear that it’s possible to report the Tx TEG ID in the multi-RTT report. If a multi-RTT report is sent, then it’s most efficient to include the TX TEG association in that report. It’s true that it should also be possible to send the TX TEG association in a separate report but that’s primarily intended for UL TDOA purposes when no multi-RTT report is sent. We propose that the note is removed or clarified in the following way:  *Note 1: The association of the Tx TEG ID to the UL SRS resource(s) can as an alternative be reported separately from the Rx-Tx time difference measurement report.* |
| Apple | If the intention is to have an association between UE Rx-Tx report and TEG for SRS used for the measurement, we are ok with the intention, although we cannot support the current version, as it is only for he case that TX TEG for SRS is reported. We know another solution is to associate Rx-Tx measurement with RxTx TEG (effective Rx TEG for PRS reception and Tx TEG for SRS transmission) |
| FL | **To Ericsson:** If I understand Ericsson comment currently, if an SRS is QCLed with a DL PRS of a TRP, the UE receveis the DL PRS, which is used for the Rx time of the Rx-Tx time measurement, then the UE should use the SRS for Tx time of the Rx-Tx time measurement, and the Tx TEG ID should be associated with the SRS. I assume Ericsson’s proposal is one step further than the current proposal, since the current proposal only say the UL SRS resource(s) are related to the Tx time of the UE Rx-Tx time measurement, but it does not say how the UE determined the UL SRS resource(s).  *“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)~~, which are related to the Tx time of the UE Rx-Tx time measurement.~~ If the DL PRS resource, which was used to determine the Rx timing of UE Rx-Tx time difference measurement, is configured to be QCLed with a SRS resource, the Tx TEG association should include the SRS resource;*   * *If the UE has been configured with an SRS with a spatial relation towards a DL PRS or SSB from a TRP, then that SRS shall be used to define the TX timing of UE Rx-Tx time difference measurements towards that TRP*   + *Note 1: The association of the Tx TEG ID to the UL SRS resource(s) can be reported separately from the Rx-Tx time difference measurement report.*   + *FFS: details of the signalling*   For the note, I assume how to report it not an critical issue. Maybe we can say:  *Note 1: The association of the Tx TEG ID to the UL SRS resource(s) can be reported together with or separately from the Rx-Tx time difference measurement report*  **To Apple:** I am notsure if I fully undersand the comment. The another solution to associate Rx-Tx measurement with RxTx TEG was already agreed. |

(Round 4) Proposal 3.3-1(a2)(H)

* *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). ~~If the DL PRS resource, which was used to determine the Rx timing of UE Rx-Tx time difference measurement, is configured to be QCLed with a SRS resource, the Tx TEG association should include the SRS resource.~~*
  + *Note 1: The association of the Tx TEG ID to the UL SRS resource(s) can be reported together with, or separately from, the Rx-Tx time difference measurement report.*
  + *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*

Comments

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| **Company** | **Comments** |
| Nokia/NSB | We think it will be simpler to just have the UE report the SRS resource ID(s) associated with the measurement and the TEG (i.e., Alt 3 of the prior agreement).   In the current proposal what do we do if the DL PRS is not QCLed with a SRS resource? |
| Qualcomm | Thanks for the discussion. Ericsson proposal is not related to TEG reporting. It is a complete separate; related to the a generic UE Rx-Tx measurement requirement principle.  The topic that Ericsson is discussing is: If the UE is transmitting multiple SRS, and if there is an Rx-Tx measurement association to an SRS (Proposal 3.3-3), then which SRS should be used to derive the Tx timing? No matter what is the answer, for the chosen SRS, the UE will report TEG, which is what this proposal is supposed to be about.  We suggest to Ericsson to include their question/topic in the 3.3-2 area (regarding the definition of Rx-Tx and association to an SRS).  Having said the above, we don’t agree with the new proposal and we suggest to try to keep each proposal self-contained and to-the-topic at task. |
| **FL** | **To Nokia**: We may consider adding FFS for the case when the DL PRS is not QCLed with a SRS resource. If SRS is configured to be QLCed with SSB, the may determine the SRS based on the SSB, which is the same TRP as the DL PRS.  **To Qualcomm:** I share the same view as Qualcomm that how to determine Tx TEG association is a separate issue from the the reporting of the Tx TEG association.   * *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). ~~If the DL PRS resource, which was used to determine the Rx timing of UE Rx-Tx time difference measurement, is configured to be QCLed with a SRS resource, the Tx TEG association should include the SRS resource.~~*   + *Note 1: The association of the Tx TEG ID to the UL SRS resource(s) can be reported together with, or separately from, the Rx-Tx time difference measurement report.*   + *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* |
| Huawei, HiSilicon | We agreed with the above modification from the FL.  With regard to suggestions from Ericsson, configuring PRS as the QCL (spatial relation) could serve as network implicity recommendation/preference of association between Rx timing and Tx timing in the UE Rx – Tx time difference, but we think the TEG-SRS association should anyway be decided by UE taking into the recommendation into account. |
| ZTE | Agree with FL’s latest modificatiom.  Erisson’s suggestion is another issue, which can be discussed in 3.3-2 . |
| MTK | Yes, FL’s version is very proper  A SRS resource has spatial relation with a DL RS. In our view, UE transmits SRS according to spatial relation. The natural operation for UE is to receive DL-PRS and transmit SRS using a same antenna panel and the spatial relation is between DL-PRS and SRS.  So we don't see this is a problem |
| vivo | OK with FL’s latest version. |
| CATT | Support the revised verion from FL above. |
| OPPO | We support Nokia’s suggestion “We think it will be simpler to just have the UE report the SRS resource ID(s) associated with the measurement and the TEG (i.e., Alt 3 of the prior agreement).” Thus, we propose some modifications as below (Highlighted by Yellow)   * *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) associated with the Tx TEG ID. ~~If the DL PRS resource, which was used to determine the Rx timing of UE Rx-Tx time difference measurement, is configured to be QCLed with a SRS resource, the Tx TEG association should include the SRS resource.~~*   + *Note 1: The association of the Tx TEG ID to the UL SRS resource(s) can be reported together with, or separately from, the Rx-Tx time difference measurement report.*   + *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* |
| Intel | Support |
| **FL2** | **To Nokia/Qualcomm**: Please check if the latest revision above of “FL” has addressed your concern.  **To OPPO**: Maybe I have missed something, but I would like to understand the motivation and the difference for OPPO’s proposal to change “*report* *the association of the Tx TEG ID to the UL SRS resource(s)” to “report the UL SRS resource(s) associated with the Tx TEG ID”.* Assume Tx TEG ID1 is assoiated with {SRS1, SRS2, …}. “Reporting *the association of the Tx TEG ID to the UL SRS resource(s)” implies the UE should send the following to the LMF:*  {Tx TEG ID 1   * SRS1 * SRS2 * …   }  Does OPPO proposes to report something differently by changing the wording to “reporting the UL SRS resource(s) associated with the Tx TEG ID”? |
|  |  |

Comments

(Round 5) Proposal 3.3-1(a2)(H)

* *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~~.~~*
  + *Note 1: The association of the Tx TEG ID to the UL SRS resource(s) can be reported together with, or separately from, the Rx-Tx time difference measurement report.*
  + *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*

Comments

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| **Company** | **Comments** |
| Ericsson | The concern that we raised in previous rounds is not addressed. So we cannot agree to the proposal. Note that it is really the TEG ID of the UL SRS that the TRP can hear (i.e., spatially related towards the DL PRS or SSB from the TRP) that we need. If the UE reports TEG ID of some other UL SRS the UE doesn’t hear, then we don’t see how this concepts work.  We can only accept this proposal if the following note is added:  Note: If the UE has been configured with an SRS with a spatial relation towards a DL PRS or SSB from a TRP, then that SRS shall be associated to the UE TX TEG reported in the UE Rx-Tx time difference measurement. |
| Qualcomm | We don’t agree with Ericsson additional Note, which is a separate topic.   * Quick comment: TEG-IDs is not only just about panels. TEG-ID can be different just because the UE changed Active BWP, or the SRS is far away from a previous SRS. * But, even without the above comment, the procedure from our understanding is:   + UE is configured with an SRS associated with a PRS/SSB. UE decides which Rx-Tx measurements will be reported. For those reported, a TEG-ID (and an TEG-ID <-> SRS) may be provided.   + So the question is not what is the TEG ID, is what is the SRS that the UE will use to report Rx-Tx measurements.   Can Ericsson acknowledge, independent of the TEG discussion, that the topic they are interested in is: Which SRS will the UE use to report Rx-Tx measurement? If yes, then this seems related to 3.3-2.  We are OK with the proposal as is now. |
| Huawei, HiSilicon | We are fine with the proposal.  Question so Ericsson comments:  1. Why does it have to be spatial relation, instead of pathloss reference, assuming we may not have spatial relation in FR1, but pathloss reference could be possible.  2. I think the intention of the second half sentence is intended to be  SRS shall be associated to the UE TX TEG reported in the UE Rx-Tx time difference measurement, in which the Rx time is derived by the DL PRS.  If that is the case, how should UE do with SSB configured as the spatial relation?  We understand the intention is to avoid mismatch between UE Rx – Tx time and gNB Rx – Tx time, however we think this should be further investigated and is a separate discussion. Putting UE mandatory behaviour in a Note is not the way forward. |
| OPPO | @FL: Let clarify a bit more on our proposal.  First of all, we share the same view as FL on the association, e.g., an associatin is copied as below (from FL example), and we refer to it by using A1  {Tx TEG ID 1   * SRS1 * SRS2 * …   }  Accordign to Note 1, A1 can be reported separately the Rx-Tx time difference measurement report. Then, in a Rx-Tx time different measurement report, if the following association (A2) is reported where SRS 1 used for the measurement, then is the association of A1 is still valid, or is the association of A1 is overrided by A2 (i.e., only SRS1 is associated with Tx TEG ID 1) ?   * If the associatin of A1 is still valid, it means the main bullet does not report the association, but the associated SRS1, which is the intention of our modification . * If the association of A1 is overrided by A2, why do we need to change the association for each report?   {Tx TEG ID 1   * SRS1   } |
| LG | We have similar view to QC and HW, we support the current version of the proposal without the note regarding ericsson’s comment. |
| CATT | Support. |
| ZTE | We’re generally fine with the current proposal without the note from Ericsson.   * SRS may always have association of TEG, no matter what the spatial relation/path loss is configured for the SRS. * For the Note 1, do we expect the TEG-SRS association can be reported for both approaches (i.e. together or separate with the measurement report) or one of the approaches ? Since we have decided the TEG-SRS association is provided by RRC+NRPPa or LPP, we prefer to change Note 1 to FFS. |
| vivo | OK with the current proposal.  Regarding the issues of ‘TEG mismatch’, we can further discuss them in the next meeting. |
| Ericsson comment 2 | Qualcomm asked us: “Can Ericsson acknowledge, independent of the TEG discussion, that the topic they are interested in is: Which SRS will the UE use to report Rx-Tx measurement? If yes, then this seems related to 3.3-2.”  Ericsson answer: No we don’t think this is related to which SRS the UE will use to report Rx-Tx measurement.  There are multiple ways to make timing error mitigation work for multi-RTT. We are trying to make agreements on bits and pieces that have to fit together to make it all work. It’s not possible to discuss one proposal in isolation. Each company has their own view on the complete picture which makes it hard to agree.  Let’s e.g. assume that we keep the current definition of the UE Rx-Tx time difference measurement. Then we note:  1. The UE RX TEG associated to, and reported together with the UE Rx-Tx td measurement is clearly coupled to the DL PRS based TOA measurement used for the UE Rx-Tx td measurement.  2. The UE has only one TX timing. There may be different timing errors for different antenna panels, but they are unknown to the UE. There is, thus no UE TX TEG associated to the UE Rx-Tx time difference measurement (assuming we keep current definition of UE Rx-Tx time difference measurement).  3. There is, however, a UE TX TEG associated to the transmission of the UL SRS that is used for the corresponding gNB Rx-Tx td measurement. This association is needed in the LMF to enable timing error mitigation and is most effectively included in the multi-RTT measurement report, despite the fact that it doesn’t really have anything to do with the UE Rx-Tx td measurement.  4. It’s crucial that the TX TEG information signaled is for the UL SRS that the TRP is using for the gNB Rx-Tx td measurement. Which SRS this is could be configured explicitly by the network or deduced implicitly by the UE based on spatial relations. It’s in principle possible to include TEG associations for multiple SRSs since the association has nothing to do with the value of the UE Rx-Tx td measurement reported (assuming we keep current definition of UE Rx-Tx time difference measurement).  5. To take into account timing adjustments made in the time interval between the RX of the DL PRS and the TX of the UL SRS, the timing adjustments made need to be signaled to the LMF (option 3 in 3.3-3). This is most effectively done by including timing adjustments in the multi-RTT report. It’s crucial that the timing adjustments reported are for the time interval between the DL PRS used for the UE Rx-Tx time difference measurement and the UL SRS that the TRP is using for the gNB Rx-Tx td measurement. Again, which UL SRS this is could be configured explicitly be the network or deduced implicitly by the UE based on spatial relations.  This is one way to make all the pieces fit together. We are not locked to one specific solution but are rather interested in making it all work.  For the sake of progress we can accept the current proposal, including the FFS. |
| **FL** | **To OPPO/ZTE**: It seems the comments are about two reports of the TEG associations for the same Tx TEG ID: one is reported with measurement report and one is separate from the measurement report. Then, there can be conflict between the two reported TEG associations. The intention of the note is that UE either either send the report together with the measurement report, or separate from the measurement report. Should the following change address the concern?  *Note: The association of the Tx TEG ID to the UL SRS resource(s) can be reported either together with, or separately from, the Rx-Tx time difference measurement report.* |

### (Round 6) Proposal 3.3-1(a2)(H)

* *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~~.~~*
  + *Note 1: The association of the Tx TEG ID to the UL SRS resource(s) can be reported either together with, or separately from, the Rx-Tx time difference measurement report.*
  + *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*

Comments

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| **Company** | **Comments** |
| Qualcomm | Support (under the common understanding that “Note 1” means that the spec will support both reporting together and separately right?) |
| Apple | I think my previuos comment is not understood or maybe I have a misunderstanding. On a separate (but related) issue, we already agreed two options for association of UE Rx-Tx and TEGs (i.e. Option 1: Reporting of UE RxTx TEG ID and Option 2: Reporting of UE Rx TEG ID and UE Tx TEG ID). Is it true to say new proposal mainly assumes option 2 in what we already agreed? Of course it starts with “if a Tx TEG ID”, but what if UE supports option 1, i.e. reports RxTx TEG ID. |
| **FL** | **To Apple**: We have the agreement to report UE RxTx TEG ID for Option 1, and reporting of UE Rx TEG ID and UE Tx TEG ID for Option 2. But, we do not have the agreement to report the association of the UE Tx TEG ID with the SRS resource(s). The UE may or may not report *Tx TEG ID.* The agreement say if *Tx TEG ID* is reported, then the UE needs to report the association of the UE Tx TEG ID with the SRS resource(s). |
| Nokia/NSB | Okay. |
| Huawei, HiSilicon | To apple: To our understanding, Tx TEG ID should be reported for both Option 1 and Option 2, otherwise, we will have problem with RxTx TEG reporting.  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 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 |
| CATT | Support. |
| OPPO | @FL: Thanks for the clarification. If I understand correctly, the proposal should be revised as below since “should” means UE needs to report the association in each UE Rx-Tx time difference measurement report. Please feel free to correct me if I misunderstood/missed something.   * *If a Tx TEG ID is reported with a UE Rx-Tx time difference measurement, the UE ~~should~~ may also report the association of the Tx TEG ID to the UL SRS resource~~.~~*   + *Note 1: The association of the Tx TEG ID to the UL SRS resource(s) can be reported either together with, or separately from, the Rx-Tx time difference measurement report.*   + *FFS: how the the association of the Tx TEG ID to the UL SRS resource(s) is determined by UE.* |
| ZTE | The same question with Qualcomm on the note. Otherwise, we prefer to treat the note as FFS or a separate issue. |
| vivo | Support |
| Intel | Support. |

(Round 2) Proposal 3.3-1(a3)(H)

* *If a RxTx TEG ID is reported with a UE Rx-Tx time difference measurement, the UE may also report the association of the RxTx TEG ID with a pair of {Rx TEG ID, Tx TEG ID}.*

Comments

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| **Company** | **Comments** |
| MTK | When a RXTX TEG ID is reported, to further report TX TEG ID is enough, not a pair of {RX TEG ID, TX TEG ID}  Also it is more important to have association between a RXTX TEG ID and a range of residual error |
| Huawei, HiSilicon | We have doubt on the necessity. Further study is suggested. |
| vivo | OK |
| ZTE | We think Tx TEG ID is already discussed in Proposal 3.3-1(a1). The Rx TEG ID needs further study. |
| Intel | Suport |
| CATT | We are fine with the reporting of Tx TEG ID. |
| Qualcomm | A UE can include optionally a TxTEG ID in addition to RxTx TEG ID in the Rx-Tx measurement report. We are OK to keep Rx TEG as FFS. It should be clear, that if TxTEG is reported, then the TxTEG to SRS association is also needed (maybe it is obvious, but it is good to repeat it).   * *If a RxTx TEG ID is reported with a UE Rx-Tx time difference measurement, the UE may also report a Tx TEG ID.*    + *Note 1: The association of the Tx TEG ID to the UL SRS resource(s) can be reported separately from the Rx-Tx time difference measurement report.* |
| **FL** | It looks most companies do not think it is necessary to report Rx TEG, but Tx TEG, when a RxTx TEG ID is reported. |
| LG | Not support. The motivation of the proposal seems unclear to us. |

(Round 3) Proposal 3.3-1(a3)(H)

* *If a RxTx TEG ID is reported with a UE Rx-Tx time difference measurement, the UE may also report a Tx TEG ID.* 
  + *Note 1: The association of the Tx TEG ID to the UL SRS resource(s) can be reported separately from the Rx-Tx time difference measurement report.*

Comments

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| **Company** | **Comments** |
| Qualcomm | Support the proposal |
| MTK | Yes, a TX TEG ID is needed within the UE measurement report. Thus LMF can know how to pair UE measurement with gNB measurement.  A RX TEG ID is not needed when a RXTX TEG ID is reported  Also a RXTX TEG ID may need to be associated with a range of error, which can also be separately reported. We may discuss this in next meeting |
| Huawei, HiSilicon | Support the proposal. |
| CATT | We are fine with the proposal. |
| OPPO | Support |
| vivo | We just want to confirm that this proposal is discussed based on the case of UE only supporting Option1 in previous agreement. If not, we think Rx TEG should be optional included, since in the case of ‘support both of the following options’(Option1+Option2), UE may provide the mapping information between ‘{Rx TEG ID,Tx TEG ID}’ and ‘RxTx TEG ID’   |  | | --- | | Agreement:  Make the following modification of the previous agreement:  For mitigating UE Tx/Rx timing errors for DL+UL positioning, a UE ~~may~~ should support, up to UE capability, either one or both of the following options:   * Option 1: Reporting of UE RxTx TEG ID ~~is supported by the UE~~   + FFS: Further details on how the UE RxTx TEG IDs are related/associated to UE Tx TEG IDs and/or UE Rx TEG IDs and to the UE Rx-Tx measurements. * Option 2: Reporting of ~~UE RxTx TEG ID is not supported by the UE; reporting of~~ UE Rx TEG ID and UE Tx TEG ID ~~is supported~~. | |
| ZTE | Okay with the proposal. |
| **FL** | **To vivo**: The wording “**may also**” means “oppotional” to me. We could use “*may oppotionally* “ if it addresses vivo’s concern. |
| Ericsson | Ok to report a *Tx TEG ID.*  Note 1 we find a bit confusing. It should be clear that it’s possible to report the Tx TEG ID in the multi-RTT report. If a multi-RTT report is sent, then it’s most efficient to include the TX TEG association in that report. Note the associated SRS is defined by the compromised note we suggested in the previous proposal:  ***“If the UE has been configured with an SRS with a spatial relation towards a DL PRS or SSB from a TRP, then that SRS shall be used to define the TX timing of UE Rx-Tx time difference measurements towards that TRP.”***  It’s true that it should also be possible to send the TX TEG association in a separate report but that’s primarily intended for UL TDOA purposes when no multi-RTT report is sent. We propose that the note is removed or clarified in the following way:   * + *Note 1: The association of the Tx TEG ID to the UL SRS resource(s) can as an alternative be reported separately from the Rx-Tx time difference measurement report.* |
| **FL** | **To Ericsson**: For the note, we may say “*Note 1: The association of the Tx TEG ID to the UL SRS resource(s) can be reported together with or separately from the Rx-Tx time difference measurement report.* |

(Round 4) Proposal 3.3-1(a3)(H)

* *If a RxTx TEG ID is reported with a UE Rx-Tx time difference measurement, the UE may also report a Tx TEG ID.* 
  + *Note 1: The association of the Tx TEG ID to the UL SRS resource(s) can be reported together with , or separately from, the Rx-Tx time difference measurement report.*

Comments

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| **Company** | **Comments** |
| Nokia/NSB | Okay. If the intention is to take Alt. 3 from the prior agreement we should make that clearer. |
| Qualcomm | OK |
| Huawei, HiSilicon | We are a little confused between a2 and a3. Are they alternative proposals or does a3 settle the condition of a2? |
| ZTE | OK.  To Huawei, a3 is saying one of the example that the Tx TEG ID needs to be reported . a2 means when Tx TEG ID is reported, UE also need to report SRS-TEG association. |
| MTK | Yes |
| vivo | OK |
| CATT | Support. |
| OPPO | OK |
| Intel | Agree with the proposal |
| **FL** | **To Huawei:** As explained by ZTE, a3 is for Option 1 when the UE reports *RxTx TEG ID, it may optionally report Tx TEG ID.* |

(Round 5) Proposal 3.3-1(a3)(H)

* *If a RxTx TEG ID is reported with a UE Rx-Tx time difference measurement, the UE may also report a Tx TEG ID.* 
  + *Note 1: The association of the Tx TEG ID to the UL SRS resource(s) can be reported together with , or separately from, the Rx-Tx time difference measurement report.*

Comments

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| --- | --- |
| **Company** | **Comments** |
| Qualcomm | OK |
| Huawei, HiSilicon | OK. |
| OPPO | OK |
| LG | Agree. |
| CATT | Support. |
| ZTE | OK in principle. The same comment for Note 1 in Proposal 3.3-1(a2). |
| vivo | OK |
| Ericsson | OK |
| **FL** | **To ZTE:** Make the similar change as Proposal 3.3-1(a2). |

### (Round 6) Proposal 3.3-1(a3)(H)

* *If a RxTx TEG ID is reported with a UE Rx-Tx time difference measurement, the UE may also report a Tx TEG ID.* 
  + *Note 1: The association of the Tx TEG ID to the UL SRS resource(s) can be reported either together with , or separately from, the Rx-Tx time difference measurement report.*

Comments

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| **Company** | **Comments** |
| Qualcomm | Support (under the common understanding that “Note 1” means that the spec will support both reporting together and separately right?) |
| Apple | Question for clarification: what is the delta between this proposal and the previous agreement (also copied by vivo)? |
| **FL** | **To Apple**: For Option 1 in the previous agreement, we have the following “*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.”* The proposal is to say, if UE takes the Option 1 to report *UE RxTx TEG IDs*, it can also report a Tx TEG ID. |
| Nokia/NSB | Okay. |
| CATT | Support. |
| OPPO | Support |
| ZTE | The same question with Qualcomm on the note. Otherwise, we prefer to treat the note as FFS or a separate issue. |
| vivo | Support |
| Intel | Support. |

### Proposal 3.3-1b(H)

* *For mitigating TRP Tx/Rx timing errors for DL+UL positioning, a TRP should support one or both of the following options:*
  + *Option 1: Reporting of TRP RxTx TEG ID*
    - *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 Rx TEG ID and 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*
* *If a Rx TEG ID is included with a Rx-Tx time difference measurement report, the TRP should report the association of the Rx TEG ID to UL SRS resource(s) corresponding to the Rx 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 UL-TDOA and DL+UL positioning by default*
* *FFS: The potential impact and modification on the definition of gNB Rx-Tx time difference measurements*

Comments

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| --- | --- |
| **Company** | **Comments** |
| Huawei, HiSilicon | We do not think we should propel on the TRP part, but if so, some wording suggestions as below.   * *For mitigating TRP Tx/Rx timing errors for DL+UL positioning, a TRP should support one or both of the following options:*   + *Option 1: Reporting of TRP RxTx TEG ID*     - *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 TRP Rx TEG ID and 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 the Tx time of the measurement*   + *Note 1: The association between Tx TEG ID and DL PRS resource(s) 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* * *If a Rx TEG ID is included with a Rx-Tx time difference measurement report, the TRP should report the association of the Rx TEG ID to UL SRS resource(s) corresponding to the Rx time of the measurement*   + *Note 1: Void*   + *Note 2: The association is the same for both UL-TDOA and DL+UL positioning by default* * *FFS: The potential impact and modification on the definition of gNB Rx-Tx time difference measurements* |
| CATT | We prefer to discuss this similar issue in UE side firstly, then consider how to apply it in the TRP side. |
| vivo | At least, change UE Rx TEG ID and Tx TEG ID to TRP Rx TEG ID and Tx TEG ID in option 2 |
| LG | Same with our view’s in proposal 3.3-1a |
| Intel | Support both options. Additionally, we support subbulets 2 and 3 except of the note 2. |
| Ericsson | In the first bullet, Option 2 should be revised as follows:   * + *Option 2: Reporting of UE TRP Rx TEG ID and Tx TEG ID* |
| FL | It might easier that we will continue the discussion for gNB after we reach the consensus on Proposal 3.3-1a for UE. |

## Configuration of the association between DL PRS and UL SRS

Submitted Proposal

* ***(Ericsson,*** [***R1-2108164***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)***[19])Proposal 15 Support signaling from the LMF to the UE of an association between each DL PRS resource set with an UL SRS, either in the NR Multi-RTT Location Information Request or in the NR Multi-RTT Assistance Data (details for RAN2 to decide). Based on what DL PRS the UE utilizes for the RX timing in the UE Rx-Tx time difference measurement, the UE shall find the associated UL SRS and utilize that UL SRS to define the TX timing in the UE Rx-Tx time difference measurement.***

FL Comment

In the previous agreement, there is a remaining issue on “*How to resolve potential mismatch between UE and gNB Rx-Tx time difference measurements (e.g. UE provides the UE Rx-Tx measurements associated with a Tx TEG with SRS1, while gNB provides the gNB Rx-Tx measurements with a Rx TEG associated with SRS2*)”. For resolving the issue, it was proposed in [19] to support signaling from the LMF to the UE of an association between each DL PRS resource set with an UL SRS, either in the NR Multi-RTT Location Information Request or in the NR Multi-RTT Assistance Data (details for RAN2 to decide). Based on what DL PRS the UE utilizes for the RX timing in the UE Rx-Tx time difference measurement, the UE shall find the associated UL SRS and utilize that UL SRS to define the TX timing in the UE Rx-Tx time difference measurement.

Proposal 3.3-2 (H)

* *Support signaling from the LMF to the UE of an association between each DL PRS resource set with an UL SRS, either in the NR Multi-RTT Location Information Request or in the NR Multi-RTT Assistance Data (details for RAN2 to decide).*

Comments

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| **Company** | **Comments** |
| Huawei, HiSilicon | We believe if it is the case for FR2, when directional SRS transmission is possible, it can be done via existing spatial relation or pathloss reference.  For FR1, since the UE is using omni transmission, it is difficult to assign one-to-one mapping between SRS and PRS. |
| CATT | We believe the issue on“*How to resolve potential mismatch between UE and gNB Rx-Tx time difference measurements (e.g. UE provides the UE Rx-Tx measurements associated with a Tx TEG with SRS1, while gNB provides the gNB Rx-Tx measurements with a Rx TEG associated with SRS2)*” can be solved by a Tx TEG ID should be associated with one or more UL SRS resources for positioning and decoupled with the Tx timing of the Rx-Tx measurement (Alt.3).  The signaling from the LMF to the UE of an association between each DL PRS resource set with an UL SRS may also solve the issue, but it need additional standard efforts, so we prefer the previous one. |
| OPPO | We understand the intension. However, we would like to know more details how LMF match PRS and SRS when PRS and SRS are transmitted with specific directions and how UE works, and we may provide, if necessary, some details/examples to RAN2 to facilitate the siganling design, which may impact NRPPa as well. For example, X(>1) PRS resources with in a set is transmitted for different direction, how should a UE to determine the Tx beam for the associated SRS to ensure that the TRP can have a good reception? |
| Ericsson | Support the proposal. |
| ZTE | This might be useful for FR2 when UE can do Tx beam sweeping. OK for further study. |
| Nokia/NSB | We are a bit unclear what exactly we are proposing. It also says between each DL PRS resource set and an UL SRS. Is the intention to map the PRS resource sets to a single SRS resource? |
| **FL** | It is also a little bit unclear to me how to “the association between each DL PRS resource **set** with an UL SRS” helps. Maybe what the proponent suggested is the “the association between each DL PRS resource within a resource **set** with an UL SRS”.  Then, the question is: even the LMF can use the information to know associated UL SRS, the UL SRS may not be received by the TRP that sends the DL PRS for the Rx-Tx measurement. On the other hand, if the assumption is that the TRP that sends the DL PRS can always received the associated UL SRS, then the association information is already indiecated by the existing QCL information in SRS configuration as Huawei commented.  It seems more discussion and clarifictino is needed. Suggest lowering the priority for this meeting. |

### (Round 2) Proposal 3.3-2

* *Support signaling from the LMF to the UE of an association between each DL PRS resource in the DL PRS resource set with an UL SRS, either in the NR Multi-RTT Location Information Request or in the NR Multi-RTT Assistance Data (details for RAN2 to decide).*

Comments

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| **Company** | **Comments** |
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## Definition of UE Rx-Tx time difference measurements

Submitted proposals

* ***(CATT,*** [***R1-2106971***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106971.doc)***[6])****Proposal 5: No need to change the definition of UE Rx-Tx time difference measurement provided in Rel-16.*
* ***(Qualcomm,*** [***R1-2107345***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107345.doc)***[9]) Proposal 1****: For the purpose of enhancing the accuracy of RTT method, support one of the following options:* 
  + *Option 1: Support a UE to optionally include in the UE Rx-Tx measurement report, an UL timestamp for a UE Rx-Tx measurement, which corresponds to the uplink [subframe/slot] used by the UE to derive the UE transmit timing* TUE-TX  *used to derive the measurement.*
  + *Option 2: Support a UE to optionally include in the UE Rx-Tx measurement report, TA change information.*
  + *FFS: Downselection and further details*
* ***(Ericsson,*** [***R1-2108164***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)***[19])****Proposal 16 Redefine the UE Rx-Tx time difference measurement as: UE Rx – Tx time difference is defined as mod(TUE-RX – TUE-TX, 1ms) Where: TUE-RX is the UE received timing of downlink subframe #i from a Transmission Point (TP) [18], defined by the first detected path in time. TUE-TX is the UE transmit timing of uplink subframe #j ~~that is closest in time to the subframe #i received from the TP~~ for the transmission of the associated SRS resource.*

FL comments

In my understanding, the main intention of the proposal in [9] to add an UL timestamp for a UE Rx-Tx measurement, which corresponds to the uplink [subframe/slot] used by the UE to derive the UE transmit timing is to address the potential UL timing changes between the time when the UE Rx-Tx measurement is reported to the time when the SRS is transmitted. Unless the UE, at the time of reporting Rx-Tx measurement, knows the potential changes of UL Tx time at a future UL subframe, the UE Rx-Tx measurement derived by the use of the current UL subframe should be the same as that derived by the use of a future uplink [subframe/slot] to derive the UE Rx-Tx measurement. Thus, Option 1 and Option 2 are only meaningful if at the time when the UE reports the UE Rx-Tx measurement report, the UE has the information of potential changes of UL Tx time (TA changes) of the future UL subframe for SRS transmission.

Proposal 3.3-3 (H)

* *For the purpose of enhancing the accuracy of RTT method, support one of the following options (downselection):* 
  + *Option 1: Support a UE to optionally include in the UE Rx-Tx measurement report, an UL timestamp for a UE Rx-Tx measurement, which corresponds to the uplink [subframe/slot] used by the UE to derive the UE transmit timing TUE-TX  used to derive the measurement.*
  + *Option 2: Support a UE to optionally include in the UE Rx-Tx measurement report, TA change information.*
* *Support signaling from the LMF to the UE of an association between each DL PRS resource set with an UL SRS, either in the NR Multi-RTT Location Information Request or in the NR Multi-RTT Assistance Data (details for RAN2 to decide).*
* *Make the following modifications to the UE Rx-Tx time difference definition:* 
  + *UE Rx – Tx time difference is defined as mod(TUE-RX –TUE-TX, 1ms)*

*Where:*

*TUE-RX is the UE received timing of downlink subframe #i from a Transmission Point (TP) [18], defined by the first detected path in time.*

*TUE-TX is the UE transmit timing of uplink subframe #j ~~that is closest in time to the subframe #i received from the~~ ~~TP~~ for the transmission of the associated SRS resource.*

Comments

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| **Company** | **Comments** |
| Qualcomm | Isnt the 2nd bullet a separate proposal in 3.3-2? Is it related to this proposal? In this proposal, the focus is on Rx-Tx reporting enhancement. We support to study both, but we generally support Option 1: Adding an UL timestamp should have been done from rel-16; the rel-16 implicit way of determing the UL-timestamp (i.e. the UL subframe closest in time to the DL PRS) has several limitations in real scenarios (e.g. mobility scenarios, or cases where SRS is far away from PRS).  The definition can change in a backward compatible fashion:  *TUE-TX is the UE transmit timing of uplink subframe #j that is closest in time to the subframe #i received from the TP, unless the UE has reported an UL Timestamp associated to the measurement, in which case, it corresponds to the UE transmit timing of the reported uplink [subframe #j].* |
| Huawei, HiSilicon | We think that including UL timing should be a simple solution.  Regarding changing the definition, we believe a simple way is to add a Note similar to HD-FDD case in LTE: e.g.  If the UE does not transmit SRS in subframe #j, 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 | It looks like no need to change the definition of UE Rx-Tx time difference measurement provided in Rel-16, if a Tx TEG ID is associated with one or more UL SRS resources for positioning and decoupled with the Tx timing of the Rx-Tx measurement. |
| **vivo** | We don’t think the modification of ‘Rx-Tx time difference’ is needed. Considering that Tx TEG information report has been supported, the similar mechanism can be used for ‘TA change report’. |
| OPPO | The 2nd bullet is discussed in Proposal 3.3-2  The 3rd bullet seems unnecessary. In the current definition, the slots for reception and transmission are also possible to be separated by some subframe(s), but there is no operation of mod. In our understanding, the received timing and transmit timing refer to the timing relative to the boundary of subframe |
| Intel | We do not support the proposal in the current form. Multiple aspects are combined in one proposal, we suggest to simplify the proposal dividing it on several parts. |
| Ericsson | as pointed out by others, 2nd bullet is part of Proposal 3.3-2.  We support bullest 1 and 3 in the proposal. |
| ZTE | The new definition may have problems as mentioned by CATT. |
| Qualcomm | To vivo/CATT: lets then start from the 1st bullet only, and not try to overload/overly-complicate discussions:   * *For the purpose of enhancing the accuracy of RTT method, support one of the following options (downselection):*    + *Option 1: Support a UE to optionally include in the UE Rx-Tx measurement report, an UL timestamp for a UE Rx-Tx measurement, which corresponds to the uplink [subframe/slot] used by the UE to derive the UE transmit timing TUE-TX  used to derive the measurement.*   + *Option 2: Support a UE to optionally include in the UE Rx-Tx measurement report, TA change information.*   Do we acknowledge that there can be a big time gap between the transmitted SRS and the UE Rx-Tx report? A UE could provide an UL timestamp to show to the network when the Rx-Tx measurement was derived? It is a measurement that has 2 compnets: DL measurement and UL transmission time. I don’t understand why the concept of “UL timestamp” in the report has created so much controversy.  For us, we are confident that any reasonable UE implementation cannot follow the 38.215 definition if it wants good UE Rx-Tx accuracy. |

FL Comments

It seems either adopting the proposal from Qualcomm or take the solution from LTE, as suggested by Huawei, may resolve the issue.

(Round 2) Proposal 3.3-3 (H)

Select one of the following alternatives related to the definition of *the UE Rx-Tx time difference definition:*

**Option 1:**

* *Make the following modifications to the UE Rx-Tx time difference definition:* 
  + *UE Rx – Tx time difference is defined as mod(TUE-RX –TUE-TX, 1ms)*

*Where:*

*TUE-RX is the UE received timing of downlink subframe #i from a Transmission Point (TP) [18], defined by the first detected path in time.*

*TUE-TX is the UE transmit timing of uplink subframe #j that is closest in time to the subframe #i received from the TP, unless the UE reports an additional UL Timestamp associated to the measurement, in which case, TUE-TX corresponds to the UE transmit timing of the uplink subframe of the UL Timestamp.*

**Option 2:**

* *Add the following note to the UE Rx-Tx time difference definition:* 
  + *Note 1: If the UE does not transmit SRS in subframe #j, it shall compensate for the difference in the transmit timing of uplink subframe #j and the transmission timing of the subframe containing positioning SRS.*

Comments

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| **Company** | **Comments** |
| Huawei, HiSilicon | Option 2.  We think that this is the direct text in spec that we can use to overcome this issue. We are fine with reporting the SRS Tx timing stamp so that LMF is aware of the potential time span between DL and SRS UL. |
| vivo | We think ‘Do not change the difinition of Rx-Tx time difference measurement’ can be added as Option 3. Based on this assumption, we think ‘Option2' in previous QC’s reply is more acceptable to us ‘*Option 2: Support a UE to optionally include in the UE Rx-Tx measurement report, TA change information*’. In addition, from our point of view, ‘UE Tx TEG report’ is better than ‘UE Rx-Tx measurement report’, since TA changes is uplink related and it can happen multiple times between Rx-Tx reports, which is more similar to Tx TEG change. We can further study it.  Therefore, we propose to add Option 3 as follows  **Option 3:**   * *Don’t change the definition of the UE Rx-Tx time difference.* * ***FFS:*** *Support a UE to optionally include in the* ***UE Tx TEG report****, TA change information*   In addition, the description of “unless .., in which case, *TUE-TX* corresponds to…” in Option1 is unclear for us.  Firstly, this is not an accurate wording of the definition, we don’t think such decription of ‘unless’ can be presented in the wording of measurement definition. For example, based on current wording, how the UE judges which definition to choose to report the measurement result.  Then, the changed definition require UE to couple DL PRS measurement with UL SRS transmission. Therefore, to determine the Rx-Tx measurement, UE has to wait for successful SRS transmission, which is not friendly to latency reduction. In other words, there are 16 SRS to be transmitted, the at most 16 Rx-Tx time differences can be done after all the UL SRS is transmitted, since the accurate UL Timestamp is uncertain at the moment of PRS measurement considering the TA change and Tx TEG change with timing. When the LMF wants to couple the latest PRS measurement with previous SRS transmission to perform RTT calculation, the latency cannot be ensured.  Besides, when the PRS period is large enough and the SRS period is small enough, then there are multiple SRS occasions between two PRS occasion. If there are multiple TA changes between two PRS occasion, the UE may report multiple Rx-Tx time difference measurements along with corresponding UL time stamps. From the perspective of report overhead, we think the overhead of ‘reporting TA change information’ is smaller.  The same issue also exists in option 2, we don’t think only modifying the definition can solve any problem. |
| ZTE | To our understanding, this proposal is trying to address the problem that TA has been changed between the DL PRS reception and UL SRS transmission. Therefore, we prefer UE can optionally include in the UE Rx-Tx measurement report, TA change information as proposed by Qualcomm rather than change the definition, which maybe similar to *nr-NTA-Offset-r16* already supported in Rel-16. |
| OPPO | In the current spec TS 38.214, we have the following description:  *The UE may be configured to measure and report, subject to UE capability, up to 4 UE Rx-Tx time difference measurements corresponding to a single configured SRS resource or resource set for positioning. Each measurement corresponds to a single received DL PRS resource or resource set which can be in different positioning frequency layers.*  From the above paragraph, Tx-Tx time measurement seem related to a SRS resource. In this sense, R16 definition indicates the measurement is correpondign to some SRS transmission. Please correct me if misunstood or missed something. |
| Intel | Prefer Option 2 |
| Qualcomm | We are supportive of enumerating options this meeting, and add a note to get an agreement on this for next meeting. For us, the issue until now has been that, several companies were not acknowledging that a problem exists when there are TA changes between PRS & SRS. Seems there are 3 options considered (together with the one from vivo).  Lets look how the options work with an example: E.g., Assume #j = 0 (subframe with DL-PRS), and the UE is configured to transmit SRS in subframes 10, 50; UE reports Rx-Tx later, eg.. subframe 100.   * Betweenn 0 and 10, the Timing has changed by +10 nsec. * Betweenn 10 and 50, the Timing has changed by +10 nsec.   Hope we all agree that the UE cannot adjust the SRS timing; SRS just follows regular procedures for changing the single-TA that a UE has.  So, the UE is now debating: I transmitted 2 SRS, with different timings, so the gNB’s measurement is affected: If the gnB does 2 Rx-Tx measurements, these 2 measurements will be different by 10 nsec. Clearly, this is a timing error and falls within the enhacnements of this subagenda. What can we do?   * For the Option 1, the UE will report RxTx1 at Subframe=10, and report RxTx2 at subframe50: Different UL timestamp, and multiple measurements (related to batch reporting also). The gNB will also report multiple measurements, the LMF will make sure the measurements derived on the same timestamp are used to get RTT. * How will Option 2 solve the problem? If there is NO UL-timestamp, the UE reports a single RxTx with the legacy DL-timestamp. Lets say it “compensates” the measurement with sth; what what though?   + If the UE assumes that the gNB measures the SRS in subframe10, the UE should subtract 10 nsec from the Rx-Tx report   + If the UE assumes that the gNB measures the SRS in subframe50, the UE should subtract 20 nsec from the Rx-Tx report   Are the proponents say that the UE reports as many Rx-Tx measurements as many timing adjustsment existed? If yes, then, wouldn’t we need an UL Timestamp again? How will the LMF know which RxTx measurement matches with with gNB RxTx measurement? In other words, for Option 2 to work, UL timestamp is again needed.   * Option 3 (TA offset + measurement). In this option, the UE would need to send:   + Single RxTx1 measurement with respect to #j=0   + AND With respect to #j=0: TA-offset = 10 occurred at subframe 10, TA-offset = 20 at subframe 50   In other words, it appears to me that we still need to send UL timestamps on the subframes for which a TA-change occured. The definition does not change, but the UE reports effectively how much the LMF should subtract from the UE-Rx-Tx measurement depending on when the gNB-Rx-Tx measurement occurred. For a measurement at subframe 10, the LMF will take RxTx1, subract 10 and add gNBRxTx to derive RTT, but for a measurement at subframe 50, the LMF will take RxTx1, subtract 20 and add gNBRxTx to take RTT.  Is that how Option 3 will look like? If yes, then why would we choose an option that “discloses” the UE-implementation TA, compared to Option1 or Option2+timestamp?  Either way, lets first make sure that we agree on the problem that we are trying to solve, and what are the potential options that may work. Lets write them down, and downselect in the next meetings. |
| Ericsson | We are fine to list the options and do a downselection in next meeting.  Our preference is Option 1. |
| OPPO2 | Thanks Alex for the detaile example. We support to include a timestamp to facilitate the matching of UE and TRP measurement, where the timestampe is corresponding to SRS used for the Rx-Tx timing difference.  However, I failed to see why the mod operation (*mod(TUE-RX –TUE-TX, 1ms)*) is needed in Option 1.   * In our understanding understanding, received timing and transmit timing is related to the boundary of subframes. For example, the UE receives the PRS at slot n and the received timing TUE-RX is relative to the boundary of slot n. The UE transmits SRS in slot n + 100 and the transmit timing TUE-TX is relative to the boundary of slot n + 100. Thus, we can get the Rx-Tx timing difference as *TUE-RX –TUE-TX*, and the mod operation is not needed. * Moreover, in R16, the downlink subframe #i and the uplink subframe #j may not be adjacent, i.e., abs(i-j) > 1.In this case, there is also not mod operation. |
| Huawei, HiSilicon | Just reply QC:  By compenstation, our intention is to simply replace the mod operation, and as we said we are not against reporting UL time stamp. |
| Qualcomm2 | Just to clarify something: We also not really think that mod operation is needed; I just haven’t yet commented on that, because I do consider it a detail, when there has been a lot of unwillingness to appreciate the problem here.  Could proponents of Option 2 (Intel?) provide more information on how their option differs from Option 1?  We make the following suggestion (Option 2 is still missing, since it is unclear to me how it works):  *Select one of the following alternatives related to the UE Rx-Tx time difference:*   * *Option 1: Subject to UE capability, the UE may report an additional UL Timestamp associated to a UE Rx-Tx measurement, in which case, TUE-TX of the measurement would correspond to the UE transmit timing of the uplink subframe of the UL Timestamp.*   + *FFS: Further modifications in the definition, e.g. is a modulo operation needed in theTUE-RX – TUE-TX* * *Option 2: ??* * *Option 3: Subject to a UE capability, a UE may optionally report 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.* |
| FL | **To Qualcomm:**  Option 2 was from LTE. There is no time stamp for SRS transmission time for LTE. I think in normal case, the subframe of DL PRS reception, the subframe of UL SRS transmission, and the time of reporting of Rx-Tx measurements should all be are configured closely. In Qualcom’s example, I would assme the UE can report the UE Rx-Tx measurement right after the subframe 0, at least no later than subframe 10, or earlier, but not wait for subframe 50.  **To OPPO2:**  The mode operation is need due to the value range of the reported UE/gNB Rx-Tx measurements is limitd to smaller than 1ms. If *TUE-RX –TUE-TX*  is larger than 1ms, the ineger number of ms is not reported in the UE/gNB Rx-Tx measurements. The LMF does not know, and does not need to know the ineger number of ms, since the propogation delays between UE/gNB is normally much smaller than ms.  It seems the repones so far are in favior of adding optionally another timestamps in case the UL SRS subframe is far away fro the DL PRS subframe. Then, we may consider it as a separate bullet. |

(Round 3) Proposal 3.3-3 (H)

* *Subject to UE capability, the UE may report an additional UL Timestamp associated to a UE Rx-Tx measurement, in which case, TUE-TX of the measurement would correspond to the UE transmit timing of the uplink subframe of the UL Timestamp*
* *Select one of the following alternatives related to the UE Rx-Tx time difference (downselection in RAN1#106b):*
  + *Option 1:* 
    - *Make the following modifications to the UE Rx-Tx time difference definition:*
    - *UE Rx – Tx time difference is defined as mod(TUE-RX –TUE-TX, 1ms)*
      * *Where:*
      * *TUE-RX is the UE received timing of downlink subframe #i from a Transmission Point (TP) [18], defined by the first detected path in time.*
      * *TUE-TX is the UE transmit timing of uplink subframe #j that is closest in time to the subframe #i received from the TP, unless the UE reports an additional UL Timestamp associated to the measurement, in which case, TUE-TX corresponds to the UE transmit timing of the uplink subframe of the UL Timestamp.*
  + *Option 2: 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, 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 3: Subject to a UE capability, a UE may optionally report 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** |
| Qualcomm | We are clearly in favor to try to address this issue, and as we explained above, we understand option 1 and 3.  With regards to Option 2: In LTE, UE Rx-Tx was only used for ECID measurement, a low accuracy method; we are now doing talking about a precise positioning method here; and It is a bit unclear to me what really Option 2 means and whether it is different than Option 1. HW seems to suggest that, this wording could be used to remove the “modulo” operation of option 1?  However, I can interpret Option 2 as follows: UE waits for the SRS to be transmitted, determines whether any TA has been applied between the PRS reception and the associated SRS, and if yes, compensate that in the UE Rx-Tx measurement. Is that what Option 2 is? Isnt that what the UE would do in Option 1 also?  To the reply from the FL with regards to the QC example: If the UE reports after subframe 0 (and before the SRS), and the SRS is transmitted later, then the RTT measurement will be **wrong**, because the gNB Rx-Tx will be affected. If a UE reports the UE Rx-Tx before the SRS is transmitted, knowing that the SRS is configured at subframe 10 or 50, will be a not-so-great implementation, especially if the UE is in a relatively mobile situation: If the UE moves, it expects that it is very likely that a TA command might be received (in the period between the subframe 0 and the SRS), or that it will have to do autonomous TA, so it should better wait for the SRS to be transmitted, and see what is the timing there, and try to compensate the UE Rx-Tx by the corresponding negative amount (which for me shall happen for both Option 1& 2 above). The difference with Option 3, is that the UE, instead of compensating in the UE Rx-Tx value, will just add report separately the TA, for the LMF to do the subtraction.  Has someone understood the difference between what the UE will do in option 1 and 2? |
| MTK | It seems to us that option 1 and option 2 are basically the same. Option 1 has a timestamp to add but option 2 doesn't  We prefer option 2 wording. We are not sure whether it is helpful to include a UL timestamp to capture the actual SRS transmission. The compensation of SRS transmission timing change already happens, and what else LMF could do? |
| Huawei, HiSilicon | To QC: Option 2 can be rephrased into: assuming Rel-16 UE does not do so, e.g. using the exact UL timing that is closest in time with the PRS reception, with the feature backward compatible, i.e. no requirement for a Rel-16 UE to compensate.   * + *Option 2: 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 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.* |
| LG | We agree with the principe and support the proposal. |
| OPPO | In our understanding, Option 2 is almost the same as Option 1 but without the operation of mod.  @FL: In R16, the downlink subframe #i and the uplink subframe #j may not be adjacent, i.e., abs(i-j) > 1.In this case, there is also not mod operation. If the mod operation is really needed, does it mean that R16 definition is wrong when abs(i-j) > 1 and can be only applicable for the adjacent subframes #i and #j ? |
| vivo | We can support the 2nd bullet.  Regarding the 1st bullet, we think it is no need to list separately, it can be automatically supported or not supported based on the support of a certain option in the 2nd bullet. |
| CATT | We are fine to solve the issue with potential solutons.  For the first main bullet, the UL timestamp reporting looks like a parallel option with the the options in second main bullet, at least with the Option3, therefore, we pefer to merge the first main bullet (i.e., UL timestamp reporting) into the options in the second main bullet, instead of separately list the UL timestamp reporting as one paralleled main bullet with the second main bullet. |
| **FL** | **To OPPO:** My understanding is that the mod optiontion was done implicity already when UE reports the UE Rx-Tx time difference as I explained before.  **To vivo/CATT**: I was thiking that the reporting an additional UL Timestamp for UE Rx-Tx measurement may be needed even for Option 3. The TA change information has a timestamp for the time when change occurs. But, LMF may also need to know whether the TA change information takes place before or after UL Tx time of the SRS. Aactually, itis unclear to me why reporting the TA is helpful. If the TA changes takes place before the UL Tx of the SRS, and the UE knows the calues of TA, the UE can/should compensate it before reporting the UE Rx-Tx measurements. If the TA changes takes place after the UL Tx of the SRS, it has no impact on the UE Rx-Tx time difference.  **To all:** Based on the discussions, it seems most companies consider the Option 1 and Option 2 are basically the same, except the mod operation. **Can we remove the Option 1, but keep the Option 2 and 3 only?** |

(Round 4) Proposal 3.3-3 (H)

* *Select one of the following alternatives related to the UE Rx-Tx time difference (downselection 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 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** |
| Qualcomm | Thanks for the discussion and the replies of the companies about Option 1 & 2. The updated Option 1 seems clear to us to us now.  We are supportive of this proposal |
| ZTE | OK with the proposal. |
| MTK | Option 1 basically follows the spirit of LTE: compensate the TA change and then report the measurement  Option 2 basically doesn't compensate the TA change before reporting. Instead, the TA change is included within the report  We feel that both options are feasible. And there is no need to down-select. UE doesn't compensate, then UE can report the delta. When UE compensate, UE doesn't need to report the delta  Remember the 3.1-2a for measuring delay difference between RX TEGs? UE could report this value, and doesn't compensate it for the conventional DL-RSTD measurement. UE could also compensate it for conventional DL-RSTD measurement without reporting it, making UE like a single RX TEG  So we don't support down-selection |
| vivo | OK |
| CATT | We prefer to list the possible options and down-select at next meeting.  Besides the Option1 and Option2, maybe we can add Option3, which means other potential solution, as shown below,   * *Select one of the following alternatives related to the UE Rx-Tx time difference (downselection in RAN1#106b):*   + *Option 1:…*   + *Option 2: …*   + *Option 3: Other potential solutions* |
| OPPO | Support the prosal |
| MTK2 | If UE reports the measurement after SRS transmission, and SRS has TA change, then UE may compensate it within the report, or include the TA change within the report  If UE reports the measurement before SRS transmission and SRS has TA change, then UE may further send a report to indicate TA chage.  Also, if the UE doesn transmit SRS in subframe #j, it still has a TA value in subframe #j. If SRS is actually transmitted later with same TA value, then basically there is no need for compensation since TA change is 0  So we consider to add option 3, which basically follows option 1 and include the option of TA change   * + *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 ~~it shall~~ 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 (TA change) without compensation within the report* |
| Intel | Support the proposal, prefer option 1 |
| **FL** | **To MTK:** Since MTK has proposed to add a new option, I would assume we have downselection in RAN1#106b.  **To CATT**: If there is another new option in mind, please propose it now. We need to close the discussion in next meeting. Thus, it would be better for me to list all of the options to be considered. |

(Round 5) Proposal 3.3-3 (H)

* *Select one of the following alternatives related to the UE Rx-Tx time difference (downselection 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 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 ~~it shall~~ 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 (TA change) without compensation within the report*

Comments

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| **Company** | **Comments** |
| Qualcomm | We are OK with the additional option suggested by MTK. Support the proposal. |
| Huawei, HiSilicon | OK for further down-selection. |
| OPPO | Support |
| LG | Support. |
| CATT | We can accpet the proposal. About our previous suggestion on including the “Other potential solutions” in the proposal, our intention is that the final selected solution may be generated after this meeting, or the final solution may not be limited to the options listed so far, but considering that we have only two meetings, we can accept the current proposal. |
| ZTE | OK with the proposal. |
| vivo | OK |
| Ericsson | TA should be spelled out as Timing Adjustment not to be confused with Time Alignment. We can support the proposal with that change.  Taking into account discussions and progress during the meeting we now lean towards option 2, i.e. keeping the current measurement definition and reporting timing adjustments. This decision, however, needs to fit with a number of other decisions in order to make timing error mitigation work as a whiole. We think, it’s good to wait until next meeting to make the downselection.  We note that if the measurement definition isn’t changed, the UE Rx-Tx time difference measurement is naturally associated to a UE RX TEG but there is no association to any TX TEG. A TX TEG association is still needed for the UL SRS used for the corresponding gNB Rx-Tx time difference measurement. This TX TEG association of the UL SRS used for the corresponding gNB Rx-Tx time difference measurement is most efficiently reported in the multi-RTT report together with the UE Rx-Tx time difference measurement. |
| **FL** | The proposal is revised, taking into Ericsson’s comments. |

### (Round 6) Proposal 3.3-3 (H)

* *Select one of the following alternatives related to the UE Rx-Tx time difference (downselection 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*

Comments

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| **Company** | **Comments** |
| Samsung | We have some concern regarding this proposal.  The assumption is that UE shall apply the TA adjustment before SRS transmission and report the TA change information (or UL timestamp) to LMF. But there is a concern regarding the TA adjustment error. In 38.133, the TA adjustment accuracy is defined as follows.    7.3.2.2         Timing Advance adjustment accuracy  The UE shall adjust the timing of its transmissions with a relative accuracy better than or equal to the UE Timing Advance adjustment accuracy requirement in Table 7.3.2.2-1, to the signalled timing advance value compared to the timing of preceding uplink transmission.The timing advance command step is defined in TS 38.213 [3].  **Table 7.3.2.2-1: UE Timing Advance adjustment accuracy**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **UL Sub Carrier Spacing(kHz)** | **15** | **30** | **60** | **120** | | **UE Timing Advance adjustment accuracy** | ±256 Tc | ±256 Tc | ±128 Tc | ±32 Tc |     Once UE performs TA adjustment, there is a timing error of tens of ns expected. Therefore the UL timing information reported by UE is not accurate anymore. Due to the above concern, I would prefer the solution that UE does not apply TA adjustment in this case, i.e., postponing gNB’s MAC-CE command. |
| Apple | Questions for clarifications:   1. in Opt1., 1st sub-bullet: What “additional” refers to? I thought in R16 there is no UL timestamp report (the specification is based on implicit UL timing at slot j closest to DL slot i)   in Opt.2, 2nd sub-bullet: the scenario that is being addressed refers to the case that report says SRS is transmitted in slot j but in reality it was sent in slot j+5? What compenstation is referred to really? If the report is after SRS transmission why should UE says SRS was on slot j, which is misleading. If report is before SRS transmission, how can UE compensate (which means UE knows a head of time it cannot transmit in j, but it can transmit in j+5)? |
| **FL** | **To Apple**: Each UE Rx-Tx time difference measurement in R16 has already one timestamp. The proposal here is to add one additional timesstamp corresponding to the timing of the uplink subframe of a positioning SRS. |
| Qualcomm | To Apple: If the Rx-Tx measurement is before the SRS, then there cannot be compensation, so it will be the rek-16 baseline.  If the report is after the SRS, the UE will say that it reports an Rx-Tx measurement that was derived at a specific slot. Since it has already sent the SRS, it can determine what is the Rx-Tx measurement; that’s what “compenstaiton” corresponds to; compensation of the UE Rx-Tx measurement by the TA amount, so when the LMF receives the gNB Rx-Tx, the summation of the 2 measurements will still be correct.  To SS: There are MAC-CE adjustments and autonomous adjastments happening. Saying that the UE will not do the adjustments that are needed for communications, just so the Rx-Tx measurement is not affected, is something that will affect the communications, in a scenario where there are solutions by just additional reporting. It is within RAN4 topic, on the Rx-Tx requirements under these cases. In rel-16, there was no way for Ran4 to add requirements when there are TA changes (due to the current definition), but maybe if signaling is included, RAN4 can consider discuss if there is a need of new requirements. We could add sth like:   * *It is up to RAN4 to decide how this agreement affects any of the measurement requirements* |
| OPPO | Suport the proposal  @QC: regarding the comment “To Apple: If the Rx-Tx measurement is before the SRS, then there cannot be compensation, so it will be the rek-16 baseline. ” , it seems that in this case, the Rx-Tx measurement is not related to any SRS. On the other side, in the current spec of TS 38.214, the Rx-Tx measurement corresponds to a SRS resource or resource set. There seems some confliction.  *The UE may be configured to measure and report, subject to UE capability, up to 4 UE Rx-Tx time difference measurements corresponding to a single configured SRS resource or resource set for positioning. Each measurement corresponds to a single received DL PRS resource or resource set which can be in different positioning frequency layers.* |
| vivo | We support this proposal with minor modification of Option2.  The reason is that if TA change happens multiple times between 2 SRS time occasions, what makes sense is to report the TA change information corresponding to the Tx timing change of the 2 SRS transmission, rather than Tx Timing change with a timestamp that this change occurred (e.g.).   * + *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, or positioning SRS Tx time change with a time stamp caused by TA.* |
| CATT | OK to the proposal. |

## Reporting of group time delys of RxTx TEGs

Submitted Proposals

* ***(MediaTek,*** [***R1-2107822***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107822.doc)***[15]) Proposal 4-3:*** *If UE determines not to compensate the delay difference between 2 RX TEGS for DL-RSTD measurement, then the delay difference reporting is required*
* ***MediaTek,*** [***R1-2107822***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107822.doc)***[15]) Proposal 5-1:*** *Support UE to report RX+TX group delay measurement for each pair of {RX TEG, TX TEG} to solve transmission timing difference between TX TEGs and receiving timing difference between RX TEGs mathematically at the location server.*
* ***(Ericsson,*** [***R1-2108164***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)***[19])Proposal 24*** *Timing errors per UE/gNB RX/TX TEG should not be ehavior by the UE/gNB to the LMF, nor from the LMF to the UE.*
* ***(Ericsson,*** [***R1-2108164***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)***[19])Proposal 25*** *Timing errors differences between UE/gNB RX/TX TEGs should not be ehavior by the UE/gNB to the LMF, nor from the LMF to the UE.*

FL comments

For RxTx TEG, the self-calibration of UE for RX+TX group delays is discussed in [15]. With the acapability of the self-calibration, the UE may have the information on RX+TX group delay, and thus, in [15], MTK proposes to support UE to report RX+TX group delay measurement for each pair of {RX TEG, TX TEG} with the consideration that the LMF can use the information for positioning enhancement (e.g., to derive the transmission timing difference between TX TEGs and receiving timing difference between RX TEGs mathematically. We may also need RAN4 to check the feasibility of UE/TRP to report RX+TX group delays.

In [19], Ericsson proposes not to support reporting the timing errors of UE/gNB RX/TX TEGs and the timing errors differences between UE/gNB RX/TX TEGs this case, the suggestion is no further discussion on the reporting of timing errors of UE/gNB RX/TX TEGs as well as reporting of timing errors differences between UE/gNB RX/TX TEGs in Rel-17. Due to the lack of the support, suggest no further discussion in this meeting on reporting the timing errors and timing errors differences related to UE/gNB RX/TX TEGs.

Proposal 3.3-4 (H)

* *Subject to UE’s capability, support UE to report UE RX+TX group time delays for each pair of UE {RX TEG, TX TEG} to LMF if the UE supports multiple Rx TEGs and/or multiple Tx TEGs;*
* *Support gNB to report TRP RX+TX group delays for each pair of TRP {RX TEG, TX TEG} to LMF if the TRP supports multiple Rx TEGs and/or multiple Tx TEGs*
* *Send LS to RAN4 to check the feasibility of UE/TRP to report RX+TX group delays*

Comments

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| **Company** | **Comments** |
| Huawei, HiSilicon | We think an easier way to allow UE to report RxTx TEG ID for DL-TDOA+UL-TDOA methods, e.g. in the DL-TDOA reporting. |
| MTK | 1, We support the proposal since in earlier we have analysed that it is feasible to derive RX TEG difference and TX TEG difference when the RX+TX group delay is measured through self-calibration  2, We are also okay to send LS to RAN4 for checking the self-calibaration feasibility, including for TDD, FDD |
| CATT | Support.  This proposal can solve the issue of how to let LMF to know whether two pairs of {UE Rx TEG ID, UE Tx TEG ID} have the same Rx+Tx timing errors or are within the same range of Rx+Tx timing errors, UE can provide the mapping information of {UE Rx TEG ID, UE Tx TEG ID} pairs to the range of Rx+Tx timing errors, so LMF can determine which UE Rx-Tx time difference measurements have the same Rx+Tx timing errors or are within the same range of Rx+Tx timing errors based on the mapping information. |
| Vivo | Support. |
| OPPO | We need RAN4’s input on the feasibility before we can agree it. |
| Intel | Support to ask RAN4 about the feasibility of two first subbulets. |
| Ericsson | We do not support this proposal. As outlined in our contribution, we stated the following reasons for not reporting the timing errors to the LMF:   1. If the UE/gNB knows the timing error then it can compensate for the timing error by correcting measurements and thus there is no need to signal the timing error to the LMF. 2. A TEG is defined as a group of measurements or RS transmissions which have timing errors within a certain margin relative to each other. Thus, a TEG doesn’t have a timing error that can be ehavior. 3. For the gNB case a timing error relative to some global clock is identical to the network synch error which is out of scope of the Rel. 17 positioning enhancement work item. |
| ZTE | Check with RAN4 on the feasibility to estimate timing error or wait for RAN4’s response on the LS sent by RAN1 in two meetings ago. |
| Nokia/NSB | Don’t support. |
| MTK2 | To E/// and Nokia,  1, the reason to report measured RX+TX group delay per pair of {RX TEG, TX TEG} is, the RX delay difference between 2 RX TEGs and TX delay difference between 2 TX TEGs could be resolved at LMF.  2, knowing RX+TX group delay doesn’t mean the respective RX group delay and TX group delay could be known.  3, If both infra vendors have concern on this bullet,   * *Support gNB to report TRP RX+TX group delays for each pair of TRP {RX TEG, TX TEG} to LMF if the TRP supports multiple Rx TEGs and/or multiple Tx TEGs*   We can only support the first one, which is   * *Subject to UE’s capability, support UE to report UE RX+TX group time delays for each pair of UE {RX TEG, TX TEG} to LMF if the UE supports multiple Rx TEGs and/or multiple Tx TEGs;*   The reason is, we do have concern to solve UE side RX delay difference between 2 RX TEGs through measuring same signal of a same TRP. This consumes UE power for finding out a suitable TRP for measurement. To report RX+TX group delay, together with DL-TOA+UL-TDOA, UE can perform TOA measurement in each RX TEG by a good TRP signal. So each RX TEG could find a TRP with good signal quality, which is easier than finding a suitable TRP signal for 2 RX TEGs  We are also okay to send LS to RAN4 to check the feasibility of RX+TX group delay measurement. But in our mind, reporting RXTX TEG ID for M-RTT technique is equivalent to having RX+TX group delay measurement capability at UE side. For UE RX-TX measurement within M-RTT technique, we can surely compensate RX+TX group delay before reporting, But for DL-TDOA, we need RX delay difference, and for UL-TDOA, we need TX delay difference |
| LG | We are on the same page with OPPO, Intel and ZTE. |
| **FL** | It seems the main consider on the proposal is the feasibility of UE/TRP to report RX+TX group delays. Maybe we can add “*If it is feasiable for UE to report of UE RX+TX group time delays to LMF,” to address the concern.*  To address the concerns from Ericsson and Nokia, we may add “FFS” to the bullet related to gNB side. |

(Round 2) Proposal 3.3-4 (H)

* *If it is feasiable for UE to report of UE RX+TX group time delays to LMF, support UE to report UE RX+TX group time delays for each pair of UE {RX TEG, TX TEG} to LMF;*
* *FFS: If it is feasiable for gNB to report of TRP RX+TX group time delays to LMF, support gNB to report TRP RX+TX group time delays for each pair of TRP {RX TEG, TX TEG} to LMF;*
* *Send LS to RAN4 to check whether it is feasiable for UE/gNB to report of UE/gNB RX+TX group time delays*

Comments

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| --- | --- |
| **Company** | **Comments** |
| MTK | We are okay for this proposal, main reasons are,  1, As we agree to report RXTX TEG ID for UE RX-TX time difference measurement, in our view, UE has capability for performing RX+TX group delay. Then why should be struggle to consider “if it is feasible” here?  2, the current agreement of measureing same signal from same TRP by 2 RX TEGs, in our view, is power consuming because it doesn't guarantee serving gNB can provide that.  3, this proposal is to say, knowing the RX+TX group delay of each pair of {RX TEG, TX TEG} could be further decomposed to know RX delay difference between 2 RX TEGs, and TX delay difference between 2 TX TEGs. The computation could be conducted at LMF. So the RX delay difference and TX delay difference naturally STORE in LMF. For the current agreement of measureing same signal from same TRP by 2 RX TEGs, UE needs to report the RX delay difference. If UE already knows RX delay difference, why not compensates it for any coventioanl DL-RSTD measurement, making it like a single RX TEG? |
| Huawei, HiSilicon | First, we suggest to clarify that UE reporting Rx+Tx group delays to LMF could be in RRC or LPP, subject to further discussion.  Second, we do not think there is need to report “each pair”, or we may interpret “each pair” as any potential combination, which should not be the case to our understanding.   * *If it is feasiable for UE to report of UE RX+TX group time delays to LMF, support UE to report UE RX+TX group time delays for the 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: If it is feasiable for gNB to report of TRP RX+TX group time delays to LMF, support gNB to report TRP RX+TX group time delays for each pair of TRP {RX TEG, TX TEG} to LMF;* * *Send LS to RAN4 to check whether it is feasiable for UE/gNB to report of UE/gNB RX+TX group time delays* |
| LG | We have simallar view to thrird point in MTK’s comments. |
| CATT | Support.  About the feasibility of reporting Rx+Tx group delays, we think it is reasonable to send an LS to RAN4 to check it. And we are also fine with Huawei’s revision. |
| **FL** | **To Huawei:** I share the similar view that it may not need to report all possible combinations due to the redundance. On the other hand, it is desirable for the UE to report a set of combinations that can be used to estimate all of the Rx/Tx erorrs. |

### (Round 3) Proposal 3.3-4 (H)

* *If it is feasiable 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: If it is feasiable for gNB to report of 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 feasiable for UE/gNB to report of UE/gNB RX+TX group time delays*

Comments

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| **Company** | **Comments** |
| **Ericsson** | Not sure if we should do conditional agreements like this. If this is agreed, what happens to the agreement if it is deemed infeasible for the UE?  In our understanding, this is an alternative to reporting Rx TEG, Tx TEG, etc. We provide some followup comments to reasons provided by MTK:  MTK comment: *“the reason to report measured RX+TX group delay per pair of {RX TEG, TX TEG} is, the RX delay difference between 2 RX TEGs and TX delay difference between 2 TX TEGs could be resolved at LMF.”*  Ericsson Reply: Why does this delay difference have to be resolved at the LMF? With the agreed {Rx TEG, TX TEG} framework, the LMF can know which measurements to combine/fuse based on the reported RX TEG/TX TEG. So we don’t see the need to introduce another solution on top of what is agreed.  MTK comment: *“The reason is, we do have concern to solve UE side RX delay difference between 2 RX TEGs through measuring same signal of a same TRP. This consumes UE power for finding out a suitable TRP for measurement. To report RX+TX group delay, together with DL-TOA+UL-TDOA, UE can perform TOA measurement in each RX TEG by a good TRP signal. So each RX TEG could find a TRP with good signal quality, which is easier than finding a suitable TRP signal for 2 RX TEGs ”*  Ericsson Reply: With the agreed framework, the UE reports the Rx TEG/Tx TEG associated with the measurement. There is no need for UE to perform TOA measurement in each RX TEG. Plus, how many RX TEGs are to be supported is still not agreed. If a large number of RX TEGs are agreed to be supported, not sure if the UE would perform TOA measurements on all these RX TEGs. Furhter, it seems that the motivation of the reporting the *UE RX+TX group time delays* to LMF is for power saving at the UE?  We have to consider the limited time left on the work item in RAN1, and the large number of remaining details in 6 different agendas we need to sort out. Such optimizations may be discussed in future (beyond Rel-17) once confirming the feasibility. So, we still have concern with this proposal. |
| Nokia/NSB | If the UE knows the group delays then why does the UE not just calibrate them out? We don’t support this proposal. |
| Huawei, HiSilicon | We are fine with the proposal. Our understanding of the proposal is that UE may be able calibrate certain pairs of Rx + Tx chains, and DL-TDOA + UL-TDOA using those chains can have similar performance as differential multi-RTT. |
| OPPO | Don’t support   * We don’t know the feasibility before any input/conclusion from RAN4. Thus, we cannot agree anything when we are not sure about the feasibility |
| MTK | Reply to Nokia:  When UE knows RX+TX group delay, it doesn't mean UE knows respective RX delay and TX delay. We are thinking,  1, use the known RX+TX group delay to derive RX delay difference between RX TEGs, and TX delay difference between TX TEGs, through the configuration of DL-TDOA and UL-TDOA  2, this method allows each RX TEG to find suitable signal to measure. As compared to previous agreement that 2 RX TEGs find the same signal suitable for measurements, we believe it consumes more UE power to find a suitable TRP for measurement of 2 RX TEGs  Reply to E///  *Ericsson Reply: Why does this delay difference have to be resolved at the LMF? With the agreed {Rx TEG, TX TEG} framework, the LMF can know which measurements to combine/fuse based on the reported RX TEG/TX TEG. So we don’t see the need to introduce another solution on top of what is agreed.*  MTK reply: Similarly, if UE knows delay difference between 2 RX TEGs, why need to report to LMF? UE can compensate it for any further DL-RSTD measurement which has TOA measurement from different TX TEG due to GDOP consideration  This is why the previous agreement regarding same signal measurement by 2 RX TEGs is marked as “optionally”. As UE vendor, we have strong concern and we don't consider to support this capability. The reason is, it depends on **probability** to find a suitable signal from a TRP so that 2 RX TEGs of a UE can measure the signal properly to understand the rx delay difference between 2 RX TEGs. It doesn consume a certain UE power  Which way is easier? 2 RX TEGs find the same signal suitable for measurements? Or each RX TEG find the signal suitable for measurement?  Furthermore, if UE already has RX+TX group delay calibration capability for each {RXTEG TXTEG}, the RX delay difference between 2 RX TEGs, and TX delay difference between 2 TX TEGs, could be resolved through mathematical computation with configured DL-TDOA and UL-TDOA  *Ericsson Reply: With the agreed framework, the UE reports the Rx TEG/Tx TEG associated with the measurement. There is no need for UE to perform TOA measurement in each RX TEG. Plus, how many RX TEGs are to be supported is still not agreed. If a large number of RX TEGs are agreed to be supported, not sure if the UE would perform TOA measurements on all these RX TEGs. Furhter, it seems that the motivation of the reporting the UE RX+TX group time delays to LMF is for power saving at the UE?*  *We have to consider the limited time left on the work item in RAN1, and the large number of remaining details in 6 different agendas we need to sort out. Such optimizations may be discussed in future (beyond Rel-17) once confirming the feasibility. So, we still have concern with this proposal.*  MTK reply: for E/// argument “there is no need for UE to perform TOA measurement in each RX TEG”.  For the previous agreement: *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*  Isn’t it to measure TOA in each RX TEG and then for RSTD to report so that LMF knows the delay difference between 2 RX TEGs?  The motivation to report RX+TX group delay, is to provide another solution to figure out RX delay difference and TX delay difference. Because as we said above, if UE has power concern by depending on probability to find a suitable TRP to measure by 2 RX TEGs, why we can’t go for another feasible solution?  Reply to Huawei: your understanding is correct, and thank you for support  Reply to Oppo: It seems to us that it is feasible for UEs with particular purpose, for example IIOT usage, in which the MIMO processing capability is reduced and UE can be designed to have better positioning capability. How about this way, let’s send LS to RAN4 only in this meeting?  We also believe that the discussion in 8.5.1 is suitable for particular scenario (IIOT). For general UEs, the pre-calibration method (circuit simulation to learn the group delay before mass production) making UE like a single RX TEG and single TX TEG is already sufficient |
| ZTE | Our understanding is that the reported values could be useful for UL-TDOA+DL+TDOA, which is quite similar to differential RTT. |
| vivo | Okay with FL proposal |
| CATT | Support the proposal. |

## Reporting of multiple UE RX-TX time difference measurements

Submitted Proposals

* ***(Ericsson,*** [***R1-2108164***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)***[19])Proposal 18*** *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 [19], 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.

### 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** |
| Ericsson | Support. This is necessary to achieve full timing error mitigation also for multi-RTT positioning and is thus of top priority.  It’s the corresponding proposal for multi-RTT as proposal 3.1-2 for DL-TDOA and bullet two and three in proposal 3.2-5 for UL TDOA. |
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## Reporting of Rx/Tx/RxTx TEGs

## Updating of Rx/Tx/RxTx TEGs

Submttted proposals

* ***(vivo, R1-2106595[3]) Proposal 7:***
  + ***The UE should report the information of the UE Tx TEG(s) change associated with transmission of SRS resource(s) to the LMF.***
    - ***The report of UE Tx TEG information should be continuous multiple reports, instead of a single report.***
    - ***The continuous multiple reports should be event-triggerred report, e.g. UE should report Tx TEG change information to the LMF when Tx TEG change happens compared with the last Tx TEG report.***
* **(Sony,** [**R1-2106809**](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106809.doc)**[4])Proposal 4: Support the time-varying property of TEG. The association information (e.g. between TEG and SRS resources) can be used to identify the TEGs at different time.**
* ***(Qualcomm,*** [***R1-2107345***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107345.doc)***[9]) Proposal 9: 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.***
* ***(LG,*** [***R1-2107542***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107542.doc)***[11]) Proposal #4:*** 
  + ***RAN1 has to consider the reporting overhead for UE if the reported information of TEG changes frequently***
* ***(InterDigital,*** [***R1-2107643***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107643.doc)***[13]) Proposal 5: Support a UE to indicate TEG in the measurement reporting when TEG information is changed compared to the previous reporting.***
* ***(InterDigital,*** [***R1-2107643***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107643.doc)***[13]) Proposal 6: Support validity time for UE TEG, i.e., upon expiration of the validity time, the UE needs to update TEG***
* ***(Ericsson,*** [***R1-2108164***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)***[19])Proposal 9 TX TEG association reports should have a configurable periodicity and the reports should include information on the UE TX TEG association of each transmission occasion of each SRS resource during the reporting period. The exact coding of this information is up to RAN2.***
* ***(Ericsson,*** [***R1-2108164***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)***[19])Proposal 10 RAN1 to study further whether to support also UE TX TEG association reporting to be triggered by a change in UE TX TEG association.***

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., [3][4][9][10][11][13][19]). Different options were proposed:

* In [3], it was proposed that the report of UE Tx TEG information should be continuous multiple reports, instead of a single report, and the continuous multiple reports should be event-triggered report;
* In [4], it was proposed that the association information (e.g. between TEG and SRS resources) can be used to identify the TEGs at different time.
* In [9], it was proposed that UE/gNB should be able to provide TEG-ID consistency information (e.g., a flag when TEG IDs are being reset)
* In [11], it was proposed that the reporting overhead needs to be considered for UE if the reported information of TEG changes frequently
* In [13], it was proposed to support a UE to update TEG information when it is changed compared to the previous reporting and to support validity time for UE TEG, i.e., upon expiration of the validity time, the UE needs to update TEG
* In [19], it was proposed to support periodic TX TEG association reports as well as the reporting to be triggered by a change in UE TX TEG association.

Proposal 3.4-1 (H)

* *Support one or both of the following options for the UE/TRP to update the information of UE/TRP Rx/Tx/RxTx TEGs to LMF:*
  + *Option 1: UE/TRP is configured by LMF to provide the periodic update of the TEG information based on a configured periodicity;*
    - *FFS: the values of the configurable periodicities*
  + *Option 2: UE/TRP provide the update of the TEG information whenever the UE/TRP determines the previous TEG information is no longer valid*

Comments

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| **Company** | **Comments** |
| Huawei, HiSilicon | We think the best approach is for the LMF to request to report if the association is dynamic. No need to suppor either options. |
| CATT | Support.  We think both options will benefit the compensation of Timing erros for the positioning engine, since the TEG information is time-varying and should be updated periodically or event-triggered. |
| Vivo | Support |
| OPPO | This is proposal is not clear. As we discussed in other proposals (e.g., 3.1-1), the new field for TEG information is optional and the UE can report TEG with each reporting. Thus, why do we need additional periodic reporting for the TEG information updating? |
| Intel | Same view as Huawei. |
| InterDigital | We support the proposal.  In addition, we support both options. In our view, both type of reporting (periodic-based or even-triggered based) are beneficial to determine the TEGs. |
| Ericsson | Support FL’s proposal. |
| NTT DOCOMO | We share the similar view with OPPO. |
| ZTE | Not support. |
| Nokia/NSB | In our view the UE/TRP reports the Tx/Rx TEG information in the beginning and then dynamically assigns IDs in the measurement reports. No need for this proposal. |
| Qualcomm | Generally supportive of the proposal, but we are proponets of Option 2: TEG information can change dynamically. E suggest to have at least a dynamic option (Option 2) specified.  To OPPO/DOCOMO: Tx-TEG reporting will not be together with any report. But even for TDOA, RTT, imagine a UE sends a first report that says a measurement is in TEG1. Then, 1 day later, sends another report that says that some other measurement is in TEG1. Should the LMF assume that these 2 measurements are really on the same TEG, just because they were associated with TEG1? Clearly not.. If we agree with this extreme example, then, we can consider some more reasonable examples: UE gets confgirued with periodic reporting, every 100 msec. In first report, UE says that same measurements are in TEG1; after 100 msec, UE says that some measurements are in TEG1. Are these measurements, across different reports, in the same or different TEG? LMF need to know whether the “TEG” has really changed or not; A flag/information/signaling needs to be sent when the previous information is no longer valid. |
| Huawei, HiSilicon2 | In our understanding, TEG ID only used to group the Rx/Tx timing. For example, at time instance #0, {TEG ID0: SRS0, SRS1}, and {TEG ID1: SRS2} is assigned by the UE, and it should not be regarded as TEG change if at time instance #1, {TEG ID0, SRS2} and {TEG ID1: SRS0, SRS1} is assigned by the UE, and time instance #2 is at least the next transmission occasion of SRS (next period of PR/SP SRS or next AP triggering occasion). |
| Vivo2 | Support.  We think at least for UL-TDOA, UE Tx TEG report should be a separate report. In addition, during the time when the UE transmits the SRS resources, as the UE flips or is blocked, it is up to UE implementation to switch Tx panel for better uplink transmission. Thus, for the same SRS resources for positioning, the associated Tx panel and Tx TEG may also change accordingly, the following figure shows a simple example.    Therefore, the report of UE Tx TEG information should be continuous multiple reports, instead of a single report at the beginning of SRS transmission. One or both of options can be supported in this meeting.  To Huawei  If it is common understanding there is no need to consider the TEG change with timing information, why do we need to change *UE Rx-Tx time difference in proposal 3.3-3* |
| Huawei, HiSilicon | To vivo:  My understanding on the motivation of 3.3-1 is that   * The Tx timing of the actual UL subframe closest in time of the DL PRS reception is different from the Tx timing of the actual UL subframe that contains the SRS, because e.g. there is TA. * There are also multiple factors that will impact the UE Tx timing; besides TA, DL synchronization change with the same TA will also result in UE UL Tx timing, which is why gNB needs to update the TA in the first place.   For SRS-TEG association, we think that the key information is on whether more than one SRS is in the TEG, and the TEG ID reported one minute earlier may not map to the same timing error as the TEG ID reported now. We believe there should be some TEG validity duration, which can take the easy form of “single SRS transmission occasion”, i.e. between different SRS transmission periods, the same TEG ID does not mean the same timing error.  In the example, as long as two the SRS resources (two SRS resource IDs) still belong to the same TEG, which TEG ID is allocated to them in each of the trnasmisison occasion does not matter that much, and UE is not required to consider it as TEG update.   * No TEG change:   + Time instance #0, {TEG ID0: SRS0, SRS1}, and {TEG ID1: SRS2}   + Time instance #1, {TEG ID0, SRS2}, and {TEG ID1: SRS0, SRS1} * With TEG change   + Time instance #0, {TEG ID0: SRS0, SRS1}, and {TEG ID1: SRS2}   + Time instance #1, {TEG ID0, SRS0, SRS2}, and {TEG ID1: SRS1} |
| vivo3 | To Huawei:  Our figure is just an example shown the Tx TEG change from the perspective of spatial (panel) domain.  Let’s take the example in your reply.   * No TEG change:   + Time instance #0, {TEG ID0: SRS0, SRS1}, and {TEG ID1: SRS2}   + Time instance #1, {TEG ID0, SRS2}, and {TEG ID1: SRS0, SRS1}   We don’t think this case does not matter that much.  In time instance 0, the RTOA measurement for SRS0 is associated with TEG0; in time instance 1, the RTOA measurement for SRS0 is associated with TEG1. Considering that time instance 0 and 1 are adjacent instance, it is possible for the LMF to jointly process them (e.g. averaging), which introduces additional timing error. So it is better to inform the TEG change to the LMF.  We believe that any Tx TEG change that affects LMF processing/calculation can be regarded as a Tx TEG change/update. In addition to panel switching, panel activation/deactivation will also lead to Tx TEG change from spatial (panel) domain. |
| LG | Before discuss about it, we think checking whether the reported TEG information is change dynamically or not is first. |
| Huawei, HiSilicon | Reply to vivo:  *it is possible for the LMF to jointly process them (e.g. averaging), which introduces additional timing error. So it is better to inform the TEG change to the LMF.*  If LMF has both RTOA measurement at the same time, I think it is because gNB reports both RTOAs to the LMF right? Then at the same time, we may have multiple TRPs reporting the RTOA based on the same SRS0 at two time instance, right?  Let’s say have RTOA(j,k,m) to denote the measurement based on SRS resource j on time instance k for TRP m.  Indeed, LMF may receive different RTOA(0, 0, 0) and RTOA(0, 1, 0), due to e.g. TEG change, but one can find that RTOA(0,0,0) – RTOA(0,0,1) (UL-TDOA at instance 0 between TRP#0 and TRP#1) would be close to RTOA(0,1,0) – RTOA(0,1,0) (UL-TDOA at instance 1 between TRP#0 and TRP#1). Then LMF can average the result via [(RTOA(0,0,0) – RTOA(0,0,1)) + (RTOA(0,1,0) – RTOA(0,1,1))/2.  Note that it is same as [RTOA(0,0,0)+RTOA(0,1,0)]/2 – [RTOA(0,0,1)+RTOA(0,1,1)]/2, meaning even if LMF averages two RTOAs for the same SRS on different occasions (with different TEG), the averaged RTOA **difference** between two TRPs would have no error. From TRP side, only RTOA measurement associated with SRS resource ID and a time stamp will be reported to the LMF; there should be no visibility of UE TEG info.. |
| **FL** | **To Huawei’s comments:** The issue to the approach of “LMF to request to report if the association is dynamic” in my view is that LMF may not have the information to know when it needs to make such request. As Huawei saied :” there should be some TEG validity duration”, the LMF does not know the TEG validity duration, and thus UE/TRP should provide the updates when/if it is needed. Take the validity duration to be “single SRS transmission occasion” seems unnesarry for most cases.  **To OPPO’s comments:** Obviously, if the UE does not support TEG, then it will not provide the updates. About the periodic report, I assume the periodicicity in the proponent mind can be much longer than the measurement reporting period to reduce the traffic. We may add the precondition “*If a UE had sent a Rx/Tx/RxTx TEG information to LMF”* to address the concern*.*  **To Nokia’s comments:** In my understanding, the main benefit of not including the TEG association for each measurement reports is the reduce the unnesasary reporting of the TEG association, since in general, we may not expect the TEG association to change very dynamically. Another benefit, although there is not much discussion on it, is for the LMF. I assume the LMF may treat the measurements reported in a sequence of time with/without the indication that the TEG information is changed. |

Proposal 3.4-1 (H)

* *Support one or both of the following options for the UE/TRP to update the information of UE/TRP Rx/Tx/RxTx TEGs to LMF:*
  + *Option 1: UE/TRP is configured by LMF to provide the periodic update of the TEG information based on a configured periodicity;*
    - *FFS: the values of the configurable periodicities*
  + *Option 2: UE/TRP provide the update of the TEG information whenever the UE/TRP determines the previous TEG information is no longer valid*

(Round 2) Proposal 3.4-1 (H)

* *If a UE/TRP had sent a Rx/Tx/RxTx TEG information to LMF, and the UE/TRP determines the previous Rx/Tx/RxTx TEG information is no longer valid, the UE should provide an update of the TEG information to the LMF.* 
  + *Note: It is up to the UE/TRP to determine whether the previous Rx/Tx/RxTx TEG information is no longer valid,*
  + *Note: A UE/TRP may include the updated Rx/Tx/RxTx TEG information in every measurement report.*
* *FFS: whether to support UE/TRP is configured by LMF to provide the periodic update of the TEG information based on a configured periodicity;*

Comments

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| **Company** | **Comments** |
| Apple | We are not against the proposal, although current version is too broad. On 2nd Note, why UE/TRP “may” include TEG update in “every” measurement report? |
| Qualcomm | Support |
| Ericsson | The difference between Periodic update of TEG information and triggered update of TEG information needs to be better understood. For instance, there could be latency – UL overhead tradeoff between these too approaches (i.e., with periodic updates the UL overhead may be controlled at the expense of possibly higher latency, etc.) Given that this is the first meeting this proposal is being discussed, we prefer to keep both options 1 and 2 on the table for now. We can decide in the next meeting whether one or both of the options need to be supported. Suggest to revert to the previous version:  Proposal 3.4-1 (H)   * *Support one or both of the following options for the UE/TRP to update the information of UE/TRP Rx/Tx/RxTx TEGs to LMF:*   + *Option 1: UE/TRP is configured by LMF to provide the periodic update of the TEG information based on a configured periodicity;*     - *FFS: the values of the configurable periodicities*   + *Option 2: UE/TRP provide the update of the TEG information whenever the UE/TRP determines the previous TEG information is no longer valid* |
| CATT | Support the proposal. |
| Vivo | Support in principle.  For 2nd Note, it is unclear to us. For Tx TEG update, it can be reported in a separate report rather than the measurement report. For event-triggered report, why UE should report TEG update in ‘every measurement report’? Whether to include ‘2nd Note’ can be FFS. |
| Huawei, HiSilicon | We do not support the proposal.  From UE side:  First, it is not clear why UE Rx TEG change reporting is needed. In our view, Rx TEG information is only valid within a RSTD measurement report. In different RSTD measurement reports, same Rx TEG ID does not mean the same Rx timing error.  Second, it is also not clear why Tx TEG change reporting is needed, in fact it is even not clear how to define a Tx TEG change. In addition, we think that this implies SRS TEG reporting in LPP is anyway needed, which is till under discussion in 3.2-1.  Third, it is not clear why UE RxTx TEG change reporting is needed, similar to DL-TDOA, since UE RxTx TEG reporting is always included in the multi-RTT measurement report, similar to Rx TEG reporting in DL-TDOA measurement report.  From TRP side:  First, it is not clear why TRP Rx TEG change reporting is needed, similar to UE RSTD measurement reporting.  Second, it is not clear why TRP Tx TEG change reporting is needed. Why would TRP suddenly change the PRS transmission chain?  Third it is not clear why TRP RxTx TEG change reporting is need, similar to UE RxTx TEG measurement reporting. |
| OPPO | We are quite confused with the intention of this proposal. There may be different interpretions (let’s take UE Tx TEG 1 as example)   * Interpretation 1: UE will report the association, e.g., {Tx TEG1, SRS resource 1, SRS resource 2, …} if the association is changed * Interpretation 2: When UE adjusted the transit timing of the SRS resource associated with Tx TEG 1, then UE report something to tell gNB that the previous transmissions associated with Tx TEG 1 are different from the new transmissions associated with Tx TEG 1   Which is the intention of this proposal? Or some other interpretation? |
| **FL** | **To Apple:** If the UE/gNB consider the TEG information is valid only for a measurement report, then the updated Rx/Tx/RxTx TEG information is included in every measurement report.  **To Huawei:** I assume the UE/gNB can decide whether the Rx/Tx/RxTx TEG information is valid only for one measurement report, or for a period of time. If TEG association is valid only for one measurement report, then UE/gNB can simply report the TEG association together with each measurement report.  **To OPPO:** I assume there can be different reasons for a UE/gNB to update the TEG assisition. The two interpretaions given in OPPO’s comments could be two of them. The proposal here is for a UE/gNB to provide the update the TEG assisition w/o telling LMF why it is updated. We may further discuss whether it is beneficial UE/gNB to tell the LMF why UE/gNB updates the TEG assisition.  **To Ericsson:** It is unclear to me why “with periodic updates the UL overhead may be controlled at the expense of possibly higher latency, etc.”. I would assume event-trigeered updates have smaller overhead and also smaller latency, because the UE/gNB provides the updates only when it is needed. I assume we could go back to the previous version if companies are not reasy to accept the event-trigeered updates. |

(Round 3) Proposal 3.4-1 (H)

* *Support at least one of the following options:*
  + *Option 1: Support the LMF to request a UE/TRP to provide the periodic update of the Rx/Tx/RxTx TEG information, based on a configured periodicity;*
    - *FFS: the values of the configurable periodicities*
  + *Option 2: Support the LMF to request a UE/TRP to provide the update of the Rx/Tx/RxTx TEG information whenever the UE/TRP determines the previous TEG information is no longer valid*
    - *Note: It is up to the UE/TRP to determine whether and when to provide the update*
  + *Option 3: Support LMF to request UE/TRP to provide the Rx/Tx/RxTx TEG information together with each measurement report*

Comments

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| **Company** | **Comments** |
| Qualcomm | Support the proposal |
| MTK | It seems to us the option 2 is better. Update the change of association with timestamp when it does change |
| Huawei, HiSilicon | We do not think any of the Options is needed.  What is the consequence of Option 1 or Option 2? In 2 LPP ProvideLocationInformation messages, the RSTD measurement associated with the same Rx TEG ID has the same Rx timing error if there is “no change”? Is it expected for the LMF to combine the measurement reports in the two LPP messages for what? We ask for clarification on the Option 1 and Option 2.  For Option 3 with Rx TEG and RxTx TEG ID, is it already supported?  In general for Tx TEG, we haven’t concluded whether the reporting is directly in LPP or RRC, the discussion should not make such decision for this issue. |
| LG | Support. |
| CATT | Support.  In our point of view, the updated TEG information may include the following information, e.g., for UE Tx TEG,   1. Updated TEG association information with SRS resources, e.g., {UE Tx TEG1: (SRS1, SRS2)} change to {UE Tx TEG1: (SRS1, SRS3)} 2. Updated TEG mapping information with the range of timing errors, e.g, {UE Tx TEG1: [-0.5ns, 0.5ns]} change to {UE Tx TEG1: [0.6ns, 1.6ns]}   And such updated TEG information may or may not be reported every time with the measurement report. |
| OPPO | Option 1 is too vague. As discussion in Round 2, there may be different information to be reported. It would be essential for us to know what information before we can agree on it.  Option 3: We share simiar view as Huawei that it is supported |
| vivo | OK |
| SONY | Support |
| ZTE | We don’t see the need to have this proposal. We think Option 3 is already supported somehow. |
| **FL** | **To Huawei:** In my understanding, there could be at least two benefits for Option 1 and 2 :a) reducing the signalling overhead, since there is no need for the UE to report the same informtio to ithe LMF if there is no change of the TEG association; and b) allow LMF to potential to combine the measurement reports in the sequential LPP messages for the better estimation of the TEG errors, which is of couse up to LMF implementation.  **To OPPO:** It is unclea to me why Option 1 is “too vague”. It basically says the UE sends the information based on the configured periodicity. For  **To Huawei/OPPO/ZTE:** For Option 3, although we agreed to reporting the iinfroamtion, we have not defined the details, e,g., reporting it with every measurement repport. It would bbe better to have the clarification now. I think Option 3 can be a default UE/TRP behaviour if Option 1 and/or Option 2 is not supported. That is why I use “at least one”.  **To All:**  **May be we can change the proposal as follows to address Huawei/OPPP’s concerns:**   * *Support UE/TRP to provide the Rx/Tx/RxTx TEG information together with each measurement report.* * *In addition, consider to support ~~at least~~ one or both of the following options:*   + *Option 1: ~~Support~~ the LMF to request a UE/TRP to provide the periodic update of the Rx/Tx/RxTx TEG information, based on a configured periodicity;*     - *FFS: the values of the configurable periodicities*   + *Option 2: ~~Support~~ the LMF to request a UE/TRP to provide the update of the Rx/Tx/RxTx TEG information whenever the UE/TRP determines the previous TEG information is no longer valid*     - *Note: It is up to the UE/TRP to determine whether and when to provide the update* * *~~Option 3: Support LMF to request UE/TRP to provide the Rx/Tx/RxTx TEG information together with each measurement report~~* |
| **Ericsson** | We support the first bullet in the revised proposal by the FL.  For the second bullet, we wonder if RX TEG, RxTx TEG, and TX TEG should be bunched together in this way. Note that RX TEG and RxTx TEGs are reported in each DL TDOA or multi-RTT measurement report as proposed in the main bullet. We see no need to have any additional periodic or trigger based reporting of Rx and RxTx TEGs.  TX TEGs for UL TDOA on the other hand have to be reported in a separate LPP or RRC message. For Tx TEGs, we are fine to keep the two options but leaving it open whether RRC or LPP signalling is used, as discussed under proposal 3.2-1.Thus we could support the following modified proposal addressing TX-TEGs in the second bullet:   * *Support UE/TRP to provide the Rx/Tx/RxTx TEG information together with each measurement report.* * *In addition, consider to support ~~at least~~ one or both of the following options:*   + *Option 1: ~~Support~~ the LMF to request a UE/TRP to provide the periodic update of the ~~Rx/~~Tx~~/RxTx~~ TEG information, based on a configured periodicity;*     - *FFS: the values of the configurable periodicities*   + *Option 2: ~~Support~~ the LMF to request a UE/TRP to provide the update of the ~~Rx/~~Tx~~/RxTx~~ TEG information whenever the UE/TRP determines the previous TEG information is no longer valid*     - *Note: It is up to the UE/TRP to determine whether and when to provide the update* |
| **FL** | **To Ericsson:** The suggested change look fine to me. |

(Round 4) Proposal 3.4-1 (H)

* *Support UE/TRP to provide the Rx/Tx/RxTx TEG association information together with each measurement report.*
* *In addition, also consider supporting the following alternatives (to be decided in RAN1#106b):*
  + *Option 1: the LMF to request a UE/TRP to provide the periodic update of the Tx TEG association information, based on a configured periodicity;*
    - *FFS: the values of the configurable periodicities*
  + *Option 2: the LMF to request a UE/TRP to provide the update of the Tx TEG association information whenever the UE/TRP determines the previous TEG association information is no longer valid*
    - *Note: It is up to the UE/TRP to determine whether and when to provide the update*

Comments

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| **Company** | **Comments** |
| Nokia/NSB | We are okay in principle with this agreement. Some questions for clarification: if the TEG information is reported with each measurement report then why do we need periodic updates? Is the periodic update related to the margin?  It would be good to clarify if companies have similar understandings of the TEG feature overall. Our understanding of the TEG feature is that the UE/TRP would report TEG information to the LMF prior to any positioning sessions (e.g., during UE capability or PRS configuration information exchange). This reporting would include the margin of each TEG (e.g., 4 ns for TEG #1, 1 ns for TEG#2). Then with each measurement report during a positioning session the UE/TRP tags the measurement with the TEG ID and reports to LMF. Is this different than other companies understanding? |
| **FL** | **To Nokia**: For Rx/Tx/RxTx TEG IDs, I assume they will be reported in each *measurement report. But, there is no need to provide the Tx TEG association information in each measurement report.* For example, a UE may not have the association of a UE Tx TEG with SRS resources until it is configured with the SRS sources. The association of a UE Tx TEG with SRS resources may not need to be reported for each *measurement report* until *Tx TEG association information changes, e.g., SRS resources are reconfigured.* |
| Huawei, HiSilicon | We share similar understanding as Nokia at least “static association between RS and Tx TEG” upon configuration is supported for both UE and TRP, which means that TRP provides the PRS-TEG association in the TRP information exchange and UE provides the SRS-TEG association in the positioning information exchange. Some companies think that UE Rx TEG association with SRS can be changing, (e.g. comments from QC in 3.2-1 round 4), we would prefer to study on the mechanism of Tx TEG update, with a clear understanding on the definition of Tx TEG change.  For the first bullet, if it is about “association information”, it is not clear. For Rx TEG ID and RxTx TEG ID, the understanding is they are associated with both Rx timig and DL PRS used to derive the timing; for Tx TEG ID, it can be either associated with the Tx timing in the Rx – Tx time difference and with the SRS resource. It seems the main bullet should not include Tx TEG association with SRS resource, because it is still under study.  For the sake of progress, we can accept the following modification:   * *Support UE/TRP to provide the association information between Rx/Tx/RxTx TEG and timing measurement together with each measurement report.* * *In addition, also consider supporting the following alternatives (to be decided in RAN1#106b):*   + *Option 1: the LMF to request a UE/TRP to provide the periodic update of the association information between Tx TEG and positioning SRS/PRS, based on a configured periodicity;*     - *FFS: the values of the configurable periodicities*   + *Option 2: the LMF to request a UE/TRP to provide the update of the association information between Tx TEG and positioning SRS/PRS whenever the UE/TRP determines the previous association information is no longer valid*     - *Note: It is up to the UE/TRP to determine whether and when to provide the update*   + *In either Option, the definition of change of association information between Tx TEG and RS should be clarified first.* |
| ZTE | We prefer to postpone the discussion before we make the progress in following proposals   * Proposal 3.2-1:Otherwise, we don’t know the TEG association is provided in each measurement report or in a separate report. * Proposal 5-3b: Where the change of TEG association may be implicitly indicated in different measurement instances. |
| vivo | Either of FL and Huawei’s version is fine to us.  To ZTE  A1: We believe the proposal is no impact on which IE carries TEG association, it can be discussed independently  A2: We think they are two issues, current proposal is discussing TEG association information update, 5-3b is discussing use same TEG for different measurement instances. Ronud 2) Proposal 5-3b  * *If a UE measurement instance (e.g., RSTD, UE Rx-Tx time difference) is associated with an UE Rx TEG, the UE measurement instance is expected to be obtained from the DL PRS resources (s) associated with the same UE Rx TEG, regardless of how many instances of the DL-PRS Resource Set are used to obtain the UE measurement instance.* * *If a TRP measurement instance (e.g., RTOA, TRP Rx-Tx time difference) is associated with an TRP Rx TEG, the TRP measurement instance is expected to be obtained from the UL SRS resources (s) associated with the same TRP Rx TEG, regardless of how many instances of the SRS measurement time occasions are used to obtain the TRP measurement instance.* |
| CATT | Support the proposal.  In our point of view, the TEG association information may include the association information between TEG and SRS/PRS, or the association information between TEG and range of values of timing error. However, the association information between TEG and range of values of timing error seems should be pre-defined and no need to be updated. Therefore, we are also fine with Huawei’s modifications, in which explain the TEG association information into the association information between TEG and SRS/PRS. |
| **OPPO** | Let me elaborate a bit more why we think it is “too vague” or not clear. There may be different interpretations on “*Rx/Tx/RxTx TEG association information*” or “*Rx/Tx/RxTx TEG information*”   * Alt.1: Rx/Tx/RxTx TEG ID * Alt.2: RS (e.g., SRS, PRS) associated with the Rx/Tx/RxTx TEG * Alt.3: Mapping of the RSs and Rx/ Rx/Tx/RxTx TEGs * Alt.4: The mapping is not change, but due to some reasons (e.g., TA adjustment), the timing error of RS associated with the same TEG for the measurement results in different reporting cannot be assumed to be within the margin.   We would like to know which interpretation is the intention of the proposal, or some other interpreations? |
| Intel | Support in general the porposal. How UE/TRP determines that the previous TEG association information is no longer valid? |
| Qualcomm | We are OK with the proposal from HW, but one aspect is not addressed in the first bullet:   * *Support UE/TRP to provide the association information between Rx/Tx/RxTx TEG and timing measurement together with each measurement report.*   Does the above means that the TEG-IDs are only valid with a single measurement report? Eg. UE reports RSTD1-> RxTEG1 in report1, and UE reports RSTD2->RxTEG1**. Does that mean that the 2 measurements are in the same TEG?** I think our question seem related to Alt. 4 interpretation that OPPO is saying in the reply above.  Form our side: TEG association information in a measurement report corresponds to:   * **Measurement <-> TEG ID (Alt.1 ? from OPPO views)** * **TEG ID consistency with previous reports (Alt. 4 from OPPO views)**   We think there should be some information included in the measurement report, whether the LMF can assume that the TEG information has changed, or is no longer valid.   * *Support UE/TRP to provide the association information between Rx/Tx/RxTx TEG and timing measurement together with each measurement report.*   + *Support including information related to whether measurements associated with a TEG-ID can be assumed to have timing errors within a margin with measurement from previous reports associated with the same TEG-ID* |
| Huawei, HiSilicon | Reply to QC: From our side, we do think the baseline assumption is that different LPP messages are not correlated. Do QC think UE can omit the RSTD reference information in a location reporting and indicate the reference info is the same as that in the previous report?  If the intention is to allow LMF to do filtering on the timing error estimation between two Rx TEGs ID across multiple reports, we think that it needs further study. We cannot agree with the agree part added by QC.  In the most case when we are dealing with immediate location, single report (with potentially early fix) is sufficient, while in the most case when we dealing with deferred MT-LR with periodical location events, I am assuming different (periodically triggered) reports may be corresponding to different LPP sessions.  This should be the same also for the TRP. |
| OPPO | Based on the discussion, there may be different interpretations or meanings for the “associated information”. We suggest to make a clear definition of association information as the first step. Then, we can check whether/how to report it |
| LG | Support. |
| ZTE2 | We should treat this proposal with low priority at this meeting,   1. For the first main bullet, we haven’t decided the TEG-RS association should be reported together or separately with measurement report. At least, the TEG-SRS and TEG-PRS may be informed to LMF by different ways. 2. It’s unclear what’s the definition of “TEG association information”, does it mean the TEG and timing association or TEG and RS association? 3. The TEG change may also be reflected in different measurement instances e.g. the same RS may be associated with different TEG in different measurement instances. So, we don’ t need the dedicated TEG update procedures. |
| vivo | Support  **Regardless of the discussion of the first bullet, we believe the second bullet is clear and should be supported first. So, we propose**   * *In addition, also consider supporting the following alternatives (to be decided in RAN1#106b):*   + *Option 1: the LMF to request a UE/TRP to provide the periodic update of the Tx TEG association information, based on a configured periodicity;*     - *FFS: the values of the configurable periodicities*   + *Option 2: the LMF to request a UE/TRP to provide the update of the Tx TEG association information whenever the UE/TRP determines the previous TEG association information is no longer valid*     - *Note: It is up to the UE/TRP to determine whether and when to provide the update*   For the first bullet, we think the critical part is Tx TEG, when SRS is transmitted, the gNB and LMF are not aware of the TEG information change. Whether we can support Tx TEG first and FFS other TEG?   * *Support UE/TRP to provide the ~~Rx/~~Tx~~/RxTx~~ TEG association information together with each measurement report.* * *FFS: Support UE/TRP to provide the Rx/RxTx TEG association information together with each measurement report.*   + *FFS: TEG association information*   + *FFS:Support including information related to whether measurements associated with a TEG-ID can be assumed to have timing errors within a margin with measurement from previous reports associated with the same TEG-ID*   In addition, we would like to further confirm how to understand the“periodic report” in the *RequestLocationInformation* message”. In our view, UE may send multiple *ProvideLocationInformation* messages for periodic reports according to this message, and the UE *LPP-TranscationID* should be set to the same. So that in this case, multiple *ProvideLocationInformation* messages should belong to the same LPP transaction and LPP session. |
| **Ericsson** | We are fine with the Huawei proposal in round 4:   * *Support UE/TRP to provide the association information between Rx/Tx/RxTx TEG and timing measurement together with each measurement report.* * *In addition, also consider supporting the following alternatives (to be decided in RAN1#106b):*   + *Option 1: the LMF to request a UE/TRP to provide the periodic update of the association information between Tx TEG and positioning SRS/PRS, based on a configured periodicity;*     - *FFS: the values of the configurable periodicities*   + *Option 2: the LMF to request a UE/TRP to provide the update of the association information between Tx TEG and positioning SRS/PRS whenever the UE/TRP determines the previous association information is no longer valid*     - *Note: It is up to the UE/TRP to determine whether and when to provide the update*   + *In either Option, the definition of change of association information between Tx TEG and RS should be clarified first.*   We are also fine with the addition proposed by Qualcomm to the proposal by Huawei:   * + *FFS:Support including information related to whether measurements  associated with a TEG-ID can be assumed to have timing errors within a margin with measurement from previous reports associated with the same TEG-ID*   We don’t agree with Nokias and Huaweis view that TEG associations to RSs are static. Due to UE rotation, UE movement, or an environmental change (e.g. movement of an object blocking channel paths) the UE may select a different antenna panel for RX/TX of the same RS, which results in a change in TEG association. |
| **Huawei, HiSilicon** | Reply to Ericsson:  Thanks for supporting the modified proposal from Huawei.  With regard to the TEG change that Ercisson did not agree with Huawei, I would like to ask one question to Ericsson:  Suppose UE has two panels, and with each panel, UE will transmits a SRS resource set. Do you consider TEG change if Panel #1 – SRS #1 and Panel #2 – SRS #2 is changed to Panel #1 – SRS #2 and Pnael #2 – SRS#1?  To our understanding, what matters is whether two SRS belonging to the same TEG is changed or not, and as long as the same two SRS still belong to the same TEG, there is no TEG change. Note that even without the TEG change in your mind, the SRS transmission timing could vary between different transmission occasion, due to DL timing adjustment, UE gradual TA change, and TA command.  If TA is interpreted as timing adjustment, it is not clear how UE could determine there is SRS timing adjustment between two periodicities. |
| **Ericsson** | Regarding to the question raised by Huawei:  Question: “Suppose UE has two panels, and with each panel, UE will transmits a SRS resource set. Do you consider TEG change if Panel #1 – SRS #1 and Panel #2 – SRS #2 is changed to Panel #1 – SRS #2 and Pnael #2 – SRS#1?”  Ericsson Answer: The answer to this depends on if the two panels belong to the same Tx TEG or different Tx TEGs. If the transmissions from Panel #1 and Panel #2 belong to the same Tx TEG. Then, there is no TEG change. But if the transmissions from Panel #1 and Panel #2 belong to different Tx TEGs, then the above example would constitute a TEG change.  Our reply above was based on the following comment made by Huawei in an earlier response:  *“static association between RS and Tx TEG” upon configuration is supported for both UE and TRP, which means that TRP provides the PRS-TEG association in the TRP information exchange and UE provides the SRS-TEG association in the positioning information exchange.”*  Ericsson Comment: According to the above comment, SRS-TEG association information is static. Let’s take your example above where   * Panel #1 (associated with Tx TEG #1) transmits SRS #1, and * Panel #2 (associated with Tx TEG #2) transmits SRS #2.   The UE may decide to turn off one of the panels (say Panel #2) for power saving purposes. With the above static association, the UE will not be able to transmit SRS#2 given that Panel #2 (associated with Tx TEG #2) is turned off. Without such static association, the UE should be able to transmit SRS #2 using Panel #1. Which panel to use for a transmission of an RS should be up to the UE to decide. This is one example of why static association between RS and TEGs does not work. |
| Qualcomm | To HW’s question: If the measurement reports are not correlated, then they should cknowledge that also the TxTEGs of SRS are not correlated. So a UE cannot just report TxTEGs once, and has to be reporting (even for periodic SRS), periodically or after there is a change.  We also strongly support that RS <-> TEG Information is not static (we agree with Ericsson).  We need to make progress, and just saying “consider” does not solve the big issue of TEG<->RS being static or not. We need to acknowledge that it can be dynamic, and decide to support at least one of the 2 solutions (or both). Either way, if some UE/TRP thinks it is static, will just support Option 2 and will never send an update. Some other UEs/TRPs will send an update if it is needed.  So, we suggest the following:   * *Support UE/TRP to provide the association information between Rx/Tx/RxTx TEG and timing measurement together with each measurement report.*   + *FFS: TEG association information*   + *FFS:Support including information related to whether measurements associated with a TEG-ID can be assumed to have timing errors within a margin with measurement from previous reports associated with the same TEG-ID* * *In addition, also ~~consider~~ support at least one of the following alternatives (to be decided in RAN1#106b):*   + *Option 1: the LMF to request a UE/TRP to provide the periodic update of the association information between Tx TEG and positioning SRS/PRS, based on a configured periodicity;*     - *FFS: the values of the configurable periodicities*   + *Option 2: the LMF to request a UE/TRP to provide the update of the association information between Tx TEG and positioning SRS/PRS whenever the UE/TRP determines the previous association information is no longer valid*     - *Note: It is up to the UE/TRP to determine whether and when to provide the update*   + *In either Option, the definition of change of association information between Tx TEG and RS should be clarified first.* |
| Nokia/NSB | To Ericsson, our view is not that the TEG association is static but that the TEG definition (i.e., “certain margin”) is static. The UE reports in each measurement report a TEG ID which can change from report to report even if the same resources are used. At least this is our understanding at the moment. |
| Huawei, HiSilicon | Reply to Ericsson:  In the example Ericsson raised, we think this can be resolved by reporting two SRS are in different TEGs in the first place even if later it can be from the same panel (same TEG). We are talking about positioning SRS, not MIMO SRS. From network side, we do not think switching off a panel for the IIoT positioning in FR2 should be encouraged (nor do we think it should be forbidden, since UE anyway would make its choice), as it leads to poor GDOP.  If two SRS simply switches TEG IDs (switching panels), we do not think it should be a TEG change.  Reply to Qualcomm:  Sorry we do not support changing “consider” to “support”, as it only overcomplicates the issue. We do aknowledge the Tx TEG are not correlated, but we do not think reporting periodically/changing-triggered association between TEG and SRS is the solution. Even for the same TEG, the SRS transmisison timing may vary between occasions, and the network may and should be capable to prepare for the worse case scenario.  The solution should be to allow gNB to perform 1-sample SRS measurement without filtering, and LMF gets the UL TDOA between two RTOA measurements belonging to the SRS in the same TEG (at the same slot). Even if an SRS is transmitted via panel#1 and then later via panel#2, the RTOA difference (UL TDOA) between TRPs for the same SRS should be the same (assuming UE location is static).  For the following part, as we said, correlating two LPP ProvideLocationInformation messages (for the case of periodic location report) should not be open for this particular case.   * + *FFS:Support including information related to whether measurements associated with a TEG-ID can be assumed to have timing errors within a margin with measurement from previous reports associated with the same TEG-ID* |
| **FL** | **To all**: Thanks for the discussions. It seems the latest comment from Qualcomm may capture most of the commens from the companies. I would add some further changes as follows, mainly for the clarity.  I assume the association information between Rx/Tx/RxTx TEG IDs and timing measurement are provided with each measurement report. I am not sure if we need to new agreement on it.  The proposal is mainly about the Tx TEG association with the positioning SRS/PRS resources. We need at least support the reporting Tx TEG association with the positioning SRS/PRS resources for each measurement report. Then, we can discuss other options for reducing the signalling overhead  So, I would suggest making to following changes on the latest version in Qualcomm’s comments:   * *Support UE/TRP to provide the association information between UE/TRP Tx TEG IDs and positioning SRS/PRS resources for each timing measurement report.*   + *FFS: Support including information related to whether the measurements associated with a TEG-ID can be assumed to have the timing errors within the same margin as the measurements of the previous reports associated with the same TEG-ID* * *In addition, also consider to support at least one of the following alternatives (to be decided in RAN1#106b):*   + *Option 1: the LMF to request a UE/TRP to provide the periodic update 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 update 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 whether and when to provide the update*   + *FFS: the definitions of static and dynamic change of association information between Tx TEG IDs and SRS/PRS resources.* |

### (Round 5) Proposal 3.4-1 (H)

* *Support UE/TRP to provide the association information between UE/TRP Tx TEG IDs and positioning SRS/PRS resources for each timing measurement report.*
  + *FFS: whether to support including information related to whether the measurements associated with a TEG ID can be assumed to have the timing errors within the same margin as the measurements of the previous reports associated with the same TEG ID*
* *In addition, also consider to support one of the following options (to be decided in RAN1#106b):*
  + *Option 1: the LMF to request a UE/TRP to provide the periodic update 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 update 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 whether and when to provide the update*
  + *FFS: The definitions of static and dynamic change of association information between Tx TEG IDs and SRS/PRS resources.*

Comments

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| **Company** | **Comments** |
| Huawei, HiSilicon | We have concern to add the first FFS subbullet, but we are fine with the proposal for the sake of progress if all other companies can live with it. |
| CATT | We are fine with the proposal. |
| OPPO | Support the proposal |
| ZTE | We prefer to to correlate the two reports in the first subbullet. The TOA measurement could be changed over time because of UE moving. I’m not sure even UE claim a TEG ID is assumed to have the timing errors within the same margin, how LMF will use it since it’s from different time occasions.  We assume Option 2 includes the case UE may not provide the response to LMF until UE has a measurement report to send. Therefore, there is no need for a dedicated update message. |
| vivo | Support in principle.  To ZTE  We think RAN4 is discussing how to group timing error difference in the same group is within a certain margin  Besides, for us, option 2 can be used in UL positioning with UE moving , if the Tx TEG is changed(for example:phone filp), but LMF is not aware this information, it may introduce error. we think it can be supported since the wording is just 'consider to support...' |
| Qualcomm | Could we clarify something: This means Tx-TEGs “for each timing measurement report” with regards to RTT? For example, if we talk about the UE,:   * In UTDOA the UE doesn’t have a timing measurement report, so I assume this line is not applicable. * For DL-TDOA, it seems FL’s understanding is that we have agreed that the RxTEG will be included in the report.   So, this means that the first bullet is applicable only to RTT reports. If yes, then why don’t we write it explicitly? In other words, for RTT, a UE could instead of reporting the TxTEGs together with the report, could send a separate report?   * I guess the motivation of having a separate report, instead of adding them inside the RTT report is the case that there is a common report for RTT & UTDOA, and the spec would need to support something for UTDOA. Is that the reasoning here?   Lets assume that this is the intention, then is it common understanding, for a report to include “TxTEGs for each timing measurement report”, would mean that this report would include timestamps (which would be the same timestamps as those in the timing measurement report). These timestamps, will be related to something that happened in the past, since the UE cannot know, or hasn’t yet created the measurement reports of the “future”; there may not even be measurement reports in the future (as far as the UE is concerned).  Turning the attention to TRP timing measurement reports and while trying to interpret the first bullet:   * These are the RTOA and the gNB-RxTx. However, for RTOA, there is no PRS. * So, really, having Tx-TEG of PRS would be related to the case that the TRP reports gNB RxTx. * Again, since the TRP may support TDOA, we would need to have a separate mechanism to send Tx-TEG <->PRS associations, and therefore, tis mechanism could be applicable to the case that the TRP reports gNB RxTx.   Having said the above, technically speaking, I think the above first line, if we try to “demystify it”, really means just the following, or am I missing some scenario?   * *Support*    + *UE to provide the association information between UE Tx TEG IDs and positioning SRS for each UE Rx-Tx measurement report.*   + *Support TRP to provide the association information between TRP Tx TEG IDs and PRS resources for each gNB Rx-Tx measurement report.*   + *Note: Reporting of UE/TRP Tx TEGs together with the UE/TRP Rx-Tx measurement report is also supported*   + *FFS: whether to support including information related to whether the measurements associated with a TEG ID can be assumed to have the timing errors within the same margin as the measurements of the previous reports associated with the same TEG ID*   On a different question, what does the following sentence mean?   * + “*FFS: The definitions of static and dynamic change of association information between Tx TEG IDs and SRS/PRS resources.*” |

## Reporting of uncertainty/margin of a Rx/Tx TEG

Submitted Proposals

* ***(Qualcomm,*** [***R1-2107345***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107345.doc)***[9]) Proposal 10: 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.***
* ***(CMCC,*** [***R1-2107403***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107403.doc)***[10])Proposal 3: Support UE to report the statistics (variance) of differences of the RX TEGs to LMF for mitigating TRP Tx timing errors and/or UE Rx timing errors for DL TDOA***
* ***(CMCC,*** [***R1-2107403***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107403.doc)***[10])Proposal 5: Support a UE to provide the statistics (variance, bound, etc.) of the Tx timing error differences between Tx TEGs to LMF.***
* ***(MediaTek,*** [***R1-2107822***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107822.doc)***[15]) Proposal 3-2: A RXTX TEG ID is associated with the a range of residual error***

FL Comments

If a UE/TRP is able to provide the error margins for a Rx/Tx/RxTx TEGs to the LMF, the information should be very useful for the positioning calculation in the LMF.

### Proposal 3.4-2

* *For mitigating timing errors in DL-TDOA,* 
  + *Support a UE, subject to UE capability, to provide the timing error margin associated with a Rx TEG*
  + *Support a TRP to provide the timing error margin associated with a Tx TEG*
* *For mitigating timing errors in UL-TDOA* 
  + *Support a UE, subject to UE capability, to provide the timing error margin associated with a Tx TEG*
  + *Support a TRP to provide the timing error margin associated with a Rx TEG*
* *For mitigating timing errors in DL+UL Positioning,* 
  + *Support a UE, subject to UE capability, to provide the timing error margin associated with a Rx/Tx/RxTx TEG*
  + *Support a TRP to provide the timing error margins associated with a 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** |
| Ericsson | Do not support. We think the timing error margin can be static and the same for all TEGs. It could be defined by RAN4 or be different for different Ues based on UE capability. We have seen no arguments why different TEGs should have different margin or why the margin would need to be non-static. |
| ZTE | Doubt whether UE or TRP can accurately get the margin. |
| **FL** |  |
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## Indexes for UE Rx/Tx TEGs

Submitted proposals

* ***(Ericsson,*** [***R1-2108164***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)***[19])Proposal 19 In NR Rel-17, support the UE to associate both a spatial and a temporal UE RX TEG index to each TOA measurement and to indicate both these indices in RSTD and UE RX-TX time difference measurements.***
* ***(Ericsson,*** [***R1-2108164***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)***[19])Proposal 20 In NR Rel-17, support the UE to associate both a spatial and a temporal UE TX TEG index to each UL SRS transmission and to signal the associated indices in a message to the LMF.***
* ***(Ericsson,*** [***R1-2108164***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)***[19])Proposal 21 Study how to handle frequency-dependent timing errors in NR Rel-17.***

FL comments

Rx/Tx timing errors may be different for different times, different beam directions and different frequencies. When different indexes are used, when there is an update of the TEG information, it may allow the indication of the update is triggerd by the change of time, or change of beam direction, or other reasons.

### Proposal 3.4-3

* *Support the UE to associate both a spatial and a temporal UE RX TEG index to each TOA measurement and to indicate both these indices in RSTD and UE RX-TX time difference measurements.*
* *Support the UE to associate both a spatial and a temporal UE TX TEG index to each UL SRS transmission and to signal the associated indices in a message to the LMF.*
* *Study how to handle frequency-dependent timing errors in NR Rel-17*

Comments

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| **Company** | **Comments** |
| Ericsson | Support.  Filter group delays may vary with time due to temperature variations that are in turn due to variations in UE heat generation e.g. when turning on and off radio transmission. In addition the UE may perform timing adjustments that impact the timing errors.  Some mechanism is needed to handle this. One possibility is to have a one bit temporal TEG index. This would be equivalent to the TEG reset bit proposed by Qualcomm. Alternatively two or more bits could be used for the temporal TEG index. Such an index would work as a counter that is incremented with time or when an event like a timing adjustment happens. Measurements with small enough difference in the temporal TEG index can be assumed to have timing errors within the margin. Note that for three consecutive measurements this would allow measurement 1 and 2, as well as measurements 2 and 3 to ‘be in the same TEG, i.e. to have timing errors within the margin’ while measurements 1 and 3 would not be in the same TEG. |
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# Reference devices for mitigating UE/gNB Tx/Rx timing errors

Background

The following agreement was made in agreement was RAN1#105e related to the use of a reference device with a known location to support the mitigating UE/gNB Tx/Rx timing errors:

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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_08_TSGR_106e/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_08_TSGR_106e/docs/R1-2106326.doc) (Email endorsement) |

Submitted Proposals

* ***(Sony,*** [***R1-2106809***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106809.doc)***[4])Proposal 5:*** *Support UE as PRU.*
* ***(Sony,*** [***R1-2106809***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106809.doc)***[4])Proposal 6:*** *Support to introduce PRU identification based on the device capability, which enable LMF to select the capable devices UE to be PRU.*
* ***(Sony,*** [***R1-2106809***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106809.doc)***[4])Proposal 7:*** *PRU with known location support the following functionalities: Location uncertainty information, stationary status, providing positioning measurement and/or estimated Tx/Rx Timing error report.*
* ***(Apple,*** [***R1-2107740***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107740.doc)***[14]) Proposal 1:*** *At least for UE-based method, LMF will provide the effective error to UE, e.g., through the LPP message Provide Assistance Data, or it may ask gNB to broadcast the effective error within posSIB*
  + *Each effective error value may be associated with a set of TRP IDs of candidate NR TRPs for measurement*
* ***(Apple,*** [***R1-2107740***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107740.doc)***[14]) Proposal 2:*** *UE will indicate, e.g., through LPP message Provide Location Information, to the LMF whether or not the effective error is compensated/applied to the positioning measurements and/or location calculation*

FL comments

* In RAN1#105e, RAN1 made the decision “*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*”. Thus, my suggestion is that we may wait for the responses from RAN2/RAN3 to see there is a need for RAN1 to do additional work related to the use of the PRU for performance enhancement.

Comments

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

Background

The following agreement was made in RAN1#104e related to the measurement enhancements for mitigating UE/gNB Tx/Rx timing errors:

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| Agreement:  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. |

## Measurement time window

Background

One of the remaining issues is: “FFS: The measurement instances are within a [configured] measurement time window”. In RAN1#105e, the following proposal was discussed without conclusion.

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| (RAN1#105e) Proposal 5-1 (H)  * Support LMF to configure the measurement time window (MTW) for a UE for the measurement instances included in a measurement report. UE is expected to perform measurements during the configured MTW. * Support LMF to configure the measurement time window for a gNB for the measurement instances included in a measurement report. gNB is expected to perform measurements during the configure MTW * FFS: the details of the MTW configuration * Note: UE/gNB’s behaviors outside of the MTWs are undefined |

Submitted Proposals

* ***(CATT,*** [***R1-2106971***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106971.doc)***[6])Proposal 6: The configurable measurement time windows should be supported, in which the UE or TRP measurement instances are obtained.***

**FL:** Further discussion in Proposal 5-1.

* ***(CATT,*** [***R1-2106971***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106971.doc)***[6])Proposal 7: 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.***

**FL:** Further discussion in Proposal 5-1.

* ***(CATT,*** [***R1-2106971***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106971.doc)***[6])Proposal 8: UE (or TRP) is not expected to measure DL-PRS (or SRS-Pos) outside of the measurement time window.***

**FL:** Further discussion in Proposal 5-1.

* ***(CATT,*** [***R1-2106971***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106971.doc)***[6])Proposal 9: (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.***

**FL:** May be further discussed after measurement time window can be agreed in Proposal 5-1.

* ***(CATT,*** [***R1-2106971***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106971.doc)***[6])Proposal 12:*** ***For configuration method 1 and the periodic DL-PRS, the length of UE measurement time window can be defined as:***
  + - * + ***is the periodicity of DL-PRS resource set;***
        + ***is the number of UE measurement instances included in the UE measurement time window,*** ≥1;
        + ***is the number of instances of DL-PRS resource set or DL-PRS occasions contained by the i-th UE measurement instance，***≥1.
* ***(CATT,*** [***R1-2106971***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106971.doc)***[6])Proposal 13:*** ***For configuration method 1 and the periodic/semi-persistent SRS-Pos, the length of TRP measurement time window can be defined as:***
  + - * + ***is the periodicity of SRS-Pos resource set;***
        + ***is the number of TRP measurement instances included in the TRP measurement time window,*** ≥1;
        + ***is the number of instances of SRS-Pos resource set or SRS-Pos occasions contained by the i-th TRP measurement instance，***≥1.

**FL:** May be further discussed after measurement time window can be agreed in Proposal 5-1.

* ***(CATT,*** [***R1-2106971***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106971.doc)***[6])Proposal 14: (Configuration method 2): 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.***
* ***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.***

**FL:** Details of measurement time window can be discussed after RAN1 makes the agreement to introduce the measurement time window.

* ***(CATT,*** [***R1-2106971***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106971.doc)***[6])Proposal 15: 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.***

**FL:** May be further discussed after measurement time window can be agreed in Proposal 5-1.

* ***(Nokia, R1- 2107057[7]) Proposal 9: UE to provide gNB its measurement time window for UE Rx-Tx time difference measurement.***

**FL:** Further discussion in Proposal 5-1.

* ***(Qualcomm,*** [***R1-2107345***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107345.doc)***[9]) Proposal 11: For UE-assisted/network-based Positioning, for enabling a device to include measurements in a single report across multiple measurement instances (i.e. Batch reporting feature), support LMF sending an optional “Time-domain Window” configuration(s) to both UE and gNBs that define the time at which the measurements are to be obtained.*** 
  + ***Each window is defined with a start/End configuration (and potentially a period for periodic location requests).***
  + ***If startTime is provided, the device (UE/gNB) shall strive to include, in a single report, measurements derived on instances that start no earlier than the startTime.***
  + ***If EndTime is provided, the device (UE/gNB) shall strive to include, in a single report, measurements derived on instances that end no later than the EndTime.***

**FL:** Further discussion in Proposal 5-1. Details of measurement time window can be discussed after RAN1 makes the agreement to introduce the measurement time window.

* ***(Qualcomm,*** [***R1-2107345***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107345.doc)***[9]) Proposal 12: With regards to the requested Time-domain measurement Window:*** 
  + ***Study further the UE ehavior when a limited number (or none) of PRS instances appears within a configured time-domain window.***
* **FL:** Details of UE ehavior can be discussed after RAN1 makes the agreement to introduce the measurement time window.
* ***(LG,*** [***R1-2107542***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107542.doc)***[11]) Proposal #3:*** 
  + ***RAN1 should consider average measurement time window for positioning measurement.***

**FL:** Further discussion in Proposal 5-1.

* ***(Apple,*** [***R1-2107740***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107740.doc)***[14]) Proposal 6: At least for UE-assisted method, UE may be indicated by LMF to perform measurements corresponding to both DL-TDOA and DL-AoD positioning techniques***
  + ***The measurements at least include DL-RSTD together with DL-PRS-RSRP over a set of (TRPs, antenna panels, PRS configurations, etc)***
  + ***Additional UE capabilities may be needed***

**FL:** The proposal seems already covered by the agreement in RAN1#104bis “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.

* ***(Ericsson,*** [***R1-2108164***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108164.doc)***[19])Proposal 22 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:** Further discussion in Proposal 5-1. Details of measurement time window can be discussed after RAN1 makes the agreement to introduce the measurement time window.

FL Comments

The intention for proposing LMF to configure the measurement time windows for both the UE and the gNB is to enable the UE and gNB to provide the one or multiple measurement insances in the same time window with the same measurement report to avoid miss-match the UL and DL measurements, which may be specially for DL+UL positioning. However, some companies consider the miss-match the UL and DL measurements may be resolved based on the timestamp included in the measurement reports, and thus there is no need for LMF to configure the measurement time window.

Proposal 5-1 (H)

* *Support LMF to configure the measurement time window (MTW) for a UE for the measurement instances included in a measurement report. UE is expected to perform measurements during the configured MTW.*
* *Support LMF to configure the measurement time window for a gNB for the measurement instances included in a measurement report. gNB is expected to perform measurements during the configure MTW*
* *FFS: the details of the MTW configuration*
* *FFS: the UE/TRP behavior when a limited number (or none) of PRS/SRS instances appears within a configured time-domain window*
* *Note: UE/gNB’s behaviors outside of the MTWs are undefined*

Comments

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| **Company** | **Comments** |
| Qualcomm | We are generally supportive of the proposal. We suggest to change the stronger wording of “ UE/gNB is expected” to : “UE/gNB shall strive to perform measurements during the MTW”.  The reasoning is the following: A device (UE/gNB) may perform additional measurements outside the window, I assume that the devices could still report those. Similarly, a device may ave additional constraints and had to skip some of the measurement instances that was requested to reported. In this case, the device could report for a subset of the instances. |
| Huawei, HiSilicon | We think this window should better be jointly discussed with regard to SA2 support of scheduling location in advance. |
| CATT | Support.  The configurable measurement time window can help LMF to eliminate the influence of timing errors of TRPs and UE. The purposes for introducing measurement time window are as follows:   * Limit the measurement ehavior of UE or TRP, and only DL-PRS/ SRS-Pos resources within the measurement time window will be measured. * Limit the measurement time of each measurement instance, and support the measurement instance which only corresponds to one DL-PRS/SRS-Pos occasion for one-shot measurement. * Facilitate the timestamps matching among various measurement instances, e.g., among UE Rx-Tx time difference measurement instances and gNB Rx-Tx time difference measurement instances for multi-RTT positioning method. * Indicate whether the measurement instances are measured within the same measurement time window. * Help LMF to track and mitigate the timing error drift over time. |
| OPPO | Measurement time window is not needed. Each measurement instance is reported with its own timestamp and LMF can know whether these measure instance is close enough or not. We also have the same comment as Nokia made in last meeting: what’s the relationship between MTW and the timing error mitigation? |
| Lenovo,Motorola Mobility | Generally fine with the FL’s proposal of an LMF configured measurement window for both UE and gNB. We are also fine to discuss this under a common measurement window configuration in the NLOS/multipath AI as the requirements (in terms of duration) and motivation are different to timing error mitigation. |
| LG | We are generally supportive of the proposal. |
| Intel | We are not convinced by current motivation to introduce the MTW concept. The note in the last subbulet is confusing. |
| Ericsson | We support the proposal. |
| ZTE | Not support. We have similar view with OPPO. |
| Nokia/NSB | Okay with the update from QC. We need to be very clear that LMF does not have control over how the radio resources are used (unless that is the intention of the proposal in which case we are opposed). |
| FL | **To Huawei’s comments:** I share the similar view that MTW can be ueful to support scheduling location in advance, although in my undersatdning the main motivation for the proposal is not for that purpose, and thus we can have a separate discussion.  **To OPPO’s comments:** The main intention of the MTW in my understanding is to configure both UE/TRP to provide the measurements at the same time durations. In my understanding, it may serve two purposes: a) avoid the mispatching of the UL/DL measurements, which is important to DL+UL positioning; b) as discussed by a number of companies, to use the measurements obtained in the same MTW for potential estimation of the Rx/Tx timing errors.  **To Intel’s comments:** The note was suggested to be added for the comments on UE/gNB’s behaviors outside of the MTWs. We may remove it in my view since the main intention of the proposal is to define the UE.  The proposal my be revised as follows mainly based on the comments: Proposal 5-1 (H)  * *Support LMF to configure the measurement time window (MTW) for a UE for the measurement instances included in a measurement report. UE shall strive to perform measurements during the configured MTW.* * *Support LMF to configure the measurement time window for a gNB for the measurement instances included in a measurement report. gNB shall strive to perform measurements during the configure MTW* * *FFS: the details of the MTW configuration* * *FFS: the UE/TRP behavior when a limited number (or none) of PRS/SRS instances appears within a configured time-domain window* |

FL Comments

The proposal is revised mainly based on the comments.

(Round 2) Proposal 5-1 (H)

* *Support LMF to configure the measurement time window (MTW) for a UE for the measurement instances included in a measurement report. UE shall strive to perform measurements during the configured MTW.*
* *Support LMF to configure the measurement time window for a gNB for the measurement instances included in a measurement report. gNB shall strive to perform measurements during the configure MTW*
* *FFS: the details of the MTW configuration*
* *FFS: the UE/TRP behavior when a limited number (or none) of PRS/SRS instances appears within a configured time-domain window*
* *Note: UE/gNB’s behaviors outside of the MTWs are undefined*
* *~~Note: UE/gNB’s behaviors outside of the MTWs are undefined~~*

Comments

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| **Company** | **Comments** |
| Apple | Support, 2nd Note is duplicated  FL: Thanks. The duplicated is removed. |
| Qualcomm | Support.  Our main motivation from our side is the alignment of RxTx measurements, and time-drift estimation at the LMF. Both these are related to timing error mitigation enhancemnts, and have nothing to do with scheduling in advance feature. The fact that scheduling in advance feature (if supported) could use these Ies is another discussion, and no need to discuss it in RAN1. |
| Ericsson | ok |
| CATT | Support. We believe configurable measurement time window is very important for measurement enhancements. |
| MTK | It seems to us that there are certain companies have concern on this features. We also have some questions to FL and QC,  1, do you expect under M-RTT technique, DL-PRS and SRS periodicity would be quite different?  2, if DL-PRS transmission periodicity and SRS transmission periodicity is quite aligned, but there are unavoidable slot offset between DL-PRS and SRS, do we need MTW?  3, if DL-PRS and SRS have quite different periodicity for example DL-PRS periodicity is much longer than SRS periodicity, UE may ONLY measure and report the DL-PRS instance nearest SRS. But if UE measures each DL-PRS instance and report them as a batch each with time stamp, and it is up to LMF to pair UE and gNB measurement by using closest time stamp, do we still need MTW? |
| Vivo | We wonder whether there is any relationship between MTW and PRS process priority window in 8.5.4 given the description” *UE shall strive to perform measurements during the configured MTW*” |
| OPPO | @FL Thanks for the explain the benefits fo the pososal. Here are some following question   * “avoid the mispatching of the UL/DL measurements, which is important to DL+UL positioning”: the measurement results are associated with timestamp. In our understanding, LMF can match the measuements based on the timestamp. Why is it not sufficient? * “use the measurements obtained in the same MTW for potential estimation of the Rx/Tx timing errors”: According to the discussion of Proposal 3.4-1, we can see that whether the TEI information is changed is not related to the MTW. * In the main bullet “*UE shall strive to*” is quite vague. It may be also related to some RAN4 requirement. |
| Lenovo,Motorola Mobility | Generally supportive, but have 2 clarification questions:   1. Regarding the MTW configuration, can the LMF configure multiple periodic MTWs (depending on the number and duration of measurement instances) for a single UE or is it limited to a single configured MTW to report all measurement instances within said MTW.  * 2. Regarding the Note, does the measurement ignalli outside the MTW preclude the possibility to report measurement instance time stamps outside the MTW or will that be separately defined in Proposal 5-2a? |
| Qualcomm | To OPPO: The timestamp is not sufficient because a UE may be providing very different timestamps than the TRP.  The expression “UE shall strive to” is intentionally vague, so that it doesn’t appear as if we enforce/mandate the UE do something. It is just a soft suggestion to the UE, and a good UE implementation will try to follow it. No need to really have requirements if RAN4 doesn’t have time, no need to create a big story/spec around this. It is just a ignalling of when should the UE/TRPs try to do their measurements. Many things in Positioning are optional & best effort, but we need at least some recommendations to help drive decisions.  To MTK: Even though we expect PRS and SRS to be similar periodicity, there is no such constraint. Also note that DL-PRS can be used for other methods also concurrently (e.g. TDOA, DL-AoD), so it is not clear that the PRS/SRS will always be the same periodicity. If LMF could really choose both, then it wouldn’t be as much of a problem, but now, unfortunately, we have the serving gNB choosing SRS and the LMF choosing PRS.  To Vivo: PRS processing window is something very different: Every after instance, the UE would need some time to finish the processing and report. MTW is much/much longer than that; It may be 500 msce long, or 1 sec, so that the UE/TRP will try to do measurements within that time. PRS processing window is a period of time in which the UE prioritizes PRS over other channels. MTW doesn’t say anything about prioritization.  Furthermore, MTW is not just for alignment of DL & UL meausrements. It is also for time-drift estimation at the LMF. If the UE/TRP provide meuasrmeents across a collection of instances, it can enable tracking & time-drift compensation at the LMF. |
| **FL** | The following is related to the email discussion between Nokia and FL:  **Nokia**:  That is the motivation for the 2nd FFS? If the UE/gNB are striving to perform the measurements in the window but are not mandated then there doesn’t seem to be any new ehaviour needed based on the note.  **FL:**  For the 2nd FFS, my understanding it is about the case when a UE/gNB tries to measure the PRS/SRS with the MTW, but does not find enough number (or none) of PRS/SRS instances for the required number of samples of the measurement. In this case, there may be a need to define what the UE/TRP should report back to LMF. For example, LMF requests UE to measure 4 samples, but there is only 2 PRS/SRS samples with the window. Should the UE reports the measurement based on the 2 samples?    For the Note, I assume it means it means this proposal does not define UE/gNB’s behaviors outside of the MTWs. Assume we have periodic DL PRS transmission, there are PRS/SRS instances inside/outside of the MTW, then whether to measure/use the PRS/SRS instances appears outside of the MTW is up to the UE/TRP. |
| **FL** | To Lenovo:   * We have “• FFS: the details of the MTW configuration”. We may need to have further discussion on single or multiple periodic MTWs once we make the agreement on the proposal. At this moment, it is unclear to me what is the need and benefits to configure multiple periodic MTWs. * Regarding the Note, I don’t think it means to preclude the possibility to report measurement instance time stamps outside the MTW (see also my response to Nokia’s comments). |
| **FL** | It seems the note may indeed cause some confusion. Given that the proposal is about the UE/gNB’s behaviour inside MTW. UE/gNB’s behaviour outside MTW should be the same case when there is MTW is not configured. Thus, my suggestion is to change it to: remove it.   * *Note: UE/gNB’s behaviors outside of the MTWs are not impacted by the configuration of MTW ~~undefined~~*   Also, I assume the configuration of the MTW are most likely to be used for more specific cases (e.g., alignment of DL & UL meausrements, time-drift estimation/ compensation, etc.), thus, I suggest adding “Optional” to the main bullet. |

FL Comments

The proposal is revised mainly based on the comments.

(Round 3) Proposal 5-1 (H)

* *Support LMF to optionally configure the measurement time window (MTW) for a UE for the measurement instances included in a measurement report. UE shall strive to perform measurements during the configured MTW.*
* *Support LMF to optionally configure the measurement time window for a gNB for the measurement instances included in a measurement report. gNB shall strive to perform measurements during the configure MTW*
* *FFS: the details of the MTW configuration*
* *FFS: the UE/TRP behavior when a limited number (or none) of PRS/SRS instances appears within a configured time-domain window*
* *Note: UE/gNB’s behaviors outside of the MTWs are not impacted by the configuration of the MTW*

Comments

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Support the proposal |
| MTK | It seems to us that, it should be transmission time window (TTW), not measurement time window (MTW)  If PRS and SRS transmission could be arranged closely, where PRS is arranged by LMF and SRS arranged by gNBs, (and gNB and LMF don’t coordinate?) then the issue may be solved  Honestly speaking, this feature is not so clear to us |
| Huawei, HiSilicon | OK |
| LG | Support. |
| CATT | Support. We are fine with the wording of “optionally”, and we believe the configurable measurement time window can give more flexibility on the measurement and report of measurement intstants. |
| OPPO | What does the note mean? Do UE/gNB still need to do perform the measurements out side MTW?   * If yes, how to report these measurement results performed outside MTW? * If no, we can make it clear with some explicit wording   We also share similar view as MTK. Adding a MTW doesn’t address the issue. This issue is related to the tranmssion of PRS and SRS. |
| ZTE | The MTW seems unclear to us.   * It’s more like an implementation issue, which depends on how gNB/LMF to configure SRS/PRS with similar periodicity. * Do we expect that UE/TRP only reports the measurements results in MTW, which may have largely impact on the UE processing capability and measurement requirement. * What’s the differences of UE behavior for inside and outside MTW? Should UE still need to follow the measurement period defined in Rel-16?   From our point of view, if LMF want to avoid the mismatch between gNB and UE, LMF can allow UE to report more measurement instances (scattered and each have their own time stamp). LMF can decide how to use the reports from gNB and UE jointly. |
| **FL** | **To MTK/OPPO:** My understanding for the proposal is more related to receiving side instead of transmission side. The gNB may continue the transmison of the DL PRS periodically. The UE is required to measure the DL PRS at a particular MTW.  **To OPPO:** The note says: ” UE/gNB’s behaviors outside of the MTWs *are not impacted* by the configuration of the MTW.” The UE may or may not be requested by the LMF to perform other measurements, which is not related to the configuration of the MTW. For example, the UE may be configured to measure and report RSTD for DL-DTOA periodically.  **To ZTE: a)** It is more than an implementation issue in my understanding, since it allows the network to have a control on the MTW when it needs; b) No. Similar to the reponse to OPPO, UE/TRP reports the measurements results in MTW is not related to this proposal; c) yes. UE should follow the existing requirements for the measurements no in the MTW in my understanding. |

(Round 4) Proposal 5-1 (H)

* *Support LMF to optionally configure the measurement time window (MTW) for a UE for the measurement instances included in a measurement report. UE shall strive to perform measurements during the configured MTW.*
* *Support LMF to optionally configure the measurement time window for a gNB for the measurement instances included in a measurement report. gNB shall strive to perform measurements during the configure MTW*
* *FFS: the details of the MTW configuration*
* *FFS: the UE/TRP behavior when a limited number (or none) of PRS/SRS instances appears within a configured time-domain window*
* *Note: UE/gNB’s behaviors outside of the MTWs are not impacted by the configuration of the MTW, but by the existing requirements.*

Comments

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia/NSB | We don’t feel the 2nd FFS brings any value and prefer to remove it. What does the end of the note mean? That UE requirements are not impacted? |
| Qualcomm | As we said before, we are supportive, but the new addition “but by the existing requirements” is still unclear. I guess it is trying to address the comments whether the MTW would result to new requirements or not. It can be left up to RAN4. Eitehr way there are no measrurement period requirements for TRPs, so I guess the question is more about Ran4 UE measurement requirements.  We would be OK to remove the 2nd FFS (potentially also the note), with just a statemenet: “Up to RAN4 to decide how this agreement affects any of the measurement requirements” |
| ZTE | Although we still think is not very necessary, we can accept this proposal for progress if there is no new UE capability or requirement should be defined. This MTW is simply a suggestion from LMF on how UE can group their measurement results. Based on this, we think,   * 2nd FFS should be removed. * Revise the Note as following, * *Note: UE/gNB’s behaviors outside&inside of the MTWs are not impacted by the configuration of the MTW, but by the existing requirements.*   In addition, we suggest we should be better to make progress of Proposal 5-2a and Proposal 5-3a since we only have two meetings left. At least we should complete the framework of multiple measurement instances. |
| MTK | For periodic PRS, if we say UE just measure these PRS within MTW, then why not confugre PRS with longer periodicity?  We still think that the issue is at transmission side, whether PRS and SRS are close enough  Now at least 3 companies have concern from round 3. At least for MTK, we are not to object the proposal strongly but the further invedtigation is necessary otherwise this could be a paper feature |
| vivo | We can support MTW in DL+UL positioning.  For DL+UL positioning, MTW is benefit for DL and UL alignment. However, for DL or UL positioning, the benefit is not clear enough to us. If the benefit is ‘time-drift estimation at the LMF’, we believe it is the benefit of ‘multiple measurement instance report which has been already supported rather than ‘the MTW’. If the benefit is ‘obtaining UE location for a certain time’, we think it is related to ‘schedule location time’, we can further discuss it based on RAN2’s conclusion. |
| CATT | Support the proposal. |
| OPPO | One question for better understanding of MTW. Which of the following optionsa is the correct understanding?  1. One-shot: gNB configure one MTW each time, and UE will report one report corresponding to this MTW. gNB can configure multiple MTWs by different configurations in different times.  2. Multiple MTWs: gNB configure multiple MTWs, and UE will report multiple reporting, each of them corresponding to each MTW.  3. periodic MTWs: gNB configure periodic MTWs, and UE will report the reporting periodically, each reporting corresponding to each MTW. |
| Qualcomm2 | To OPPO: The MTW configuration hasn’t been discussed. The LMF configures MTW, likely together with the Location request. Whether we are going to have a periodicity/offset/number-of-times, how many MTW, is up for further discussion.  From our understanding, if the LMF asks for periodic reporting, as a baseline, it could just be a single MTW for each period (aka, just a periodiocty, an offset and a length, such that the periodicity muches the reporting periodicity). For one-shot location request report, it is even simpler, and again, from our side, it can be as simple as a single MTW.  To vivo: For compromise, we can accept to have it only for DL+UL positionng.  To MTK: PRS periodicity may not be configurable (at least in rel-16 it is not; it is based on deployment). Even if we have on-demand PRS in rel-17, it is likely that the LMF will configure the smallest PRS across Ues (since PRS will still be broadcast/groupcast), even though some Ues would just be OK to be measuring much less than the nominal PRS configured. |
| Huawei, HiSilicon | We think the window can also be useful to align the Rx measurement occasions for UL-only positioning. |
| OPPO2 | @QC: if LMF configures a periodic MTW (e.g., a single MTW for each period), then LMF can also configure a UE only with the PRS in the same time-domain resource but without MTW, which can achieve the same purpose. Thus, why do we need MTW? |
| LG | We are generally fine with the current version. |
| MTK2 | From the feedback by FL and QC, it seems to us that there is strong assumption that gNB and UE may not measure SRS and DL-PRS at each time instance. From our perspective, it may happen for CRS measurement of neighboring cells in LTE since CRS comes in each subframe. DL-PRS comes with a period, normally 160ms at least from our field trial observation in LTE  So, UE is asked to transmit SRS but TRPs may not measure all of them. This wastes UE power. When UE may not measure all instances of DL-PRS, then such the deployment of DL-PRS wastes the RS overhead  If a UE wants to support DL+UL positioning, then UE should measure DL-PRS surrounding SRS transmission (and assume unfortunately SRS and DL-PRS have quite different periodicity). And it is also weird to us if a system has interest for DL+UL positioning, why SRS and DL-PRS can’t be same periodicity?  From above discussion, it also seems to us that LMF can’t control SRS arrangement since it is done by gNB. So if LMF arrange MTW it could be useless because SRS may not be within MTW.  To move forward, we kind of support Nokia’s proposal. The similar proposal from our side is,  1, Up to UE capability, support UE to report measurement instance of DL-PRS surrounding SRS transmission for positioning   * + FFS on details   2, LMF informs TRPs the measurement instance of UEs |
| ZTE2 | * We share some similar view with OPPO2. It’s up to implementation to configure the PRS within the window, there is no need an explicit MTW. If LMF doesn’t expect to receive the measurement results outside the MTW, why not configure the RS with larger periodicity. * From our understanding, the MTW can be realized by another way. For a periodical measurement report, the report interval is naturally a MTW. If LMF want to align the UL and DL measurement at the same time window, LMF can simply configure the same report interval for UL measurement and DL measurement. There is no spec impact. |
| Lenovo,Motorola Mobility | Thanks to FL for the clarifications. The MTW configuration would depend on the type periodic/one-shot PRS to be measured within the window, hence we share similar understanding that a MTW configuration can match the transmitted PRS/SRS transmission configuration. In any case, this aspect is an FFS point. Generally, support the proposal but unsure about the need of “..but by existing requirements” on the last Note as it raises additional RAN4-related discussions. |
| Ericsson | Ok |
| CATT | Support the proposal. We are also fine with adding the “Support MTW at least in DL+UL positioning” to address the concern from company. |

### (Round 5) Proposal 5-1 (H)

* *Support LMF to optionally configure the measurement time window (MTW) for a UE for the measurement instances included in a measurement report. UE shall strive to perform measurements during the configured MTW.*
* *Support LMF to optionally configure the measurement time window for a gNB for the measurement instances included in a measurement report. gNB shall strive to perform measurements during the configure MTW*
* *FFS: the details of the MTW configuration*
* *It is up to RAN4 to decide how this agreement affects any of the measurement requirements*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Support |
| Nokia/NSB | This is okay with us in principle. Question for clarification: How will “UE/gNB shall strive to perform” show up in the spec? |
| CATT | Support. |
| OPPO | Not support. The technical comments have been made before. |
| NTT DOCOMO | We are supportive of the proposal. |
| MTK | Need some clarification, but our questions above are not answered. The proposals from different round is actually the same. Is it like using a M1A2 tank to smash the concerns/questions? ☺  1, It seems to us that the issue is whether PRS and SRS could be allocated closely and whether UE and gNB perform measurement when PRS and SRS are closely allocated. We wonder whether MTW could solve the problem that PRS and SRS could be allocated closely |
| ZTE | We have concerns on this proposal. The questions raised by OPPO/MTK/ZTE in last round were not addressed. |
| vivo | We can accept MTW in DL+UL positioning as proposed in our previous reply. And same question as Nokia. |

## Timestamp of measurement instance

Background

It was agreed in RAM1#104bis-e that each measurement instance has its own timestamp. However, there is no definition on how the UE/TRP provide the timestamp for the measurement.

Submitted proposals and FL comments

* ***(Huawei,*** [***R1-2106449***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106449.doc)***[1]) Proposal 8:*** *Support for single report containing multiple measurement instances*
  + *Specifying the time stamp selection for each measurement instance.*
  + *Scattering the measurement instances throughout the measurement time.*

**FL:** Further discussion in Proposal 5-2a and 5-2b..

* ***(ZTE,*** [***R1-2106549***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106549.doc)***[2]) Proposal 8:*** *Define the time stamp for a measurement instance, where the time stamp is a time window indicated by,*
  + *A starting time instance that corresponds to a reception time of the first reference signal for determining a measurement instance, and*
  + *An ending time instance that corresponds to a reception time of the last reference signal for determining the measurement instance.*

**FL:** Further discussion of timestamp in Proposal 5-2a.

* ***(vivo,*** [***R1-2106595***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106595.doc)***[3]) Proposal 14:*** 
  + *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.*

**FL:** Further discussion of timestamp in Proposal 5-2b. For this proposal, it is unclear on how the certain time before the measurement report is determined by the UE. If there are multiple measurement instances in a measurement report obtained in a measurement time duration, in my opinon, the UE is expected to report the measurement instances (evenly) distributed in the measurement time duration similar to the proposal in [1]

* ***(CATT,*** [***R1-2106971***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106971.doc)***[6])Proposal 10:*** *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.*

**FL:** Further discussion of timestamp in Proposal 5-2a.

* ***(OPPO,*** [***R1-2107213***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107213.doc)***[8])Proposal 14:*** *For the timestamps for the measurement instances in a measurement report, support Option 1 with the following modification:*
  + *Option 1: The timestamp of the UE (or TRP) measurement instance corresponds to the reception time of the last ~~DL-PRS resource set/~~PRS resource (or the last ~~SRS resource set/~~SRS resource for the positioning purpose) that are used to determining the measurement instance.*

**FL:** Further discussion of timestamp in Proposal 5-2a.

* ***(Lenovo,*** [***R1-2108142***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108142.doc)***[18]) Proposal 1:*** *The timestamp should correspond to the reception time of the last received PRS in a set of one or more measurement instances.*

**FL:** Further discussion of timestamp in Proposal 5-2a.

Proposal 5-2a (H)

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

* *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 the reception time of the last DL-PRS resource set (or the last SRS resource set) that are used to determining the measurement instance.*
* *Option 3: The timestamp of the UE (or TRP) measurement instance corresponds to as a time window indicated by,*
  + *A starting time instance that corresponds to a reception time of the first reference signal for determining a measurement instance, and*
  + *An ending time instance that corresponds to a reception time of the last reference signal for determining the measurement instance.*

Comments

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| **Company** | **Comments** |
| Huawei, HiSilicon | Option 1. The time stamp is associated with measurement for a DL PRS resource. |
| CATT | Support Option 3 or the following Option 4:   * Option 4: 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. |
| Vivo | Option 1 is preferred |
| OPPO | We prefer Option 1 since it can avoid some uncertainty. |
| Lenovo,Motorola Mobility | Option 1 |
| LG | We are generally fine with the proposal. Also, we think one option can be selected among option 1 and option 3. |
| Ericsson | We prefer Option 3 with some modifications:   * *Option 3: The timestamp of the UE (or TRP) measurement instance corresponds to as a time window indicated by,*   + *A starting time instance that corresponds to a reception time of the first instance of the DL PRS (or UL SRS) resource averaged/filtered over to give the measurement reported in the measurement instance, and*   + *An ending time instance that corresponds to a reception time of the last instance of the DL PRS (or UL SRS) resource averaged/filtered over to give the measurement reported in the measurement instance .* |
| ZTE | Support Option 3. In our understanding, a measurement instance should correspond to measurements conducted in a time window. The timing error shift is relatively small or can be neglected within the time window. UE is aware of its time error shift, so it’s better let UE to decide the duration of the time window. Therefore, the time stamp should be defined by a starting instance and an ending instance. |
| Nokia/NSB | Okay to agree and downselect at next meeting. |
| Qualcomm | Up to UE implementation as it has been traditionally been. The UE decides what the timestamp will be. |
| FL | It seems no company support Option 2.  **For Nokia’s comments:** Okay, although it is best that we close the issue in this meeting, since situation may not change much for the next meeting.  **For Qualcomm’s comments:** Based on the feedback from the companies, it is important to us to have a rule on how UE/gNB provides the timestamp for the measurements. Also, I don’t see either Option 1 or Option 3 will introduce particular implementation issue/burden in UE/gNB.  **For Ericsson’s comments:** I think the description can be simplified as follows:   * *Option 3: The timestamp of the UE (or TRP) measurement instance corresponds to as a time window indicated by,*   + *A starting time instance that corresponds to a 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 that 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 .* |

### (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.*

Comments

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| **Company** | **Comments** |
| Apple | Not needed, especially is a MTW is defined, the rest should be left to implementation. |
| Qualcomm | Suggest to focus on proposal 5-1 first. If the UE/TRP get a MTW, they ll be able to provide back good measurements derived when they are supposed to. |
| Ericsson | Ok to downselect in RAN1#106b. |
| CATT | Support. |
| Vivo | OK |
| OPPO | Support |
| Lenovo,Motorola Mobility | Ok to downselect in next meeting but this depends on the outcome of P5-1. |
| **FL** | My thinking is that the clarification of the time stamp is independent from the discussion of Proposal 5-1. One measurement instance may have 4 samples, and the PRS/SRS period can be very long,. Thus, different UE/TRPs may report quite different timestamps if we do not have a clear definition on the timestamp. |

### Proposal 5-2b

*When multiple measurement instances are reported in a measurement report, the reported measurement instances are expected to be:*

* *Option 1: Scattering evenly throughout the measurement time.*
* *Option 2: Most recent measurement instances in advance of a certain time before the measurement report.*

Comments

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| --- | --- |
| **Company** | **Comments** |
| Huawei, HiSilicon | Option 1. Even though we support Option 1, we would consider it as a recommendation, instead of mandating UE behaviour. |
| CATT | Support Option 1. |
| vivo | We think the two options are different thing  Option 1 is the intention of multiple instances that the different instances(instance gap is periodicity) are used for resistance to channel fading, e.g. frequency-domain selective fading    Option 2 is which available instance is chosen to be reported. The most recent measurement instances are reasonable for this case. |
| OPPO | It is up to UE implementation. UE should have the flexibility to drop some measurement instance with the bad quality due to the intereference. Moreover, UE know better its velocity and it can make better decision on which subset of the measure instances are more useful. |
| Ericsson | We think it’s unclear what is meant with the two option. If there are 12 occasions of a periodic DL PRS within the measurement time and four measuremenmt instances are reported, each based on three consecutive occasions of the DL PRS then the reported measurement instances are ‘scattered evenly throughout the measurement time’ but they are also the four most recent measurement instances. |
| NTT DOCOMO | We see the motivation to specify the expectation of measurement instances. However, considering the flexibility at UE behaviour, it may be better to leave it to UE implementation. |
| ZTE | Agree with Ericsson. |
| Nokia/NSB | Not sure we need to specify anything here. |
| Qualcomm | If there is a measurement window, there will not be a need of this proposal. The UE reports the measurements derived in all the instances inside the window. |
| FL | The priority of the proposal is lowered based on the feedbacks. It seems the majority of the feedbacks do no consider there is a need to consier either of the proposed options. |

## 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.*

|  |
| --- |
| * *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,*** [***R1-2106549***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106549.doc)***[2]) Proposal 6:*** *Further discuss how to configure the number of instances of DL PRS resource set in a UE measurement instance (i.e. the value N), at least consider one of the following alternatives,*
  + *Alt.1: configured by LMF per DL PRS resource set.*
  + *Alt.2: configured by LMF per TRP.*
  + *Alt.3: configured by LMF per positioning frequency layer.*
  + *Alt.4: configured by LMF per measurement report.*

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

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

* ***(vivo,*** [***R1-2106595***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106595.doc)***[3]) Proposal 15:*** 
  + *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,*** [***R1-2106595***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106595.doc)***[3]) Proposal 16:*** 
  + *For 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:** The issue seems important to be discussed. Further discussion in Proposal 5-3b.

* ***(vivo,*** [***R1-2106595***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106595.doc)***[3]) Proposal 17:*** 
  + *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:** Further discussion in Proposal 5-3.

* ***(Qualcomm,*** [***R1-2107345***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107345.doc)***[9]) Proposal 13:*** *Support LMF requesting the UE or gNB to perform measurements on specific PRS/SRS resources across multiple time-domain instances.*

**FL:** The issue may be complicated, since UE/gNB may not be able to detect all of the signals of specific PRS/SRS resources across multiple time-domain instance. Further discussion in Proposal 5-3c.

Proposal 5-3a (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.1: per DL PRS resource set*
* *The values of N can be*
  + *Option 1: N=[1,2, 4, 8,…,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:*
  + *Alt.1: per measurement report*
  + *Alt.2: per UE*

*The values of M can be*

* + *Option 1: M=[1,2, 4, 8,…,256]*
  + *Option 2: M is decided by RAN4*

Comments

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| **Company** | **Comments** |
| Huawei, HiSilicon | * *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*   We support Alt. 1   * *The values of N can be*   + *Option 1: N=[1,2, 4, 8,…,256]*   + *Option 2: N is decided by RAN4*   We support Option 1.   * *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:*   + *Alt.1: per measurement report*   + *Alt.2: per UE*   We think Alt.1 and Alt.2 are the same, since NRPPa measurement procedure is non-UE associated. Alt. 1 would be more aligned with RAN3 terminology.  *The values of M can be*   * + *Option 1: M=[1,2, 4, 8,…,256]*   + *Option 2: M is decided by RAN4*   We support Option 1. |
| CATT | Support to further discuss the concret values of N and M. We prefer the values of N and M as follows,   * Each UE measurement instance can be configured with N instances of the DL-PRS resource set. N = [1, 2, …, 256], using 8 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, … , 256] , using 8 bits to indicate which value is configured for M. |
| vivo | Alt.1 is preferred |
| OPPO | We prefer Option ~~1~~2. One clarification question for Alt.1: Does it mean different N will be used for RSTD, Multi-RTT or different N will be used for different RSTD measurements? |
| Lenovo,Motorola Mobility | Support downselecting the following alternatives/options.  UE measurement instance: Support Alt. 1:per measurement report, Option 1: N=[1,2, 4, 8,…,256]  gNB measurement instances: Support Alt. 1:per measurement report, Option 1: N=[1,2, 4, 8,…,256] |
| Ericsson | Support the proposal |
| ZTE | Support the proposal. |
| Nokia/NSB | We don’t see the benefit of such an agreement and don’t support it. We feel the measurement configuration is already quite flexible. |
| Qualcomm | We are OK to have this proposal |
| **FL** | **To Nokia’s comments:** I assume the main intention of proponents is to have some restriction of theflexibility.  **To OPPO’s comments: Alt.1: per measurement report** implies all measurements in the measurement report. If the report contains RSTD, Multi-RTT, etc., they have the same N.  From the feedback, it seems most companies are supportive to the proposal. We can add that the downselection to be done in RAN1#106b. |

### (Round 2) Proposal 5-3a (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 (downseletion in RAN1#106b) :*
  + *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, 4, 8,…,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, 4, 8,…,256]*
  + *Option 2: M is decided by RAN4*

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| **Company** | **Comments** |
| Qualcomm | Even though we are supportive of the general feature and we need to make progress; I might have been a bit confused when I said that we support this specific proposal; I think the wording is confusing actually, and had to recollect the context of the discussion to understand what is the intention.  My understanding is the following: UE/TRP gets a configuration (N/M) on how many instances should be reported together in a single measurement report. If yes, then why N/M can be as large as 256? Have you considered the size of the LPP package (256 times larger than now)? If PRS periodicity is 160 msec, having 256 instances reported, will correspond to 256\*160 -> 41 seconds worth of Positioning measurements in a single report!  We already agreed that LMF will request for 4-sample vs a M-sample measurement for the UE. So, for this proposal, if N=4, does it correspond to the a single report derived using 4-samples, or does the UE understand that it is expected to include 4 sub-reports in a report, wherein for each one, K-samples are being used? Example is the understanding the following:   * N instances in the report & K-sample measurements -> UE averages/filters K instaces and derives a sub-report, and repeats the process N times-> N sub-reports, each one derived using K-samples are included in a single report.   Or is the following:   * N instances in the report & K-sample measurements -> UE averages/filters K instaces and derives a sub-report, and does that N/K times, and reports the N/K sub-reports in a single report. |
| CATT | Support, we can downselect in RAN1#106b. |
| vivo | OK |
| Huawei, HiSilicon | I am also a little bit confused at the proposal.  So we agreed multiple measurement instances in a report for UE/gNB in RAN1#104, but the proposal is not talking about how the number of measurement instances is indicated. Instead it is talking about in each measurement instance, how many PRS/SRS measurement occasion is indicated, which to our understanding, is fixed to 4 for UE and not specified for gNB in Rel-16, and we are discussing M (e.g. 1) in Rel-17. Is it duplicated discussion?  Or is the intention to say N here is a value larger than value of the samples (4/M)?  We may also consider possible to incate the number of measurement instances in a single report, and UE may calculate N based on this? |
| OPPO | Support |
| Lenovo,Motorola Mobility | Also agree that some clarification is required based on QC’s observations on reporting N measurements instances as a function of number of measurement samples being requested by the LMF for each Nth measurement instance. We would like to also avoid any potentially large reporting overhead resulting from this. |
| **FL** | The following agreement was made in AI 8.5.4:  Agreement: (2nd GTW)  M-sample (1<=M<4) PRS processing corresponding to measurements performed within M instances of the DL PRS resource set on a PRS resource, subject to UE capability, is beneficial from a RAN1 perspective for latency reduction.   * One sample corresponds to one instance   Agreement:  Subject to UE capability, support LMF to explicitly request UE to report the measurement with either M-sample or 4-sample, if RAN4 has supported M-sample measurement.  FFS signalling details.  With above agreements, I would like to check with the group to see if there is a need to further discuss Proposal 5-3a (H) (e.g., whether there is a need to support more than 4 samples instances of the DL PRS resource set for each measurement insance). |
| **ZTE** | Okay with this proposal.  We think M-sample and multiple measurement instances can be discussed separately. The M-sample is to reduce positioning latency. However, we’re trying to address the timing delay problem, which may pre-assume that many instances may be configured and reported in a measurement report. UE has t know how to group their measurements into multiple measurement instances. If low latency is expected, we don’t need to configure/report multiple measurement instances.  Agree with Huawei, we also need to discuss the number of measurement instances included in a measurement report. Some of proposals are somehow talking about how to configure the number of measurement instances in a measurement report. |

Proposal 5-3b (H)

* *The same Rx TEG(s) should be used to measure all instances of the DL-PRS Resource Set for one UE measurement instance of RSTD and/or UE Rx-Tx time difference measurement;*
* *The same Rx TEG(s) should be used to measure all instances of the SRS measurement time occasions for one TRP measurement instance of RTOA and/or gNB Rx-Tx time difference measurement.*

Comments

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| **Company** | **Comments** |
| Qualcomm | We do not agree. The reason the UE reports this information is exactly because it is inevitable in some occasions that different Rx-TEGs are used. We are OK to say that the UE is requested to do something, and the UE to optionally attempt to do so, but not how the proposal is written now. |
| Huawei, HiSilicon | I am assuming the same UE Rx TEG applied for a TRP throughout the time, instead of across all TRPs.  It should be OK from our side if the above understanding is the intention. |
| CATT | We think it will benefit the combination of multiple measurement instances for one measurement report if the same Rx TEG is used to measure all instances which are used to derive one measurement report. |
| OPPO | When UE is moving/rotating, UE may change the Rx panels for the same PRS. |
| Ericsson | Ok. Somewhat confusing to use the word instance both for ‘DL PRS occasions’ and for ‘measurement instances’. |
| vivo | OK  If the intention is that for the same PRS resource across multiple PRS instances in a measurement instance, the same Rx TEG across multiple PRS instances is required, we agreed. Therefore, we propose: Proposal 5-3b (H)  * *The same Rx TEG(s) should be used to measure all instances of the DL-PRS Resource Set on a PRS resource for one UE measurement instance of RSTD and/or UE Rx-Tx time difference measurement;* * *The same Rx TEG(s) should be used to measure all instances of the SRS measurement time occasions on a SRS resource for one TRP measurement instance of RTOA and/or gNB Rx-Tx time difference measurement.* |
| ZTE | Low priority for this meeting. We should finalize the framework of measurement instance first. |
| Nokia/NSB | Don’t think this restriction is needed. |
| LG | We prefer to deal with the proposal as low priority. |
| FL | In my view, if a UE measurement instance is associated with an UE Rx TEG and one DL PRS resource, the measurement instance is  obtained from measuring from the DL PRS resource with the same Rx TEG. If a UE measurement instance is associated with an UE Rx TEG and more than one DL PRS resource, the measurement instance is obtained from measuring from these DL PRS resources with the same Rx TEG. I assume this is a common understanding of the default UE behavior since one UE measurement instance is assicoated with no more than one Rx TEG.  The priority of the proposal is lowered based on the feedbacks. Suggest further discussion of the we may not need to gave the new agreement. |

### (Ronud 2) Proposal 5-3b

* *If a UE measurement instance (e.g., RSTD, UE Rx-Tx time difference) is associated with an UE Rx TEG, the UE measurement instance is expeted to be obtained from the DL PRS resources (s) associated with the same UE Rx TEG, regardless of how many instances of the DL-PRS Resource Set are used to obtain the UE measurement instance.*
* *If a TRP measurement instance (e.g., RTOA, TRP Rx-Tx time difference) is associated with an TRP Rx TEG, the TRP measurement instance is expeted to be obtained from the UL SRS resources (s) associated with the same TRP Rx TEG, regardless of how many instances of the SRS measurement time occasions are used to obtain the TRP measurement instance.*

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

Submitted proposals

* ***(Lenovo,*** [***R1-2108142***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2108142.doc)***[18]) Proposal 2:*** *The existing UE timing quality indication can be extended to indicate the quality of timing-based measurement instances such as RSTD and UE Rx-Tx time difference measurements.* 
  + *FFS if the indication is applicable to one or more measurement instances.*

**FL:** It seems reasonable to allow each timing measurement instance (e.g., RSTD, RTOA, UE/gNB time difference measurements) to has its own indication of the measurement quality (e.g., NR-TimingQuality-r16)

### Proposal 5-4

* *The existing UE/TRP timing quality indication of of RSTD, RTOA and UE/gNB Rx-Tx time difference measurements can be extended 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** |
| Lenovo,Motorola Mobility | Support FL’s proposal. |
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## Measurement instances in a measurement report

Submitted proposals

* ***(ZTE,*** [***R1-2106549***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106549.doc)***[2]) Proposal 7:*** *Further discuss the association between measurement instances and UE measurement report, at least consider one of the following options,*
  + *Option 1: For each indicated DL PRS resource in a measurement report, multiple measurement instances are associated with the indicated DL PRS resource.*
  + *Option 2: For each indicated DL PRS resource set in a measurement report, multiple measurement instances are associated with the indicated DL PRS resource set.*
  + *Option 3: For each indicated measurement element (i.e. TRP) in a measurement report, multiple measurement instances are associated with the indicated measurement element.*
  + *Option 4: For each indicated positioning method in a measurement report, multiple measurement instances are associated with the indicated positioning method.*
  + *Option 5: Multiple measurement instances are directly associated with a measurement report*

**FL:** The proposal seems related to how the associate the measurement measurement instances with the DL PRS/SRS resources, in the measurement report, which may be best handled by RAN2/RAN3 in my view.

* ***(vivo,*** [***R1-2106595***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2106595.doc)***[3]) Proposal 13:*** 
  + *The UE or the TRP can be configured to report one or more measurement instances in a single measurement report to the LMF.*

**FL:** The proposal seems to be part of the previous agreement.

* ***(OPPO,*** [***R1-2107213***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107213.doc)***[8])Proposal 11:*** *The current LPP signaling can support the feature that UE reports one or more measurement instances in a single measurement report to LMF, with potential extension to support a larger number than 4.*
* ***(OPPO,*** [***R1-2107213***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107213.doc)***[8])Proposal 12:*** *No enhancement is needed for the current NRPPa signaling to support the feature that TRP reports one or more measurement instances with the same quantity in a single measurement report to LMF.*
* ***(OPPO,*** [***R1-2107213***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107213.doc)***[8])Proposal 13:*** *Enhancement on the association of measurement instances should be introduced to support the feature that TRP reports one or more measurement instances with different quantities in a single measurement report to LMF.*

**FL:** Once RAN1 reaches the final agreement on the enhancement on the measurement instances and reports, RAN1 will send LS to RAN2/3/4. The impact on LPP/NRPPs signalling may be discussed in RAN2/3.

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 discussed in RAN2/3.

Comments

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| **Company** | **Comments** |
| ZTE | It’s better that RAN1 can discuss some basic assumption of reporting structure since it has connection with configuration level of value N and M. |
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# Additional proposals

## Multiple reference timings

Submitted Proposals

* ***(LG,*** [***R1-2107542***](file:////Users/renda000/Downloads/2021_08_TSGR_106e/docs/R1-2107542.doc)***[11]) Proposal #2:*** 
  + *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

The benefits and necessary to have multiple reference timings work for DL RSTD, DL PRS-RSRP, and UE Rx-Tx time difference measurements may need to be studies. For DL PRS-RSRP and UE Rx-Tx time difference measurements, my understanding is no need for UE to select the reference timing. For RSTD, it is up UE to use or not use the configured reference timing. 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** |
| LG | Support |
| Ericsson | Not support. There should only be one reference time used for all measurements in a measurement report. Consequently it should not be possible to configure multiple reference timings. |
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