**3GPP TSG RAN WG1 Meeting #106bis R1-21xxxxx**

**e-meeting, Oct. 11 – 19, 2021**

**Title: Higher layer parameters for NR Positioning Enhancements**

**Source: Moderator (CATT)**

**Agenda item: 8.5**

**Document for:** **Discussion and Decision**

1. Introduction

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

[Post-106-e-Rel17-RRC-05] NR Positioning Enhancements – moderated by Ren Da (CATT)

The purpose of these email discussions is to initiate the preparations to send the first LS to RAN2 on Rel-17 RRC parameters in October (e.g. tabulate agreed RRC parameters so far and identify ones that RAN1 should discuss whether or not to define).

Intention of the email discussion is to collect company views and provide the initial assessment Rel-17 RRC parameters for NR Positioning Enhancements.

Note: In the template of RRC parameters (Excel file), it has the following three columns on the parameter names:

* “RAN2 ASN.1 name”
* “Parameter name in the spec.”
* “Parameter name in the text”

For simplicity, in this document we do not distinguish these names, and assume it is up to RAN2/RAN3 to use the same or different names.

2. Accuracy improvements by mitigating UE Rx/Tx and/or gNB Rx/Tx timing delays

(Round 1)Parameter Table

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| **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parent IE** | **RAN2 ASN.1 name** | **Parameter name in the spec** | **New or existing?** | **Parameter name in the text** | **Description** | **Value range** | **Default value aspect** | **Per (UE, cell, TRP, …)** | **UE-specific or Cell-specific** | **Specification** | **Comment** |
| Mitigation of UE Rx/Tx timing delays |  |  | FFS for RAN2 | ueRxTEG-ID |  | New |  | The ID of a UE Rx timing error group, which is sent with RSTD measurements | FFS |  |  |  | FFS for RAN2 | 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. |
| Mitigation of UE Rx/Tx timing delays |  |  | FFS for RAN2 | ueTxTEG |  | New |  | 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.  ueTxTEG may be sent from UE to LMF for supporting UL-TDOA or multi-RTT. |  |  |  |  | FFS for RAN2 | FFS: Whether the association information is sent directly from UE to LMF, or is first provided to gNB and then forwarded to LMF. |
| Mitigation of UE Rx/Tx timing delays |  |  | ueTxTEG | ueTxTEG-ID |  | New |  | The ID of a UE Tx timing error group.  One UE Tx TEG ID can be associated with one or more UL positioning SRS resource IDs | FFS |  |  |  | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |  |  | ueTxTEG | srs-PosResourceSetId |  | Existing |  |  |  |  |  |  | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |  |  | ueTxTEG | srs-PosResourceId |  | Existing |  |  |  |  |  |  | FFS for RAN2 | FFS: the maximum number of positioning SRS Resources |
| Mitigation of UE Rx/Tx timing delays |  |  | FFS for RAN2 | ueRxTxTEG-ID-group |  | New |  | Up to UE capability, a UE may report any of the following combinations of the TEG IDs with a UE Rx-Tx measurement:   * An UE RxTx TEG ID * A pair of UE {RxTx TEG ID, TxTEG ID} * A pair of UE {Rx TEG ID, TxTEG ID} * A triplet of UE {RxTx TEG, Rx TEG ID, TxTEG ID} | FFS |  |  |  | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |  |  | ueRxTxTEG-ID-group | ueRxTxTEG-ID |  | New |  | The ID of a UE RxTx timing error group. | FFS |  |  |  | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |  |  | ueRxTxTEG-ID-group | ueTxTEG-ID |  | New |  | The ID of a UE Tx timing error group. | FFS |  |  |  | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |  |  | ueRxTxTEG-ID-group | ueRxTEG-ID |  | New |  | The ID of a UE Rx timing error group. | FFS |  |  |  | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |  |  | FFS for RAN2 | maxNumOfUE-RxTEG |  | New |  | The maximum number of UE-RxTEG per UE | FFS |  |  |  | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |  |  | FFS for RAN2 | maxNumOfUE-TxTEG |  | New |  | The maximum number of UE-TxTEG per UE | FFS |  |  |  | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |  |  | FFS for RAN2 | maxNumOfSRSResourcesPerTxTEG |  | New |  | The maximum number of SRS resources associated with one UE TxTEG | FFS |  |  |  | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |  |  | FFS for RAN2 | maxNumOfUE-RxTxTEG |  | New |  | The Max number of UE-RxTxTEG per UE | FFS |  |  |  | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |  |  | FFS for RAN2 | numOfUERxTEG-PerPRSResource |  | New |  | **The** number of  **different** UE Rx TEGs that the LMF request a UE to measure the **same** DL PRS resource of a TRP for RSTD. | FFS |  |  |  | FFS for RAN2 | Agreement:  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. |
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| Mitigation of TRP Rx/Tx timing delays |  |  | FFS for RAN3 | trpRxTEG-ID |  | New |  | The ID of a TRP Rx timing error group, which is sent with RTOA measurements. |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | FFS for RAN3 | trpTxTEG |  | New |  | 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.  trpTxTEG may be sent from gNB to LMF for supporting DL-TDOA or multi-RTT. |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | trpTxTEG | trpTxTEG-ID |  | New |  | The ID of a TRP Tx timing error group.  One TRP Tx TEG ID can be associated with one or more DL PRS resources |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | trpTxTEG | NR-DL-PRS-ResourceSetID |  | Existing |  |  |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | trpTxTEG | NR-DL-PRS-ResourceID |  | Existing |  |  |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | FFS for RAN3 | trpRxTxTEG-ID-group |  | New |  | A TRP may report any of the following combinations of the TEG IDs with a TRP Rx-Tx measurement:   * An TRP RxTx TEG ID * A pair of TRP {RxTx TEG ID, TxTEG ID} * A pair of TRP {Rx TEG ID, TxTEG ID} * A triplet of TRP {RxTx TEG, Rx TEG ID, TxTEG ID} | FFS |  |  |  |  |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | trpRxTxTEG-ID-group | trpRxTxTEG-ID |  | New |  | The ID of the TRP RxTx timing error group. |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | trpRxTxTEG-ID-group | trpTxTEG-ID |  | New |  | The ID of a TRP Tx timing error group. |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | trpRxTxTEG-ID-group | trpRxTEG-ID |  | New |  | The ID of a TRP Rx timing error group. |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | FFS for RAN3 | maxNumOfTRPRxTEG |  | New |  | The maximum number of TRP-RxTEG per TRP |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | FFS for RAN3 | maxNumOfTRPTxTEG |  | New |  | The maximum number of TRP-TxTEG per TRP |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | FFS for RAN3 | maxNumOfPRSResourcesPerTxTEG |  | New |  | The maximum number of PRS resources associated with one TRP TxTEG |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | FFS for RAN3 | maxNumOfTRPRxTxTEG |  | New |  | The Max number of TRP RxTxTEG per TRP |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | FFS for RAN3 | numOfTRPRxTxTEG-PerPRSResource |  | New |  | **The** number of  **different** TRP Rx TEGs that the LMF requests a TRP to measure the **same U**L SRS resource of a UE |  |  |  |  | FFS for RAN3 | Agreement:  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 |
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## Comments

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| **Company** | **Comments** |
| Huawei, HiSilicon | Comment #1:  General comment is that we suggest to clarify in the description column or comment column that parameter is in a DL message (network 🡪 UE/LMF 🡪 gNB) or in a UL message (UE 🡪 network/gNB 🡪 LMF).  FL: Added more comments into the comment column.  Comment #2:  For the following parameters, it is suggested with the following change.   |  |  | | --- | --- | | ueTxTEG | ueTxTEG-ID | | ueTxTEG | srs-PosResourcesID |   FL: Changed 1st ueTxTEG to ueTxTEG-ID. Changed to SRS Resource to include the srs-PosResourceSetId and srs-PosResourceIdList based on the parameter names in TS 38.331.  Comment #3:  We think for multi-RTT, in addition to UE RxTx TEG ID reporting, we should also include UE Rx TEG ID and UE Tx TEG ID based on the agreements.  FL: In the description, added that the parameter can be ueRxTEG-ID may be sent with RSTD measurements for DL-TDOA, or with UE Rx-Tx time difference measurement for multi-RTT. ueTxTEG may be sent from UE to LMF for supporting UL-TDOA, or for multi-RTT.  Comment #4:  Are the following parameters subject to UE capability discussion, or simply the maximum number allowed by LPP/RRC, e.g. clause 6.4 (Multiplicity and type constraint definitions) of RRC specification?   |  | | --- | | maxNumOfUE-RxTEG | | maxNumOfUE-TxTEG | | maxNumOfSRSResourcesPerTxTEG | | maxNumOfUE-RxTxTEG |   FL: My thinking is that we will first have these parameters in clause 6.4 in TS 38.331. Then, we will discussion whether to have UE capability to support the values smaller than the maximum numbers in clause 6.4 in TS 38.331.  Comment #5: The above comments also applies for TRP side.  FL: Similar responses as UE side. |
| Qualcomm | 1. Shouldn’t the 3rd row’s name be ueTxTEG-ID (since this corresponds to the ID)?   FL: Corrected.   1. Parant IE –> Parent IE   FL: Corrected.   1. Add in the description of ueRxTxTEG-ID that: “An RxTx TEG ID can reported with a UE Rx-Tx time difference measurement”   FL: Added   1. Add additional row for ueTxTEG-ID to be reported in association with a UE Rx-Tx time difference measurement according to the agreement:   Agreement:  If a RxTx TEG ID is reported with a UE Rx-Tx time difference measurement, the UE may optionally also report a Tx TEG ID.  FL: Added. With a new IE ueRxTxTEG-ID-group for supporting different combinations of the TEG IDs with a UE Rx-Tx measurement:   1. Add in the description of the 1st row the agreement: “A UE may 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” according to the agreement below:   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   FL: Added   1. Suggest to add a separate ueRxTEG-ID that will correspond to the IE that a UE would include in the UE Rx-Tx measurement report as has been agreed below. The difference with the ueRxTEG-ID shown in the 1st row is that the Parent IE will be different; one will in the TDOA report and the other in the MRTT report in LPP.   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 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~~. * 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   FL: Added. With a new IE ueRxTxTEG-ID-group for supporting different combinations of the TEG IDs with a UE Rx-Tx measurement:   1. The description “The maximum number of UE-RxTEG per UE” of the field maxNumOfTRPRxTEG need to change to “The maximum number of TRP-RxTEG per TRP”. Similar error in the maxNumOfTRPTxTEG.   FL: Corrected. |
| vivo | 1. Same views as Qualcomm and Huawei for row #3 changing” ueTxTEG” to “ueTxTEG-ID”, and we wonder why only” Tx TEG” in row #2, but no” Rx TEG”( that is Tx side includes ” ueTxTEG” and “ueTxTEG-ID”, but Rx only includes ueRxTEG-ID.   FL: New IE ueTxTEG is used for UE to report the association between each Tx TEG ID with one or more positioning SRS resources. For UE Rx TEG, when the Rx TEG ID is reported with a measurement, e.g., RSTD measurement, there is no need to have a new IE, e.g., ueRxTEG, because the DL PRS resources associated with Rx TEG ID is already included in the RSTD measurement.  2) For row#4, in our view, shouldn’t one or more UL SRS resources be associated with the “ueTxTEG-ID” rather than” ueTxTEG” based on the following agreement  Agreement:   * If a Tx TEG ID is reported with a UE Rx-Tx time difference measurement, the UE should also report the association of the Tx TEG ID to the UL SRS resource(s)   + FFS: how the the association of the Tx TEG ID to the UL SRS resource(s) is determined by UE.   + FFS: details of the signalling   FL: the association of the Tx TEG ID to the UL SRS resource(s) is reported with the IE ueTxTEG.  3) Same views as Qualcomm and Huawei that the association between Rx/TX/RX TX TEG ID with measurement result should be described.  FL: Added. With a new IE ueRxTxTEG-ID-group for supporting different combinations of the TEG IDs with a UE Rx-Tx measurement:  4) For row#10, “New” for “New or existing” is missing  FL: Corrected  5) For the TRP side, some red words in the above table should be changed to TRP.  FL: Corrected |

(Round 2)Parameter Table

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| **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parent IE** | **RAN2 ASN.1 name** | **Parameter name in the spec** | **New or existing?** | **Parameter name in the text** | **Description** | **Value range** | **Default value aspect** | **Per (UE, cell, TRP, …)** | **UE-specific or Cell-specific** | **Specification** | **Comment** |
| Mitigation of UE Rx/Tx timing delays |  |  | FFS for RAN2 | ueRxTEG-ID |  | New |  | The ID of a UE Rx timing error group, which is sent with RSTD measurements from UE to LMF. | FFS |  |  |  | FFS for RAN2 | 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. |
| Mitigation of UE Rx/Tx timing delays |  |  | FFS for RAN2 | ueTxTEG |  | New |  | 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.  ueTxTEG may be sent from UE to LMF for supporting UL-TDOA or multi-RTT. |  |  |  |  | FFS for RAN2 | FFS: Whether the association information is sent directly from UE to LMF, or is first provided to gNB and then forwarded to LMF. |
| Mitigation of UE Rx/Tx timing delays |  |  | ueTxTEG | ueTxTEG-ID |  | New |  | The ID of a UE Tx timing error group.  One UE Tx TEG ID can be associated with one or more UL positioning SRS resource IDs. | FFS |  |  |  | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |  |  | ueTxTEG | srs-PosResourceSetId |  | Existing |  |  |  |  |  |  | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |  |  | ueTxTEG | srs-PosResourceId |  | Existing |  |  |  |  |  |  | FFS for RAN2 | FFS: the maximum number of positioning SRS Resources |
| Mitigation of UE Rx/Tx timing delays |  |  | FFS for RAN2 | ueRxTxTEG-ID-group |  | New |  | Up to UE capability, a UE may report any of the following combinations of the TEG IDs with a UE Rx-Tx measurement from UE to LMF:   * An UE RxTx TEG ID * A pair of UE {RxTx TEG ID, TxTEG ID} * A pair of UE {Rx TEG ID, TxTEG ID} * A triplet of UE {RxTx TEG, Rx TEG ID, TxTEG ID} | FFS |  |  |  | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |  |  | ueRxTxTEG-ID-group | ueRxTxTEG-ID |  | New |  | The ID of a UE RxTx timing error. | FFS |  |  |  | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |  |  | ueRxTxTEG-ID-group | ueTxTEG-ID |  | New |  | The ID of a UE Tx timing error group. | FFS |  |  |  | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |  |  | ueRxTxTEG-ID-group | ueRxTEG-ID |  | New |  | The ID of a UE Rx timing error group. | FFS |  |  |  | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |  |  | FFS for RAN2 | maxNumOfUE-RxTEG |  | New |  | The maximum number of UE-RxTEG per UE | FFS |  |  |  | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |  |  | FFS for RAN2 | maxNumOfUE-TxTEG |  | New |  | The maximum number of UE-TxTEG per UE | FFS |  |  |  | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |  |  | FFS for RAN2 | maxNumOfSRSResourcesPerTxTEG |  | New |  | The maximum number of SRS resources associated with one UE TxTEG | FFS |  |  |  | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |  |  | FFS for RAN2 | maxNumOfUE-RxTxTEG |  | New |  | The Max number of UE-RxTxTEG per UE | FFS |  |  |  | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |  |  | FFS for RAN2 | numOfUERxTEG-PerPRSResource |  | New |  | **The** number of  **different** UE Rx TEGs that the LMF request a UE to measure the **same** DL PRS resource of a TRP for RSTD. | FFS |  |  |  | FFS for RAN2 | Agreement:  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. |
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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | FFS for RAN3 | trpRxTEG-ID |  | New |  | The ID of a TRP Rx timing error group, which is sent with RTOA measurements from gNB to LMF. |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | FFS for RAN3 | trpTxTEG |  | New |  | 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 from gNB to LMF.  trpTxTEG may be sent from gNB to LMF for supporting DL-TDOA or multi-RTT. |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | trpTxTEG | trpTxTEG-ID |  | New |  | The ID of a TRP Tx timing error group.  One TRP Tx TEG ID can be associated with one or more DL PRS resources |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | trpTxTEG | NR-DL-PRS-ResourceSetID |  | Existing |  |  |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | trpTxTEG | NR-DL-PRS-ResourceID |  | Existing |  |  |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | FFS for RAN3 | trpRxTxTEG-ID-group |  | New |  | A TRP may report any of the following combinations of the TEG IDs with a TRP Rx-Tx measurement from gNB to LMF:   * An TRP RxTx TEG ID * A pair of TRP {RxTx TEG ID, TxTEG ID} * A pair of TRP {Rx TEG ID, TxTEG ID} * A triplet of TRP {RxTx TEG, Rx TEG ID, TxTEG ID} | FFS |  |  |  | FS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | trpRxTxTEG-ID-group | trpRxTxTEG-ID |  | New |  | The ID of the TRP RxTx timing error group. |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | trpRxTxTEG-ID-group | trpTxTEG-ID |  | New |  | The ID of a TRP Tx timing error group. |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | trpRxTxTEG-ID-group | trpRxTEG-ID |  | New |  | The ID of a TRP Rx timing error group. |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | FFS for RAN3 | maxNumOfTRPRxTEG |  | New |  | The maximum number of TRP-RxTEG per TRP |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | FFS for RAN3 | maxNumOfTRPTxTEG |  | New |  | The maximum number of TRP-TxTEG per TRP |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | FFS for RAN3 | maxNumOfPRSResourcesPerTxTEG |  | New |  | The maximum number of PRS resources associated with one TRP TxTEG |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | FFS for RAN3 | maxNumOfTRPRxTxTEG |  | New |  | The Max number of TRP RxTxTEG per TRP |  |  |  |  | FFS for RAN3 |  |
| Mitigation of TRP Rx/Tx timing delays |  |  | FFS for RAN3 | numOfTRPRxTxTEG-PerPRSResource |  | New |  | **The** number of  **different** TRP Rx TEGs that the LMF requests a TRP to measure the **same U**L SRS resource of a UE |  |  |  |  | FFS for RAN3 | Agreement:  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 |
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## Comments

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| **Company** | **Comments** |
| Huawei, HiSilicon | Generally we are fine with the update from the rapporteur. Two additional comments:  Comment #1:  We wonder the necessity of reporting SRS resource set ID along with SRS resource ID in Tx TEG reporting, since SRS resource ID is already globally defined within a BWP for a UL carrier. At least some clarification could be helpful, e.g. reporting SRS resource set ID without reporting SRS resource ID would mean that all SRS resources in the SRS resource set should belong to the same TEG.  Comment #2:  We think that SRS resource set ID/SRS resource ID should be added to the gNB Rx timing reporting based on the following agreement. Similar to comment #1, some clarification may be needed how SRS resource set ID is used.  Agreement:   * 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 |
| Ericsson | * On the Description for ‘ueRxTEG-ID’, we suggest the following clarification (shown in green) to reflect what has been agreed in RAN1:   The ID of a UE Rx timing error group which is sent with RSTD measurements from UE to LMF. The UE includes one *ueRxTEG-ID* for the RSTD reference time and one *ueRxTEG-ID* for each DL RSTD measurement.   * On ‘ueTxTEG’, we wonder what is the need for defining this parent IE. Isn’t it enough to just define the ‘ueTXTEG-ID’ as this is what will be reported by the UE? If this is defined for the purpose of RRC IE structuring, can’t we leave this up to RAN2? * Similar question on ‘ueRxTxTEG-ID-group’. What is the need for defining ‘ueRxTxTEG-ID-group’ as a parent IE? Isn’t it enough for now to define ‘ueRxTxTEG-ID’? If this is defined for the purpose of RRC IE structuring, can’t we leave this up to RAN2? * On ‘trpTxTEG’, we wonder what is the need for defining this parent IE. Isn’t it enough to just define the ‘trpTXTEG-ID’ as this is what will be reported by the gNB? * Similar question on ‘trpRxTxTEG-ID-group’. What is the need for defining ‘trpRxTxTEG-ID-group’ as a parent IE? Isn’t it enough for now to define ‘trpRxTxTEG-ID’? |
| ZTE | * Suggest to remove the “A triplet of UE {RxTx TEG, Rx TEG ID, TxTEG ID}” under the IE “ueRxTxTEG-ID-group” since we haven't agreed to report Rx TEG ID for now. * The following parameters are subject to further UE capability discussion, prefer to remove it for now. We’re not sure the parameters are defined per UE/band/band combination. The same comments also apply to TRP side.   maxNumOfUE-RxTEG  maxNumOfUE-TxTEG  maxNumOfSRSResourcesPerTxTEG  maxNumOfUE-RxTxTEG   * For the row “numOfUERxTEG-PerPRSResource”, at least for now, we’re not sure how to understand this IE. It’s very natural that the same DL PRS may be received by different UE RX TEGs in different time instances because of UE’s moving or rotation etc. What needs to be requested is to allow UE to receive the same DL PRS by different UE RX TEGs simultaneously (i.e. in the same time stamp). From our understanding the IE should be changed to “numOfSimultaneousUERxTEG-PerPRSResource” or we can remove it for now and wait for more input in next meeting. The same comments also apply to “numOfTRPRxTxTEG-PerPRSResource” |
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3. Accuracy improvements for UL-AoA positioning solutions

(Round 1)Parameter Table

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| **Sub-feature group** |  | **RAN1 specification** | | **Section** | **RAN2 Parent IE** | **RAN2 ASN.1 name** | **Parameter name in the spec** | **New or existing?** | **Parameter name in the text** | **Description** | **Value range** | **Default value aspect** | **Per (UE, cell, TRP, …)** | **UE-specific or Cell-specific** | **Specification** | **Comment** |
| UA-AOA Enhancement |  |  | |  | FFS RAN3 | Expected UL Angle of Arrival |  | New |  | Indication of expected AoA/ZoA value and uncertainty (of the expected AoA/ZoA value) range(s)  IE names are already used by RAN3 in R3-214516 | FFS |  |  | FFS RAN3 | FFS RAN3 | Agreement:  Granularity of 0.1 degrees is applied for the expected AoA (φAOA), expected ZoA (θZOA ) and the corresponding uncertainty values |
| UA-AOA Enhancement |  |  | |  | Expected UL Angle of Arrival | Expected Azimuth AoA |  | New |  |  | FFS |  |  | FFS RAN3 | FFS RAN3 |  |
| UA-AOA Enhancement |  |  | |  | Expected UL Angle of Arrival | Expected Zenith AoA |  | New |  |  | FFS |  |  | FFS RAN3 | FFS RAN3 |  |
| UA-AOA Enhancement |  |  | |  | Expected Azimuth AoA | Expected Azimuth AoA Value |  | New |  |  | FFS |  |  | FFS RAN3 | FFS RAN3 |  |
| UA-AOA Enhancement |  |  | |  | Expected Azimuth AoA | Expected Azimuth AoA Uncertainty Range |  | New |  |  | FFS |  |  | FFS RAN3 | FFS RAN3 |  |
| UA-AOA Enhancement |  |  | |  | Expected Zenith AoA | Expected Zenith AoA Value |  | New |  | Uncertainty range for expected azimuth angle of arrival | FFS |  |  | FFS RAN3 | FFS RAN3 |  |
| UA-AOA Enhancement |  |  | |  | Expected Zenith AoA | Expected Zenith AoA Uncertainty Range |  | New |  | uncertainty range for expected zenith angle of arrival | FFS |  |  | FFS RAN3 | FFS RAN3 |  |
| UA-AOA Enhancement |  | |  |  | TRP Measurement Result | Zenith Angle of Arrival |  | New |  | This information element contains the Zenith Angle of Arrival, which can correspond to linear array measurement | FFS |  |  | FFS RAN3 | FFS RAN3 | Agreement:  ● The following option is supported to enhance signaling of UL-AOA measurement report in case of a linear array  ○ Option 2: The z-axis of LCS is defined along the linear array axis. gNB reports only the ZoA relative to z-axis in the LCS, and the LCS-to-GCS translation function is used to set up the specific z-axis direction |
| UA-AOA Enhancement |  |  | |  | FFS RAN3 | ULAoAOfFirstPathPerSRSResource |  | New |  | The multiple UL-AOAs values (pair of AOA & ZOA values) can be reported per SRS resource for the first arrival path corresponding to the same timestamp. | FFS |  |  | FFS RAN3 | FFS RAN3 | Agreement:  Reporting of one UL-RTOA and multiple UL-AOAs measurements for the first arrival path per SRS resource for positioning and per SRS resource for MIMO in a single gNB report to LMF is supported  • The above measurements are associated with SRS resource ID which is also reported to LMF  • FFS: Reporting of RSRP for the first arrival path  • Note: The use of SRS for MIMO resource is transparent to the UE  • FFS: Reporting of gNB Rx-Tx  Agreement:  Reporting of one gNB Rx-Tx time difference and multiple UL-AOAs measurements for the first arrival path per SRS resource for positioning in a single gNB report to LMF is supported  • The above measurements are associated with SRS resource ID which is also reported to LMF  • FFS: Reporting of RSRP for the first arrival path |
| UA-AOA Enhancement |  |  | |  | ULAoAOfFirstPathPerSRSResource | firstPathAoA |  | New |  | A pair of AOA & ZOA values to be reported per SRS resource | FFS |  |  | FFS RAN3 | FFS RAN3 | FFS RAN3 |
| UA-AOA Enhancement |  |  | |  | ULAoAOfFirstPathPerSRSResource | firstPathZoA |  | New |  | A pair of AOA & ZOA values to be reported per SRS resource | FFS |  |  | FFS RAN3 | FFS RAN3 | FFS RAN3 |
| UA-AOA Enhancement |  |  | |  | FFS RAN3 | maxNumOfULAoAOfFirstPathPerSRSResource |  | New |  | The maximum number of UL-AOAs values (pair of AOA & ZOA values) to be reported per SRS resource for the first arrival path corresponding to the same timestamp. | 8 |  |  | FFS RAN3 | FFS RAN3 | Agreement:  The maximum number of UL-AOAs values (pair of AOA & ZOA values) to be reported per SRS resource for the first arrival path corresponding to the same timestamp is 8. |
| UA-AOA Enhancement |  |  | |  |  |  |  |  |  |  |  |  |  | FFS RAN3 | FFS RAN3 |  |
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## Comments

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| **Company** | **Comments** |
| Huawei, HiSilicon | We think that ZoA only for linear array should also be listed. It is already implemented in the RAN3 BL CR.  FL: added as suggested.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **RAN2 Parant IE** | **RAN2 ASN.1 name** | **Parameter name in the spec** | **New or existing?** | **Parameter name in the text** | **Description** | | TRP Measurement Result | Zenith Angle of Arrival |  | New |  | This information element contains the Zenith Angle of Arrival, which can correspond to linear array measurement. | |
| Qualcomm | 1. Suggest to add to the comment of the row maxNumOfULAoAOfFirstPathPerSRSResource how the “8” value was chosen as a reference:   Agreement:  The maximum number of UL-AOAs values (pair of AOA & ZOA values) to be reported per SRS resource for the first arrival path corresponding to the same timestamp is 8.  FL: added as suggested.   1. Suggest to add in the comment of the row “ULAoAOfFirstPathPerSRSResource” that this is applicable for both gNB Rx-Tx and RTOA, i.e. add in the comment section that:   Agreement:  Reporting of one UL-RTOA and multiple UL-AOAs measurements for the first arrival path per SRS resource for positioning and per SRS resource for MIMO in a single gNB report to LMF is supported   * The above measurements are associated with SRS resource ID which is also reported to LMF * FFS: Reporting of RSRP for the first arrival path * Note: The use of SRS for MIMO resource is transparent to the UE * FFS: Reporting of gNB Rx-Tx   Agreement:  Reporting of one gNB Rx-Tx time difference and multiple UL-AOAs measurements for the first arrival path per SRS resource for positioning in a single gNB report to LMF is supported   * The above measurements are associated with SRS resource ID which is also reported to LMF * FFS: Reporting of RSRP for the first arrival path   FL: added as suggested. |
| vivo | 1. Do we need to add a comment stating that“Both GCS and LCS are supported for UL AoA/ZoA assistance information indication”, and for the LCS, it is up to RAN3 to decide how to support indication of UL AoA/ZoA assistance information in LCS for LCS to GCS translation.   FL: Added the following agreement to the new IE “Zenith Angle of Arrival”.  Agreement:   * The following option is supported to enhance signaling of UL-AOA measurement report in case of a linear array   + Option 2: The z-axis of LCS is defined along the linear array axis. gNB reports only the ZoA relative to z-axis in the LCS, and the LCS-to-GCS translation function is used to set up the specific z-axis direction * UL-AOA signalling details for support of Option 2 are left up to RAN WG3   2) Do we need an row to indicate that hybrid positioning(e.g Reporting of one UL-RTOA and multiple UL-AOAs measurements) is supported?  FL: added the agreement to the comment column of ULAoAOfFirstPathPerSRSResource. Assume RAN3 knows how to consider the requirement into NRPPs design.  Agreement:  Reporting of one UL-RTOA and multiple UL-AOAs measurements for the first arrival path per SRS resource for positioning and per SRS resource for MIMO in a single gNB report to LMF is supported   * The above measurements are associated with SRS resource ID which is also reported to LMF * FFS: Reporting of RSRP for the first arrival path * Note: The use of SRS for MIMO resource is transparent to the UE * FFS: Reporting of gNB Rx-Tx     Agreement:  Reporting of one gNB Rx-Tx time difference and multiple UL-AOAs measurements for the first arrival path per SRS resource for positioning in a single gNB report to LMF is supported   * The above measurements are associated with SRS resource ID which is also reported to LMF * FFS: Reporting of RSRP for the first arrival path |

(Round 2)Parameter Table

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| **Sub-feature group** |  | **RAN1 specification** | | **Section** | **RAN2 Parent IE** | **RAN2 ASN.1 name** | **Parameter name in the spec** | **New or existing?** | **Parameter name in the text** | **Description** | **Value range** | **Default value aspect** | **Per (UE, cell, TRP, …)** | **UE-specific or Cell-specific** | **Specification** | **Comment** |
| UA-AOA Enhancement |  |  | |  | FFS RAN3 | Expected UL Angle of Arrival |  | New |  | Indication of expected AoA/ZoA value and uncertainty (of the expected AoA/ZoA value) range(s)  IE names are already used by RAN3 in R3-214516 | FFS |  |  | FFS RAN3 | FFS RAN3 | Agreement:  Granularity of 0.1 degrees is applied for the expected AoA (φAOA), expected ZoA (θZOA ) and the corresponding uncertainty values |
| UA-AOA Enhancement |  |  | |  | Expected UL Angle of Arrival | Expected Azimuth AoA |  | New |  |  | FFS |  |  | FFS RAN3 | FFS RAN3 |  |
| UA-AOA Enhancement |  |  | |  | Expected UL Angle of Arrival | Expected Zenith AoA |  | New |  |  | FFS |  |  | FFS RAN3 | FFS RAN3 |  |
| UA-AOA Enhancement |  |  | |  | Expected Azimuth AoA | Expected Azimuth AoA Value |  | New |  |  | FFS |  |  | FFS RAN3 | FFS RAN3 |  |
| UA-AOA Enhancement |  |  | |  | Expected Azimuth AoA | Expected Azimuth AoA Uncertainty Range |  | New |  |  | FFS |  |  | FFS RAN3 | FFS RAN3 |  |
| UA-AOA Enhancement |  |  | |  | Expected Zenith AoA | Expected Zenith AoA Value |  | New |  | Uncertainty range for expected azimuth angle of arrival | FFS |  |  | FFS RAN3 | FFS RAN3 |  |
| UA-AOA Enhancement |  |  | |  | Expected Zenith AoA | Expected Zenith AoA Uncertainty Range |  | New |  | uncertainty range for expected zenith angle of arrival | FFS |  |  | FFS RAN3 | FFS RAN3 |  |
| UA-AOA Enhancement |  | |  |  | TRP Measurement Result | Zenith Angle of Arrival |  | New |  | This information element contains the Zenith Angle of Arrival, which can correspond to linear array measurement | FFS |  |  | FFS RAN3 | FFS RAN3 | Agreement:  ● The following option is supported to enhance signaling of UL-AOA measurement report in case of a linear array  ○ Option 2: The z-axis of LCS is defined along the linear array axis. gNB reports only the ZoA relative to z-axis in the LCS, and the LCS-to-GCS translation function is used to set up the specific z-axis direction |
| UA-AOA Enhancement |  |  | |  | FFS RAN3 | ULAoAOfFirstPathPerSRSResource |  | New |  | The multiple UL-AOAs values (pair of AOA & ZOA values) can be reported per SRS resource for the first arrival path corresponding to the same timestamp. | FFS |  |  | FFS RAN3 | FFS RAN3 | Agreement:  Reporting of one UL-RTOA and multiple UL-AOAs measurements for the first arrival path per SRS resource for positioning and per SRS resource for MIMO in a single gNB report to LMF is supported  • The above measurements are associated with SRS resource ID which is also reported to LMF  • FFS: Reporting of RSRP for the first arrival path  • Note: The use of SRS for MIMO resource is transparent to the UE  • FFS: Reporting of gNB Rx-Tx  Agreement:  Reporting of one gNB Rx-Tx time difference and multiple UL-AOAs measurements for the first arrival path per SRS resource for positioning in a single gNB report to LMF is supported  • The above measurements are associated with SRS resource ID which is also reported to LMF  • FFS: Reporting of RSRP for the first arrival path |
| UA-AOA Enhancement |  |  | |  | ULAoAOfFirstPathPerSRSResource | firstPathAoA |  | New |  | A pair of AOA & ZOA values to be reported per SRS resource | FFS |  |  | FFS RAN3 | FFS RAN3 | FFS RAN3 |
| UA-AOA Enhancement |  |  | |  | ULAoAOfFirstPathPerSRSResource | firstPathZoA |  | New |  | A pair of AOA & ZOA values to be reported per SRS resource | FFS |  |  | FFS RAN3 | FFS RAN3 | FFS RAN3 |
| UA-AOA Enhancement |  |  | |  | FFS RAN3 | maxNumOfULAoAOfFirstPathPerSRSResource |  | New |  | The maximum number of UL-AOAs values (pair of AOA & ZOA values) to be reported per SRS resource for the first arrival path corresponding to the same timestamp. | 8 |  |  | FFS RAN3 | FFS RAN3 | Agreement:  The maximum number of UL-AOAs values (pair of AOA & ZOA values) to be reported per SRS resource for the first arrival path corresponding to the same timestamp is 8. |
| UA-AOA Enhancement |  |  | |  |  |  |  |  |  |  |  |  |  | FFS RAN3 | FFS RAN3 |  |
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## Comments

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| **Company** | **Comments** |
| Nokia/NSB | For Expected AoA/ZoA this is already implemented in RAN3 BL CR. See R3-214297. Do we need to send this parameters if they are already in the spec? If yes then we should copy the names and values that were already agreed in RAN3. |
| ZTE | * The same comment as Nokia. * According to the following agreement the SRS resource ID should also be reported to LMF.   Agreement:  Reporting of one UL-RTOA and multiple UL-AOAs measurements for the first arrival path per SRS resource for positioning and per SRS resource for MIMO in a single gNB report to LMF is supported   * The above measurements are associated with SRS resource ID which is also reported to LMF * FFS: Reporting of RSRP for the first arrival path * Note: The use of SRS for MIMO resource is transparent to the UE * FFS: Reporting of gNB Rx-Tx |
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4. Accuracy improvements for DL-AoD positioning solutions

(Round 1)Parameter Table

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| **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parent IE** | **RAN2 ASN.1 name** | **Parameter name in the spec** | **New or existing?** | **Parameter name in the text** | **Description** | **Value range** | **Default value aspect** | **Per (UE, cell, TRP, …)** | **UE-specific or Cell-specific** | **Specification** | **Comment** |
| DL-AoD Enhancement |  |  | TBD | TBD |  | New |  | gNB beam/antenna information  reported from gNB to LMF for DL-AoD.  The information can be provided to the UE for UE-based DL-AoD. | FFS |  |  |  | FFS RAN3 | Agreement:  Regarding support of angle calculation enhancement for DL-AoD:  • Support gNB providing the beam/antenna information to the LMF.  o The gNB beam/antenna information can be provided to the UE for UE-based DL-AoD |
| DL-AoD Enhancement |  |  | FFS in RAN2 | requestFirstPathRSRP |  | New |  | The parameter is used for LMF to request a UE to report the RSRP of first arrival path. | FFS |  |  |  | FFS RAN2 | Agreement:  For both UE-based and UE-assisted DL-AOD, the UE can be requested subject to UE capability to measure and report (for UE-assisted) the PRS RSRP of the first path |
| DL-AoD Enhancement |  |  | FFS in RAN2 | firstPathRSRP |  | New |  | The reported PRS RSRP of the first path from UE to LMF. | FFS |  |  |  | FFS RAN2 | Agreement:  For both UE-based and UE-assisted DL-AOD, the UE can be requested subject to UE capability to measure and report (for UE-assisted) the PRS RSRP of the first path |
| DL-AoD Enhancement |  |  | TBD | TBD |  | New or existing |  | PRS assistance information for DL-AoD from LMF to UE | FFS |  |  |  | FFS RAN2 | Agreement:  For UE-assisted DL-AOD positioning method, select one or more of the following to enhance the signaling to the UE for the purpose of PRS resource(s) measurement and reporting: |
| DL-AoD Enhancement |  |  | TBD | maxNumRSRPperTRP |  | New |  | More then 8 DL PRS RSRP measurements per TRP | FFS |  |  |  | FFS RAN2 | Agreement:  • For UE-A DL-AOD, support reporting more than 8 DL PRS RSRP measurements per TRP.  • Note: Multiple RSRPs corresponding to same or different Rx Beam index should be able to be reported for a given PRS resource for different timestamps.  • FFS: Limit the maximum number of DL PRS RSRP associated with the same Rx beam index |
| ~~UE capability~~ |  |  | ~~TBD~~ | ~~SupportOf firstPathRSRP~~ | ~~SupportOf firstPathRSRP~~ | ~~New~~ | ~~SupportOf firstPathRSRP~~ | ~~UE capability to support providing the PRS RSRP of the first path~~  ~~0: not support~~  ~~1: support~~ | ~~[0, 1]~~ |  |  |  |  | ~~For both UE-based and UE-assisted DL-AOD, the UE can be requested subject to UE capability to measure and report (for UE-assisted) the PRS RSRP of the first path~~ |

## Comments

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| **Company** | **Comments** |
| Huawei, HiSilicon | Comment #1:  General comment is that we suggest to clarify in the description column or comment column that parameter is in a DL message (network 🡪 UE/LMF 🡪 gNB) or in a UL message (UE 🡪 network/gNB 🡪 LMF).  FL: Removed to UE capability list to be discussed.  Comment #2:  We think that the one related to UE capability could be removed.  FL: Removed to UE capability list to be discussed.  Comment #3:  We think the parameter on the number of RSRP larger than 8 could be captured following the agreement made in RAN1#106-e, since we are also listing other FFSs.  Agreement:   * For UE-A DL-AOD, support reporting more than 8 DL PRS RSRP measurements per TRP. * Note: Multiple RSRPs corresponding to same or different Rx Beam index should be able to be reported for a given PRS resource for different timestamps. * FFS: Limit the maximum number of DL PRS RSRP associated with the same Rx beam index   FL: Added a new parameter. Maximum number of DL PRS RSRP is currently hard coded to 8 in TS 37.355. |
| Qualcomm | 1. We want to keep the UE capability one as suggested by the moderator. Need to add “FFS: per UE/band/etc”   FL: We are currently drafting the UE feature list for ePOS. RAN1 will start the email discussion of the UE capability soon.     1. We agree with HW/HiSi to add the parameter on the number of RSRPs to be captured   FL: Added.   1. The column that has the description: “PRS assistance information for DL-AoD”, is really just for “UE-assisted AoD”, so we suggest to change the description. It may not be a New field, if we agree with the already available boresight direction, so we prefer to keep the “New or Existing” as FFS.   FL: Added.   1. Add a parameter that the UE “can be requested to measure and report the RSRP of first arrival path”. In LPP, there would need to be a request from the LMF to the UE, to do this, according to the following agreement. Note, that this is different than the UE capability parameter.   Agreement:  For both UE-based and UE-assisted DL-AOD, the UE can be requested subject to UE capability to measure and report (for UE-assisted) the PRS RSRP of the first path   * FFS: Details of measurement and reporting of PRS RSRP of the first path   FL: Added. |
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(Round 2)Parameter Table

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| **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parent IE** | **RAN2 ASN.1 name** | **Parameter name in the spec** | **New or existing?** | **Parameter name in the text** | **Description** | **Value range** | **Default value aspect** | **Per (UE, cell, TRP, …)** | **UE-specific or Cell-specific** | **Specification** | **Comment** |
| DL-AoD Enhancement |  |  | TBD | TBD |  | New |  | gNB beam/antenna information  reported from gNB to LMF for DL-AoD.  The information can be provided to the UE for UE-based DL-AoD. | FFS |  |  |  | FFS RAN3 | Agreement:  Regarding support of angle calculation enhancement for DL-AoD:  • Support gNB providing the beam/antenna information to the LMF.  o The gNB beam/antenna information can be provided to the UE for UE-based DL-AoD |
| DL-AoD Enhancement |  |  | FFS in RAN2 | requestFirstPathRSRP |  | New |  | The parameter is used for LMF to request a UE to report the RSRP of first arrival path. | FFS |  |  |  | FFS RAN2 | Agreement:  For both UE-based and UE-assisted DL-AOD, the UE can be requested subject to UE capability to measure and report (for UE-assisted) the PRS RSRP of the first path |
| DL-AoD Enhancement |  |  | FFS in RAN2 | firstPathRSRP |  | New |  | The reported PRS RSRP of the first path from UE to LMF. | FFS |  |  |  | FFS RAN2 | Agreement:  For both UE-based and UE-assisted DL-AOD, the UE can be requested subject to UE capability to measure and report (for UE-assisted) the PRS RSRP of the first path |
| DL-AoD Enhancement |  |  | TBD | TBD |  | New or existing |  | PRS assistance information for DL-AoD from LMF to UE | FFS |  |  |  | FFS RAN2 | Agreement:  For UE-assisted DL-AOD positioning method, select one or more of the following to enhance the signaling to the UE for the purpose of PRS resource(s) measurement and reporting: |
| DL-AoD Enhancement |  |  | TBD | maxNumRSRPperTRP |  | New |  | Maximum number of DL PRS RSRP measurements per TRP | FFS |  |  |  | FFS RAN2 | Agreement:  • For UE-A DL-AOD, support reporting more than 8 DL PRS RSRP measurements per TRP.  • Note: Multiple RSRPs corresponding to same or different Rx Beam index should be able to be reported for a given PRS resource for different timestamps.  • FFS: Limit the maximum number of DL PRS RSRP associated with the same Rx beam index |

## Comments

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| **Company** | **Comments** |
| Nokia/NSB | Do we need the IE requestFirstPathRSRP? I don’t think we have similar parameters for other measurements. It is just going to be written in 214 that the LMF can request the firstPathRSRP. |
| ZTE | * The first row can be split into two rows, the first one is for antenna information from gNB to LMF and the second one is for antenna information from LMF to UE. |
| Lenovo, Motorola Mobility | Share a similar understanding as Nokia on whether a “requestFirstPathRSRP” IE is really needed, if it can be simply mentioned in the spec. |
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5. Latency improvements for both DL and DL+UL positioning

(Round 1)Parameter Table

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| **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parent IE** | **RAN2 ASN.1 name** | **Parameter name in the spec** | **New or existing?** | **Parameter name in the text** | **Description** | **Value range** | **Default value aspect** | **Per (UE, cell, TRP, …)** | **UE-specific or Cell-specific** | **Specification** | **Comment** |
| Latency improvements |  |  | FFS in RAN2 | numOfSamples-perMeasurement | numOfSampless-perMeasurement | new | numOfSampless-perMeasurement | LMF can explicitly request UE to report the measurement with M-samples (LMF🡪UE) | [1, 4]  FFS: others |  |  |  |  | May need to change *perMeasurement* to *perMeasInstance* due to the agreement for supporting multiple measurement instances in one measurement report |
| ~~UE Capability~~ |  |  | ~~FFS in RAN2~~ | ~~ListOfNrOfSampless-perMeasurement~~ | ~~ListOfNrOfSampless-perMeasurement~~ | ~~new~~ | ~~ListOfNrOfSampless-perMeasurement~~ | ~~The list of M values that a UE is able to support for M-sample measurements.~~ | ~~[1, 4]~~  ~~FFS: others~~ |  |  |  |  | ~~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.~~ |
| ~~UE Capability~~  ~~PRS processing window~~ |  |  |  | ~~Capability 1A~~ |  |  |  | ~~The DL signals/channels from all DL CCs (per UE) are affected~~ |  |  |  |  |  |  |
| ~~UE Capability~~  ~~PRS processing window~~ |  |  |  | ~~Capability 1B~~ |  |  |  | ~~Only the DL signals/channels from a certain band/CC are affected~~ |  |  |  |  |  |  |
| ~~UE Capability~~  ~~PRS processing window~~ |  |  |  | ~~Capability 2~~ |  |  |  | ~~PRS prioritization over other DL signals/channels only in the PRS symbols inside the window~~ |  |  |  |  |  |  |

## Comments

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| **Company** | **Comments** |
| Huawei, HiSilicon | Comment #1:  General comment is that we suggest to clarify in the description column or comment column that parameter is in a DL message (network 🡪 UE/LMF 🡪 gNB) or in a UL message (UE 🡪 network/gNB 🡪 LMF).  FL: added  Comment #2:  We think that the one related to UE capability could be removed.  FL: Removed. |
| Qualcomm | 1. We prefer to keep the UE capabilities, if they have already been identified. Clearly there will be more dedicated discussions on those later , but its good to start some book keeping. 2. In the description of Capability 1A & 1B, add in the sentence: “…in all symbols inside the window”   FL: We are currently drafting the UE feature list for ePOS. RAN1 will start the email discussion of the UE capability soon. |
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(Round 2)Parameter Table

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| **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parent IE** | **RAN2 ASN.1 name** | **Parameter name in the spec** | **New or existing?** | **Parameter name in the text** | **Description** | **Value range** | **Default value aspect** | **Per (UE, cell, TRP, …)** | **UE-specific or Cell-specific** | **Specification** | **Comment** |
| Latency improvements |  |  | FFS in RAN2 | numOfSamples-perMeasurement | numOfSampless-perMeasurement | new | numOfSampless-perMeasurement | LMF can explicitly request UE to report the measurement with M-samples from LM to UE. | [1, 4]  FFS: others |  |  |  |  | May need to change *perMeasurement* to *perMeasInstance* due to the agreement for supporting multiple measurement instances in one measurement report |
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## Comments

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| **Company** | **Comments** |
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6. Potential enhancements of information reporting from UE and gNB for multipath/NLOS mitigation

(Round 1)Parameter Table

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| **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parent IE** | **RAN2 ASN.1 name** | **Parameter name in the spec** | **New or existing?** | **Parameter name in the text** | **Description** | **Value range** | **Default value aspect** | **Per (UE, cell, TRP, …)** | **UE-specific or Cell-specific** | **Specification** | **Comment** |
| Multipath/NLOS mitigation |  |  | FFS: RAN2 |  | losNlosIndictor | New |  | For LoS/NLoS indicators, a single-indicator can be reported and the supported values are a discrete set in the interval [0, 1].  This parameter is used for UE to report LoS/NLoS information for RSTD and UE Rx-Tx time difference measurements from UE to LMF. | [0, ..,1]  FFS: the discrete values between [0, 1] |  |  |  | FFS: RAN2 | Agreement:  • Support LoS/NLoS indicators which are reported to the LMF for DL and DL+UL positioning measurements taken at UE for UE-assisted positioning or UL and DL+UL measurements at the TRP for NG-RAN assisted positioning.  o Reporting from UE is subject to UE capability. |
| Multipath/NLOS mitigation |  |  | FFS: RAN3 |  | losNlosIndictor | New |  | For LoS/NLoS indicators, a single-indicator can be reported and the supported values are a discrete set in the interval [0, 1].  This parameter is used for gNB to report LoS/NLoS information for RTOA and gNB Rx-Tx time difference measurements for TRP from gNB to LMF. | [0, ..,1]  FFS: the discrete values between [0, 1] |  |  |  | FFS: RAN3 | Agreement:  • Support LoS/NLoS indicators which are reported to the LMF for DL and DL+UL positioning measurements taken at UE for UE-assisted positioning or UL and DL+UL measurements at the TRP for NG-RAN assisted positioning.  o Reporting from UE is subject to UE capability. |
| Multipath/NLOS mitigation |  |  | FFS: RAN2 | FFS: RAN2 | losNlosIndictor | New |  | For LoS/NLoS indicators, a single-indicator can be reported and the supported values are a discrete set in the interval [0, 1].  This parameter is used for LMF to include LoS/NLoS information for RTOA and gNB Rx-Tx time difference measurements from LMF to UE. | [0, ..,1]  FFS: the discrete values between [0, 1] |  |  |  | FFS: RAN2/RAN3 | Agreement:  • Positioning assistance data from LMF is enhanced for UE-based positioning by including LoS/NLoS indicators. |
| Multipath/NLOS mitigation |  |  | FFS: RAN2 | FFS: RAN2 | maxNumOfAdditionalPath | New |  | The maximum number of reporting relative timing of additional path relative to the timing of the first detected path for UE timing measurement.  Note: In Rel-16, N is set to hard-coded to 2 in  NR-AdditionalPathList-r16 in TS 37.355. | FFS |  |  |  | FFS: RAN2 | Agreement:  • For up to N>2 additional paths, support reporting relative timing (to the first detected path) in the measurement reports from UE to LMF for at least DL-TDOA and multi-RTT |
| Multipath/NLOS mitigation |  |  | FFS: RAN3 | FFS: RAN3 | maxnopath | existing |  | The maximum number of reporting relative timing of additional path relative to the timing of the first detected path for UE timing measurement.  Note: In Rel-16, *maxnopath* is 2 in TS 38.455. |  |  |  |  | FFS: RAN3 | Agreement:  • For multipath reporting enhancements, support reporting from TRP to LMF, angle, timing, for up to additional N>2 paths for at least UL-TDOA and multi-RTT. |
| ~~Capability~~ |  |  |  |  | ~~SupportOfLOSNLOSIndicator~~ | ~~New~~ |  | ~~The capability to support reporting the losNlosIndictor~~ |  |  |  |  |  | ~~Agreement:~~  ~~Support LoS/NLoS indicators which are reported to the LMF for DL and DL+UL positioning measurements taken at UE for UE-assisted positioning or UL and DL+UL measurements at the TRP for NG-RAN assisted positioning.~~  ~~o Reporting from UE is subject to UE capability~~ |
| Multipath/NLOS mitigation |  |  | FFS: RAN3 | FFS: RAN3 | ULAoAOfAdditionalPathPerSRSResource | New |  | UL-AoA values per SRS resource for the additional path |  |  |  |  | FFS: RAN3 | Agreement:  Reporting multiple UL-AoA values per SRS resource for the additional path is supported for at least UL TDOA and multi-RTT.  • FFS: maximum number of UL-AoA values per additional path. |
| Multipath/NLOS mitigation |  |  | FFS: RAN3 | FFS: RAN3 | maxNumOfULAoAOfAdditionalPathPerSRSResource | New |  | The maximum number of UL-AOAs values (pair of AOA & ZOA values) to be reported per SRS resource for the additional arrival path. |  |  |  |  | FFS: RAN3 | Agreement:  Reporting multiple UL-AoA values per additional path is supported for at least UL TDOA and multi-RTT.  • FFS: maximum number of UL-AoA values per additional path. |
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## Comments

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| **Company** | **Comments** |
| Huawei, HiSilicon | Comment #1:  We think that the one related to UE capability could be removed.  FL: Removed. |
| Qualcomm | 1. The parameters on additional path report is missing for both UE and TRP   Agreement:   * For up to N>2 additional paths, support reporting relative timing (to the first detected path) in the measurement reports from UE to LMF for at least DL-TDOA and multi-RTT   Agreement:   * For multipath reporting enhancements, support reporting from TRP to LMF, angle, timing, for up to additional N>2 paths for at least UL-TDOA and multi-RTT.   FL: Added. In Rel-16, in TS 37.355, N is hard-coded to 2 in NR-AdditionalPathList-r16. In TS 38.455, N=parameter maxnopath.   1. The LOS/NLOS indicators may also be in the assistance data, so we suggest to add a separate row, since it will be an IE associated with the PRS resources in the Assitance Data, which is different, than the LOS/NLOS IE that will be in the measurement report from the UEs and TRPs.   Agreement:   * Support LoS/NLoS indicators which are reported to the LMF for DL and DL+UL positioning measurements taken at UE for UE-assisted positioning or UL and DL+UL measurements at the TRP for NG-RAN assisted positioning.   + Reporting from UE is subject to UE capability * **Positioning assistance data from LMF is enhanced for UE-based positioning by including LoS/NLoS indicators.**   FL: Okay. Assume the parameter is used for three messages: from UE to LMF, from TRP to LMF, from LMF to UE.   1. Add a new parameter for AoA for additional path (from TRP to LMF), for example, ULAoAOfAdditionalPathPerSRSResource   Agreement:  Reporting multiple UL-AoA values per additional path is supported for at least UL TDOA and multi-RTT.   * FFS: maximum number of UL-AoA values per additional path.   FL: Okay. Added two parameters: one for multiple UL-AoA values per additional path; one for the maximum number of UL-AoA values per additional path. |
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(Round 2)Parameter Table

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| **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parent IE** | **RAN2 ASN.1 name** | **Parameter name in the spec** | **New or existing?** | **Parameter name in the text** | **Description** | **Value range** | **Default value aspect** | **Per (UE, cell, TRP, …)** | **UE-specific or Cell-specific** | **Specification** | **Comment** |
| Multipath/NLOS mitigation |  |  | FFS: RAN2 |  | losNlosIndictor | New |  | For LoS/NLoS indicators, a single-indicator can be reported and the supported values are a discrete set in the interval [0, 1].  This parameter is used for UE to report LoS/NLoS information for RSTD and UE Rx-Tx time difference measurements from UE to LMF. | [0, ..,1]  FFS: the discrete set of values between [0, 1] |  |  |  | FFS: RAN2 | Agreement:  • Support LoS/NLoS indicators which are reported to the LMF for DL and DL+UL positioning measurements taken at UE for UE-assisted positioning or UL and DL+UL measurements at the TRP for NG-RAN assisted positioning.  o Reporting from UE is subject to UE capability. |
| Multipath/NLOS mitigation |  |  | FFS: RAN3 |  | losNlosIndictor | New |  | For LoS/NLoS indicators, a single-indicator can be reported and the supported values are a discrete set in the interval [0, 1].  This parameter is used for gNB to report LoS/NLoS information for RTOA and gNB Rx-Tx time difference measurements for TRP from gNB to LMF. | [0, ..,1]  FFS: the discrete set of values between [0, 1] |  |  |  | FFS: RAN3 | Agreement:  • Support LoS/NLoS indicators which are reported to the LMF for DL and DL+UL positioning measurements taken at UE for UE-assisted positioning or UL and DL+UL measurements at the TRP for NG-RAN assisted positioning.  o Reporting from UE is subject to UE capability. |
| Multipath/NLOS mitigation |  |  | FFS: RAN2 | FFS: RAN2 | losNlosIndictor | New |  | For LoS/NLoS indicators, a single-indicator can be reported and the supported values are a discrete set in the interval [0, 1].  This parameter is used for LMF to include LoS/NLoS information for RTOA and gNB Rx-Tx time difference measurements from LMF to UE. | [0, ..,1]  FFS: the discrete set of values between [0, 1] |  |  |  | FFS: RAN2/RAN3 | Agreement:  • Positioning assistance data from LMF is enhanced for UE-based positioning by including LoS/NLoS indicators. |
| Multipath/NLOS mitigation |  |  | FFS: RAN2 | FFS: RAN2 | maxNumOfAdditionalPath | New |  | The maximum number of reporting relative timing of additional path relative to the timing of the first detected path for UE timing measurement from UE to LMF.  Note: In Rel-16, N is set to hard-coded to 2 in  NR-AdditionalPathList-r16 in TS 37.355. | FFS |  |  |  | FFS: RAN2 | Agreement:  • For up to N>2 additional paths, support reporting relative timing (to the first detected path) in the measurement reports from UE to LMF for at least DL-TDOA and multi-RTT |
| Multipath/NLOS mitigation |  |  | FFS: RAN3 | FFS: RAN3 | maxnopath | existing |  | The maximum number of reporting relative timing of additional path relative to the timing of the first detected path for TRP timing measurement to be reported from gNB to LMF.  Note: In Rel-16, *maxnopath* is 2 in TS 38.455. |  |  |  |  | FFS: RAN3 | Agreement:  • For multipath reporting enhancements, support reporting from TRP to LMF, angle, timing, for up to additional N>2 paths for at least UL-TDOA and multi-RTT. |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Multipath/NLOS mitigation |  |  | FFS: RAN3 | FFS: RAN3 | ULAoAOfAdditionalPathPerSRSResource | New |  | UL-AoA values per SRS resource for the additional path to be reported from gNB to LMF. |  |  |  |  | FFS: RAN3 | Agreement:  Reporting multiple UL-AoA values per SRS resource for the additional path is supported for at least UL TDOA and multi-RTT.  • FFS: maximum number of UL-AoA values per additional path. |
| Multipath/NLOS mitigation |  |  | FFS: RAN3 | FFS: RAN3 | maxNumOfULAoAOfAdditionalPathPerSRSResource | New |  | The maximum number of UL-AOAs values (pair of AOA & ZOA values) per SRS resource for the additional arrival path to be reported from gNB to LMF. |  |  |  |  | FFS: RAN3 | Agreement:  Reporting multiple UL-AoA values per additional path is supported for at least UL TDOA and multi-RTT.  • FFS: maximum number of UL-AoA values per additional path. |
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## Comments

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| **Company** | **Comments** |
| Lenovo, Motorola Mobility | Suggested editorial correction highlighted in red for parameter name (first 3 rows): losNlosIndicator. Also share the same understanding that “losNlosIndicator” also applies to DL PRS-RSRP and UL SRS-RSRP. In the 3rd row, under the UE-based description it is mentioned that “*LoS/NLoS information for RTOA and gNB Rx-Tx time difference measurements from LMF to UE*”, which is a bit confusing since UE-based positioning methods do not support these measurements/methods. |
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7. On-demand transmission and reception of DL PRS

(Round 1)Parameter Table

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| **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parent IE** | **RAN2 ASN.1 name** | **Parameter name in the spec** | **New or existing?** | **Parameter name in the text** | **Description** | **Value range** | **Default value aspect** | **Per (UE, cell, TRP, …)** | **UE-specific or Cell-specific** | **Specification** | **Comment** |
| On-demand PRS |  |  | FFS: RAN2/RAN3 |  | On-demand PRS information | New |  | The IE name “On-demand PRS information” is used by RAN3 in (R3-214516) |  |  |  |  | FFS: RAN2/RAN3 | Agreement:  At least the following list of on-demand DL PRS parameters is supported for UE-initiated and LMF-initiated on-demand DL PRS requests  1. DL PRS Periodicity  2. DL PRS resource bandwidth  3. DL PRS QCL information |
| On-demand PRS |  |  | On-demand PRS information |  | NR-DL-PRS-Periodicity-and-ResourceSetSlotOffset | Existing |  |  |  |  |  |  | FFS: RAN2/RAN3 |  |
| On-demand PRS |  |  | On-demand PRS information |  | dl-PRS-ResourceBandwidth | Existing |  |  |  |  |  |  | FFS: RAN2/RAN3 |  |
| On-demand PRS |  |  | On-demand PRS information |  | DL-PRS-QCL-Info | Existing |  |  |  |  |  |  | FFS: RAN2/RAN3 |  |
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## Comments

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| **Company** | **Comments** |
| Huawei, HiSilicon | Comment #1:  We could also add FFS RAN2/RAN3 to DL PRS QCL information.  FL: Added |
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(Round 2)Parameter Table

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| **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parent IE** | **RAN2 ASN.1 name** | **Parameter name in the spec** | **New or existing?** | **Parameter name in the text** | **Description** | **Value range** | **Default value aspect** | **Per (UE, cell, TRP, …)** | **UE-specific or Cell-specific** | **Specification** | **Comment** |
| On-demand PRS |  |  | FFS: RAN2/RAN3 |  | On-demand PRS information | New |  | The IE name “On-demand PRS information” is already used by RAN3 in (R3-214516) |  |  |  |  | FFS: RAN2/RAN3 | Agreement:  At least the following list of on-demand DL PRS parameters is supported for UE-initiated and LMF-initiated on-demand DL PRS requests  1. DL PRS Periodicity  2. DL PRS resource bandwidth  3. DL PRS QCL information |
| On-demand PRS |  |  | On-demand PRS information |  | NR-DL-PRS-Periodicity-and-ResourceSetSlotOffset | Existing |  |  |  |  |  |  | FFS: RAN2/RAN3 |  |
| On-demand PRS |  |  | On-demand PRS information |  | dl-PRS-ResourceBandwidth | Existing |  |  |  |  |  |  | FFS: RAN2/RAN3 |  |
| On-demand PRS |  |  | On-demand PRS information |  | DL-PRS-QCL-Info | Existing |  |  |  |  |  |  | FFS: RAN2/RAN3 |  |
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## Comments

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| **Company** | **Comments** |
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8. Support of positioning for UEs in RRC\_ INACTIVE state

(Round 1)Parameter Table

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| **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parent IE** | **RAN2 ASN.1 name** | **Parameter name in the spec** | **New or existing?** | **Parameter name in the text** | **Description** | **Value range** | **Default value aspect** | **Per (UE, cell, TRP, …)** | **UE-specific or Cell-specific** | **Specification** | **Comment** |
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## Comments

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| **Company** | **Comments** |
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9. References

[1] RAN1 Chair’s Notes#104e.

[2] RAN1 Chair’s Notes#104bis-e.

[3] RAN1 Chair’s Notes#105e.

[4] RAN1 Chair’s Notes#106e.