**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**

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.*

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

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| **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parant 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.  |  FFS |   |   |   | FFS for RAN2 |  |
| 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.  |  |   |  |   | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |   |   | ueTxTEG | ueTxTEG |   | New |  | The ID of a UE Tx timing error group. |  FFS |   |  |   | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |   |   | ueTxTEG |  SRS Resources |   |  Existing |  | One or more UL SRS resources associated with the UE Tx TEG |   |   |   |   | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |   |   | FFS for RAN2 | ueRxTxTEG-ID |   |  New |  | The ID of the UE RxTx timing error group.  |  FFS |   |   |   | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |   |   | FFS for RAN2 | maxNumOfUE-RxTEG |   |  New |  | The Max number of UE-RxTEG per UE |  FFS |   |   |   | FFS for RAN2 |  |
| Mitigation of UE Rx/Tx timing delays |   |   | FFS for RAN2 | maxNumOfUE-TxTEG |   |  New |  | The Max 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 |   |  |  | **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.  |   |   |   |   | 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.  |   |   |   |   | FFS for RAN3 |   |
| Mitigation of TRP Rx/Tx timing delays |   |   | ueTxTEG | trpTxTEG-ID |   |   New |   | The ID of a TRP Tx timing error group. |   |   |   |   | FFS for RAN3 |   |
| Mitigation of TRP Rx/Tx timing delays |   |   | ueTxTEG |  DL PRS resources |   |  Existing |   | One or more DL PRS resources associated with the UE Tx TEG |   |   |   |   | FFS for RAN3 |   |
| Mitigation of TRP Rx/Tx timing delays |   |   | FFS for RAN3 | trpRxTxTEG-ID |   |   New |   | The ID of the UE RxTx timing error group.  |   |   |   |   | FFS for RAN3 |   |
| Mitigation of TRP Rx/Tx timing delays |   |   | FFS for RAN3 | maxNumOfTRPRxTEG |   |   New |   | The maximum number of UE-RxTEG per UE |   |   |   |   | FFS for RAN3 |   |
| Mitigation of TRP Rx/Tx timing delays |   |   | FFS for RAN3 | maxNumOfTRPTxTEG  |   |   New |   | The maximum number of UE-TxTEG per UE |   |   |   |   | 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 UE-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 ithe 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).Comment #2: For the following parameters, it is suggested with the following change.

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| ueTxTEG | ueTxTEG-ID |
| ueTxTEG |  srs-PosResourcesID |

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.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?

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| maxNumOfUE-RxTEG |
| maxNumOfUE-TxTEG |
| maxNumOfSRSResourcesPerTxTEG |
| maxNumOfUE-RxTxTEG |

Comment #5: The above comments also applies for TRP side. |
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Accuracy improvements for UL-AoA positioning solutions

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| **Sub-feature group** |  | **RAN1 specification** | **Section** | **RAN2 Parant 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 |  |   |   | 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 RAN3 |  FFS RAN3 | NR supports gNB reporting of the first arrival path UL-AOA/ZOA measurement per SRS for positioning resource and SRS for MIMO resource. |
| 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 |   |
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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.

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| **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. |

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Accuracy improvements for DL-AoD positioning solutions

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| **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parant 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 |  TBD |  New |  TBD | gNB beam/antenna information |   |   |   |   |   | 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 | firstPathRSRP | firstPathRSRP |  New  | firstPathRSRP |  the PRS RSRP of the first path |   |   |   |   |   | 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 |  TBD |  New |  TBD |  PRS assistance information for DL-AoD |   |   |   |   |   | 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 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| UE capability |   |   |  TBD | SupportOf firstPathRSRP | SupportOf firstPathRSRP |  New | SupportOf firstPathRSRP | UE capability to support providing the PRS RSRP of the first path0: not support1: 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).Comment #2:We think that the one related to UE capability could be removed.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
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Latency improvements for both DL and DL+UL positioning

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| **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parant 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 | [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 CapabilityPRS processing window |   |   |   | Capability 1A |   |   |   | The DL signals/channels from all DL CCs (per UE) are affected |   |   |   |   |   |   |
| UE CapabilityPRS processing window |   |   |   | Capability 1B |   |   |   | Only the DL signals/channels from a certain band/CC are affected |   |   |   |   |   |   |
| UE CapabilityPRS 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).Comment #2:We think that the one related to UE capability could be removed. |
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Potential enhancements of information reporting from UE and gNB for multipath/NLOS mitigation

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| **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parant 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/RAN3 |  FFS: RAN2/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]. | [0, ..,1]FFS: the discrete values between [0, 1]  |   |   |   | FFS: RAN2/RAN3 |  |
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|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  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 |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
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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. |
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On-demand transmission and reception of DL PRS

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| **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parant 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 requests1. DL PRS Periodicity2. DL PRS resource bandwidth3. DL PRS QCL information |
| On-demand PRS |   |   | On-demand PRS information | DL PRS Periodicity |   |  Existing |   |   |   |   |   |   |  FFS: RAN2/RAN3 |  |
| On-demand PRS |   |   | On-demand PRS information | DL PRS resource bandwidth |   |  Existing |   |   |   |   |   |   |  FFS: RAN2/RAN3 |   |
| On-demand PRS |   |   | On-demand PRS information | DL PRS QCL information |   |  Existing |   |   |   |   |   |   |   |   |
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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. |
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Support of positioning for UEs in RRC\_ INACTIVE state

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| **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parant 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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| **Company** | **Comments**  |
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Other parameters

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| **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parant 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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| **Company** | **Comments**  |
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