**3GPP TSG RAN WG1 #108-e R1-2nnnnn**

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

**Source: Ad-Hoc Chair (AT&T)**

**Title: Session Notes of AI 8.16.5**

**Agenda Item:** **8.16.5**

**Document for:** **Endorsement**

1.

#### 8.16.5 UE features for NR positioning enhancements

[108-e-R17-UE-features-ePos-01] Email discussion UE on features for NR positioning enhancements – Ralf (AT&T)

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

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 27. NR\_pos\_enh | 27-6 | DL PRS processing capabilities in RRC inactive state  | 1. DL PRS buffering capability a) Type 1 – sub-slot/symbol level bufferingb) Type 2 – slot level buffering2. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE3. Max number of DL PRS resources that UE can process in a slot under it […] | FFS | No |  |  | Per band | FFS | FFS | FFS | Component 1 candidate values: {Type 1, Type 2}Component 2 candidate values:T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} msN: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} msComponent 3 candidate values:FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHzFR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHzNeed for location server to know if the feature is supportedNote: Having the PRS processing capabilities in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state ~~[, but instead LMF may set the response time assuming a specific RRC state during the PRS measurement and inform the gNB on the assumed RRC state, while the actual RRC state is still determined by UE/gNB that take the response time requirement and assumed RRC state into account.]~~ | Optional with capability signaling |

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| 27. NR\_pos\_enh | 27-16 | OLPC for positioning SRS in RRC\_INACTIVE state | Same as~~LPP~~~~OLPC-SRS-Pos-r16~~RRCOLPC-SRS-Pos-r16 |  | Yes |  |  | Per band | n/a | n/a | n/a | ~~Need for location server to know if the feature is supported.~~ | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-16a | OLPC for positioning SRS in RRC\_INACTIVE state | Same asLPPOLPC-SRS-Pos-r16 |  | No |  |  | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported.Support of OLPC in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signaling |

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| 27. NR\_pos\_enh | 27-19 | Spatial relation for positioning SRS in RRC\_INACTIVE state | Same as*~~LPP~~**~~SpatialRelationsSRS-Pos-r16~~**RRC**SpatialRelationsSRS-Pos-r16* |  | Yes |  |  | Per band | n/a | n/a | n/a | ~~Need for location server to know if the feature is supported.~~ | Optional with capability signalling |
| 27. NR\_pos\_enh | 27-19a | Spatial relation for positioning SRS in RRC\_INACTIVE state | Same as*LPP**SpatialRelationsSRS-Pos-r16* |  | No |  |  | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported.Support of spatial relation in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signalling |

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| 27. NR\_pos\_enh | 27-18a | Support of PRS measurement in RRC\_INACTIVE state for DL-TDOA | Support of PRS measurement in RRC\_INACTIVE state state for DL-TDOA |  | FFS |  |  | FFS | FFS | FFS | FFS | ~~[~~Need for location server to know if the feature is supported.~~]~~Note: Applicable for both UE-assisted and UE-based DL-TDOANote: PRS capabilities for DL-TDOA measurement and reporting described in FGs in 13-3, 13-3a, 13-3b, 13-6, 13-13 are the same for RRC Inactive.Support of PRS processing measurement in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signaling. |
| 27. NR\_pos\_enh | 27-18b | Support of PRS measurement in RRC\_INACTIVE state for DL-AoD | Support of PRS measurement RRC\_INACTIVE state for DL-AoD |  | FFS |  |  | FFS | FFS | FFS | FFS | ~~[~~Need for location server to know if the feature is supported.~~]~~Note: Applicable for both UE-assisted and UE-based DL-AoDNote: PRS capabilities for DL-AOD measurement and reporting described in FGs 13-2, 13-2a, 13-2b, 13-5, 13-13 are the same for RRC Inactive.Support of PRS processing measurement in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signaling. |
| 27. NR\_pos\_enh | 27-18c | Support of PRS measurement in RRC\_INACTIVE state for Multi-RTT | 1. Support of PRS measurement in RRC\_INACTIVE state for Multi-RTT~~[2. Support of positioning SRS transmission in RRC\_INACTIVE state]~~ |  | FFS |  |  | FFS | FFS | FFS | FFS | ~~[~~Need for location server to know if the feature is supported.~~]~~Note: PRS capabilities for Multi-RTT measurement and reporting described in FGs in 13-4, 13-4a, 13-4b, 13-11, 13-11a, 13-14 are the same for RRC InactiveSupport of PRS processing measurement in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signaling. |

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| 27. NR\_pos\_enh | 27-15 | ~~Support of~~ Positioning SRS transmission in RRC\_INACTIVE state for initial UL BWP | 1. Max number of SRS Resource Sets for positioning supported by UE2. Max number of ~~[~~P/SP~~]~~ SRS Resources for positioning3. Max number of ~~[~~P/SP~~]~~ SRS Resources for positioning per slot4. Max number of periodic SRS Resources for positioning 5. Max number of periodic SRS Resources for positioning per slot~~Note: OLPC for SRS for positioning based on SSB from the last serving cell (the cell that releases UE from connection) is part of this FG. No dedicated capability signaling is intended for this component~~ |  | Yes |  |  | Per band | n/a | n/a | n/a | Component 1 candidate values: {1, 2, 4, 8, 12, 16}Component 2 candidate values: {1,2,4,8,16,32,64}Component 3 candidate values: {1, 2, 3, 4, 5, 6, 8, 10, 12, 14}Component 4 candidate values: {1,2,4,8,16,32,64}Component 5 candidate values: {1, 2, 3, 4, 5, 6, 8, 10, 12, 14}Note: OLPC for SRS for positioning based on SSB from the last serving cell (the cell that releases UE from connection) is part of this FG. No dedicated capability signaling is intended for this componentNeed for location server to know if the feature is supported~~FFS: outside initial BWP~~ | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-15b | Positioning SRS transmission in RRC\_INACTIVE state configured outside initial UL BWP  | 1. Maximum SRS bandwidth supported for each SCS that UE supports within a single CC
2. Max number of SRS Resource Sets for positioning supported by UE
3. Max number of periodic SRS Resources for positioning
4. Max number of periodic SRS Resources for positioning per slot
5. [Different numerology between the SRS and the initial UL BWP is supported]
6. [SRS operation without restriction on the BW: BW of the SRS may not include BW of the CORESET#0 and SSB]
7. Max number of P/SP SRS Resources for positioning
8. Max number of P/SP SRS Resources for positioning per slot
9. FFS: center frequenecy
 | 27-15 | Yes |  |  | Per band |  |  |  | Component 1 candidate values: FFSComponent 2 candidate values: {1, 2, 4, 8, 12, 16}Component 3 candidate values: {1,2,4,8,16,32,64}Component 4 candidate values: {1, 2, 3, 4, 5, 6, 8, 10, 12, 14}Component 5 candidate values: FFSComponent 6 candidate values: FFSComponent 7 candidate values: FFSNote 1: The SRS should have a locationAndBandwidth, SCS, CP, defined the same way as a legacy BWP. [Note 2: Based on other signalled UE capabilities, the UE supports at least one connected mode configuration where a hypothetical BWP defined by this SRS is the active BWP and switching between this active BWP and the initial BWP is supported.][Note 3: If component 5 is not signaled, the UE only supports same numerology between the SRS and the initial UL BWP][Note 4: If component 6 is not signaled, the UE supports only SRS BW that include the BW of the CORESET #0 and SSB.][Need for location server to know if the feature is supported] | Optional with capability signaling |

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| 27. NR\_pos\_enh | 27-13a | First path RSRPP reporting for UE-assisted DL-TDOA | 1. Support of RSRPP reporting for first path | 13-1 | No |  |  | ~~FFS: Per UE or~~ per band | ~~No~~ n/a | ~~No~~ n/a | ~~No~~ n/a | Need for location server to know if the feature is supported. | Optional with capability signaling. |

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| 27. NR\_pos\_enh | 27-14a | First path RSRPP reporting for Multi-RTT | 1. Support of RSRPP reporting for first path | 13-1 | No |  |   | ~~FFS: Per UE or~~ per band | ~~No~~ n/a | ~~No~~ n/a | ~~No~~ n/a | Need for location server to know if the feature is supported. | Optional with capability signaling. |

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 27. NR\_pos\_enh | 27-17 | Support of positioning in RRC\_INACTIVE state | Support of PRS processing in RRC\_INACTIVE | [13-1, 13-2, 13-3, 13-4~~]~~, 13-8] | ~~FFS~~ Yes |  |  | ~~FFS~~ Pe | ~~FFS~~ n/a | ~~FFS~~ n/a | ~~FFS~~ n/a | ~~[Need for location server to know if the feature is supported.]~~~~FFS: separate UE capability for location information reporting in RRC\_INACTIVE state using SDT~~Note: UE supporting this feature may support at least one from DL RSTD, DL PRS-RSRP, or UE Rx – Tx time difference measurement | Optional with capability signaling. |

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| 27. NR\_pos\_enh | 27-2-1 | DL PRS RSRPP measurement report of the first path for UE-assisted DL-AoD | 1.) Support of measuring and reporting the PRS RSRPP of the first path for DL-AoD positioning method2.) The maximum number of first path PRS RSRPP per TRP | 13-5 ~~or 27-2-2~~  | No |  |  | ~~FFS: Per UE or~~ per band | n/a | n/a | n/a | Component 2 candidate values: 1, 2,4,8,16,24Need for location server to know if the feature is supportedThe maximum number of first path PRS RSRP per TRP should be less than or equal to the maximum number of PRS RSRP (27-2-2)[Note: Having FG 13-5 as the prerequisite FG does not imply that in a measurement report, reporting PRS-RSRP of a PRS resource should be the prerequisite of reporting PRS-RSRPP for the first path of the PRS resource] | Optional with capability signalling |

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| 27. NR\_pos\_enh | 27-3-2 | DL PRS measurement outside MG and in a PRS processing window ~~- processing types~~ | 1. Supported PRS processing types subject to the UE determining that DL PRS to be higher priority for PRS measurement outside MG and in a PRS processing window2. Support of priority handing options of PRS: Option1, Option2 or Option3* 1. Option 1: UE may indicates support of two priority states.
		1. State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS
		2. State 2: PRS is lower priority than all PDCCH/PDSCH/CSI-RS
	2. Option 2: UE may indicate support of three priority states
		1. State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS
		2. State 2: PRS is lower priority than PDCCH and URLLC PDSCH and higher priority than other PDSCH/CSI-RS
			1. Note: The URLLC channel corresponds a dynamically scheduled PDSCH whose PUCCH resource for carrying ACK/NAK is marked as high-priority.
		3. State 3: PRS is lower priority than all PDCCH/PDSCH/CSI-RS
	3. Option 3: UE may indicate support of single priority state
		1. State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS

Note:* Type 1A refers to the determination of prioritization between DL PRS and other DL signals/channels in all OFDM symbols within the PRS processing window. The DL signals/channels from all DL CCs (per UE) are affected across LTE and NR
* Type 1B refers to the determination of prioritization between DL PRS and other DL signals/channels in all OFDM symbols within the PRS processing window. The DL signals/channels from a certain band are affected ~~(FFS FR2)~~
* Type 2 refers to the determination of prioritization between DL PRS and other DL signals/channels only in DL PRS symbols within the PRS processing window ~~[The DL signals/channels from all DL CCs (per UE) are affected (FFS FR2)]~~
* ~~[For Type 2 PRS processing time, the PRS processing in one FR2 band may affect the downlink receiving in a second FR2 band]~~

Note: When the UE determines higher priority for other DL signals/channels over the PRS measurement/processing, the UE is not expected to measure/process DL PRS which is applicable to all of the above capability optionsNote: Within a PRS processing window, UE measurement is inside the active DL BWP with PRS having the same numerology as the active DL BWP | 13-1 | Yes |  | DL PRS measurement outside MG and in a PRS processing window is not supported | per band | n/a | n/a | n/a | Component 1 candidate values: ~~[~~One or more of~~]~~ {Type 1A, Type 1B, Type 2}Component 2 candidate values: {option1, option2, option3}Need for location server to know if the feature is supportedNote: Component 2 can be reported per supported band for each type supported by the UE, details left to RAN2 ~~Note: A UE that supports FG 27-3-2 also needs to support FG 27-3-2a~~ | Optional with capability signaling |
| ~~27. NR\_pos\_enh~~ | ~~27-3-2a~~ | ~~Support of priority handing of PRS when PRS measurement is outside MG~~ | ~~Support of priority handing options of PRS: Option1, Option2 or Option3~~* 1. ~~Option 1: UE may indicates support of two priority states.~~
		1. ~~State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS~~
		2. ~~State 2: PRS is lower priority than all PDCCH/PDSCH/CSI-RS~~
	2. ~~Option 2: UE may indicate support of three priority states~~
		1. ~~State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS~~
		2. ~~State 2: PRS is lower priority than PDCCH and URLLC PDSCH and higher priority than other PDSCH/CSI-RS~~
			1. ~~Note: The URLLC channel corresponds a dynamically scheduled PDSCH whose PUCCH resource for carrying ACK/NAK is marked as high-priority.~~
		3. ~~State 3: PRS is lower priority than all PDCCH/PDSCH/CSI-RS~~
	3. ~~Option 3: UE may indicate support of single priority state~~

~~State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS~~ | ~~[27-3-3]~~ | ~~Yes~~  |  |  | ~~Per band~~  | ~~No~~ | ~~No~~ | ~~No~~ | ~~Candidate values: {option1, option2, option3}~~~~Note: A UE that supports FG 27-3-2a also needs to support FG 27-3-2~~~~Note: if the FFS in FG 27-2a gets resolved as “per band’, FG 27-2a will be deleted and becomes a component of FG 27-3-2~~ | ~~Optional with capability signaling~~ |

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| 27. NR\_pos\_enh | 27-17 | ~~Support of positioning in RRC\_INACTIVE state~~ PRS processing in RRC\_INACTIVE | Support of PRS processing in RRC\_INACTIVE | [13-1, 13-2, 13-3, 13-4] | ~~FFS~~ Yes |  | ~~FFS~~ PRS processing in RRC\_INACTIVE is not supported | ~~FFS~~ per band | ~~FFS~~ n/a | ~~FFS~~ n/a | ~~FFS~~ n/a | ~~[Need for location server to know if the feature is supported.]~~~~FFS: separate UE capability for location information reporting in RRC\_INACTIVE state using SDT~~Note: UE supporting this feature may support at least one from DL RSTD, DL PRS-RSRP, or UE Rx – Tx time difference measurement | Optional with capability signaling. |

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| 27. NR\_pos\_enh | 27-18a | Support of PRS measurement in RRC\_INACTIVE state for DL-TDOA | Support of PRS measurement in RRC\_INACTIVE state for DL-TDOA |  | ~~FFS~~ No |  | ~~FFS~~ PRS measurement in RRC\_INACTIVE state for DL-TDOA is not supported | ~~FFS~~ per band | ~~FFS~~ n/a | ~~FFS~~ n/a | ~~FFS~~ n/a | Need for location server to know if the feature is supported.Note: Applicable for both UE-assisted and UE-based DL-TDOANote: PRS capabilities for DL-TDOA measurement and reporting described in FGs in 13-3, 13-3a, 13-3b, 13-6, 13-13 are the same for RRC Inactive.Support of PRS processing measurement in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signaling. |
| 27. NR\_pos\_enh | 27-18b | Support of PRS measurement in RRC\_INACTIVE state for DL-AoD | Support of PRS measurement in RRC\_INACTIVE state for DL-AoD |  | ~~FFS~~ No |  | ~~FFS~~ PRS measurement in RRC\_INACTIVE state for DL-AoD is not supported | ~~FFS~~ per band | ~~FFS~~ n/a | ~~FFS~~ n/a | ~~FFS~~ n/a | Need for location server to know if the feature is supported.Note: Applicable for both UE-assisted and UE-based DL-AoDNote: PRS capabilities for DL-AOD measurement and reporting described in FGs 13-2, 13-2a, 13-2b, 13-5, 13-13 are the same for RRC Inactive.Support of PRS processing measurement in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signaling. |
| 27. NR\_pos\_enh | 27-18c | Support of PRS measurement in RRC\_INACTIVE state for Multi-RTT | 1. Support of PRS measurement in RRC\_INACTIVE state for Multi-RTT |  | ~~FFS~~ No |  | ~~FFS~~ PRS measurement in RRC\_INACTIVE state for for Multi-RTT is not supported  | ~~FFS~~ per band | ~~FFS~~ n/a | ~~FFS~~ n/a | ~~FFS~~ n/a | Need for location server to know if the feature is supported.Note: PRS capabilities for Multi-RTT measurement and reporting described in FGs in 13-4, 13-4a, 13-4b, 13-11, 13-11a, 13-14 are the same for RRC InactiveSupport of PRS processing measurement in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signaling. |

[R1-2200925](file:///C%3A%5CUsers%5Cyouns%5COneDrive%5CDocuments%5C3GPP%5CRAN1%20tdocs%5CTSGR1_108-e%5CDocs%5CR1-2200925.zip) Remaining issues of Rel-17 positioning UE feature Huawei, HiSilicon

[R1-2201123](file:///C%3A%5CUsers%5Cyouns%5COneDrive%5CDocuments%5C3GPP%5CRAN1%20tdocs%5CTSGR1_108-e%5CDocs%5CR1-2201123.zip) Discussion on UE features for NR positioning enhancements vivo

[R1-2201200](file:///C%3A%5CUsers%5Cyouns%5COneDrive%5CDocuments%5C3GPP%5CRAN1%20tdocs%5CTSGR1_108-e%5CDocs%5CR1-2201200.zip) UE features for NR positioning enhancements ZTE

[R1-2201245](file:///C%3A%5CUsers%5Cyouns%5COneDrive%5CDocuments%5C3GPP%5CRAN1%20tdocs%5CTSGR1_108-e%5CDocs%5CR1-2201245.zip) UE features for NR positioning enhancements OPPO

[R1-2201347](file:///C%3A%5CUsers%5Cyouns%5COneDrive%5CDocuments%5C3GPP%5CRAN1%20tdocs%5CTSGR1_108-e%5CDocs%5CR1-2201347.zip) Remaining issues on Rel-17 UE features for NR Positioning enhancements CATT

[R1-2201412](file:///C%3A%5CUsers%5Cyouns%5COneDrive%5CDocuments%5C3GPP%5CRAN1%20tdocs%5CTSGR1_108-e%5CDocs%5CR1-2201412.zip) On UE features for NR positioning enhancements Nokia, Nokia Shanghai Bell

[R1-2201447](file:///C%3A%5CUsers%5Cyouns%5COneDrive%5CDocuments%5C3GPP%5CRAN1%20tdocs%5CTSGR1_108-e%5CDocs%5CR1-2201447.zip) UE features for Rel-17 NR positioning enhancements China Telecom

[R1-2201505](file:///C%3A%5CUsers%5Cyouns%5COneDrive%5CDocuments%5C3GPP%5CRAN1%20tdocs%5CTSGR1_108-e%5CDocs%5CR1-2201505.zip) Discussion on Rel-17 UE features for NR positioning enhancements NTT DOCOMO, INC.

[R1-2201730](file:///C%3A%5CUsers%5Cyouns%5COneDrive%5CDocuments%5C3GPP%5CRAN1%20tdocs%5CTSGR1_108-e%5CDocs%5CR1-2201730.zip) UE features for Rel.17 NR positioning enhancements Intel Corporation

[R1-2201795](file:///C%3A%5CUsers%5Cyouns%5COneDrive%5CDocuments%5C3GPP%5CRAN1%20tdocs%5CTSGR1_108-e%5CDocs%5CR1-2201795.zip) Views on UE features for NR positioning enhancements Apple

[R1-2201883](file:///C%3A%5CUsers%5Cyouns%5COneDrive%5CDocuments%5C3GPP%5CRAN1%20tdocs%5CTSGR1_108-e%5CDocs%5CR1-2201883.zip) Discussion on UE features for NR positioning enhancement CMCC

[R1-2201953](file:///C%3A%5CUsers%5Cyouns%5COneDrive%5CDocuments%5C3GPP%5CRAN1%20tdocs%5CTSGR1_108-e%5CDocs%5CR1-2201953.zip) Discussion on UE features for NR Positioning Enhancements Xiaomi

[R1-2202042](file:///C%3A%5CUsers%5Cyouns%5COneDrive%5CDocuments%5C3GPP%5CRAN1%20tdocs%5CTSGR1_108-e%5CDocs%5CR1-2202042.zip) UE features for NR positioning enhancements Samsung

[R1-2202169](file:///C%3A%5CUsers%5Cyouns%5COneDrive%5CDocuments%5C3GPP%5CRAN1%20tdocs%5CTSGR1_108-e%5CDocs%5CR1-2202169.zip) UE features for NR positioning enhancements Qualcomm Incorporated

[R1-2202388](file:///C%3A%5CUsers%5Cyouns%5COneDrive%5CDocuments%5C3GPP%5CRAN1%20tdocs%5CTSGR1_108-e%5CDocs%5CR1-2202388.zip) Views on NR positioning enhancements UE features Ericsson