**3GPP TSG RAN WG1 #106bis-e R1-2109915**

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

**Agenda Item: 8.17.5**

**Source: Moderator (AT&T)**

**Title: Summary of UE features for NR positioning enhancements**

**Document for:** **Discussion/Decision**

# Introduction

This document presents the summary of email discussion/approval [106bis-e-R17-UE-features-ePos-01] during RAN1 #106bis-e. According to the Chairman’s Notes:

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| [106bis-e-R17-UE-features-ePos-01] Email discussion UE features for NR positioning enhancements – Ralf (AT&T)* 1st check point: October 14
* Final check point: October 19
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The following was discussed and/or agreed during RAN1 #106bis-e within the scope of [106bis-e-R17-UE-features-ePos-01]. All proposals are based on the latest RAN1 UE features list for Rel-17 NR in [1].

# Summary of Contributions Submitted to RAN1 #106bis-e

The following is the moderator’s summary of contributions submitted to RAN1 #106bis-e in this agenda item.

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|  27. NR\_pos\_enh | 27-x1 | Mitigation of UE Rx timing delays | The maximum number of UE-RxTEG per UE, which is supported and reported by UE for DL TDOAFFS: the values (>1). FFS: whether to have a value=1 to indicate UE Rx timing errors is well calibratedFFF: whether to have separate values for DL TDOA and/or Multi-RTT positioning |  | No |  | Mitigation of UE Rx timing delays is not supported | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

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| Company | Summary |
| ZTE [2] | For the mitigation of UE RX timing delays, the following aspects should be considered for the maximum number of UE-RxTEG supported by UE.* DL measurements from different bands may experience different timing error since the group delay is frequency dependent. Hence, this UE feature should be provided per band.
* The number of the UE-RxTEG should be considered from both frequency domain and spatial domain, e.g., UE can support up to 4 positioning frequency layers and 4 ports. So, the candidate values can be {1, 2, 4, 8, 16}
* Value=1 is to indicate that the timing error differences between all DL measurements are within a certain margin
* Some of the Rel-16 UE features are defined per positioning method (e.g. max number of DL PRS Resources). To follow the same principle, we propose to have separate values for DL TDOA and/or Multi-RTT positioning.

**Proposal: For the mitigation of UE RX timing delays, maximum number of UE-RxTEG supported by UE is defined as following,*** **This UE feature is provided per band.**
* **The candidate values are {1, 2, 4, 8, 16}**
* **Value=1 is to indicate that the timing error differences between all DL measurements are within a certain margin**
* **Have separate values for DL TDOA and/or Multi-RTT positioning**
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| Vivo [3] | * + FFS: whether to have a value=1 to indicate UE Rx timing errors is well calibrated
* We can support a value of 1, but we don’t think the value of 1 represents ‘well calibrated’. We think value=1 only represents that all the timing errors for UE Rx (e.g., based on RF chains and antenna panel) is grouped in the same group such that timing error difference in the same group is within a certain margin, rather than ‘well calibrated’. Even if some UEs cannot be ‘well calibrated’, they may support Rx TEG number of 1.
* In addition to UE Rx TEG, we share the similar view for ‘FFS’ in UE Tx TEG and RxTx TEG.
	+ Regarding the UE capability of the maximum number of UE-RxTEG per UE, FFS: whether to have separate values for DL TDOA and/or Multi-RTT positioning
* Our answer is no. The UE capability is up to RF design such as RF chains or panel, we don’t see the need to differentiate to different values of the same feature for different positioning method.
* In addition to UE Rx TEG, we share the similar view for ‘FFS’ in UE Tx TEG.
	+ Regarding the UE capability of the maximum number of UE Tx TEG per UE, FFS: Per UE or per band
* Our preference is per band. The UE capability is up to RF design which is band/frequency dependent. For example, we don’t think the TEG capabilities are the same in FR1 and FR2.
* Similarly, in addition to Tx TEG, the types of UE capability for UE Rx TEG and RxTx TEG should also be changed to ‘per band’.
	+ FFS: whether gNB needs to know if the feature (the maximum number of UE Tx TEG per UE) is supported.
* Our answer is no. From our point of view, the UE Tx TEG information is determined by the UE and there is no use for the serving gNB to obtain this information.
	+ Regarding UE feature in ‘27-x1’, we think this UE feature can also be applied to Multi-RTT positioning. Therefore, we propose to modify the description of ‘The maximum number of UE-RxTEG per UE, which is supported and reported by UE for DL TDOA’ to ‘The maximum number of UE-RxTEG per UE, which is supported and reported by UE for DL TDOA and/or Multi-RTT positioning’.
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| OPPO [4] | Rel-17 supports the UE to report more than 2 additional paths for DL-TDOA positioning measurement. That should be subject to the UE capability. In UE feature, the UE can report if the UE supports to report more than 2 additional paths and the UE can reports the maximal number of additional paths for DL-TDOA positioning measurement. Regarding the maximal number of additional paths, 4 shall be one candidate value. **Proposal: Reporting > 2 additional paths for DL-TDOA is UE capability and the UE can report the maximal number of additional paths for DL-TDOA:*** **The candidate values for maximal number additional paths are 2 and 4.**

It was also agreed in Rel-17 that UE can report more than 2 additional paths for Multi-RTT positioning measurement. That should be subject to the UE capability too. In UE feature, the UE can report if the UE supports to report more than 2 additional paths and the UE can reports the maximal number of additional paths for multi-RTT positioning measurement. Similarly, 4 shall be a candidate value for the maximal number of additional paths.**Proposal: Reporting > 2 additional paths for Multi-RTT is UE capability and the UE can report the maximal number of additional paths for multi-RTT:*** **The candidate values for maximal number additional paths are 2 and 4.**
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| Huawei/HiSilicon [5] | In the FG 27-x1, FG 27-x2, and FG 27-x3, there were FFS on the number of 1 to indicate UE timing error being well calibrated. We believe that should be the case, and it should be different from Rel-16.In Rel-16, there is no TEG reporting, which means that identification of timing error is not supported, regardless of whether UE makes any calibration effort. From the network perspective, LMF should not assume any TEG information. Note that RAN4 also considered some sort of remaining calibration error, however, we think at least the margin and target accuracy is not for Rel-17.Then in Rel-17, UE could report support of single TEG, which means that UE supports the TEG feature, and after calibration, UE claims to have a single TEG. From the network perspective, LMF should assume a single TEG at UE side, and may not request UE to report TEG ID during the follow-up localization.We think that the value = 1 should be kept.**Proposal: Keep the value = 1 for the number of TEGs that UE supports.** |
| CATT [6] |

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|  27. NR\_pos\_enh | 27-x1 | The maximum number of UE-RxTEGs for DL TDOA | The maximum number of UE-RxTEG per UE, which is supported and reported by UE for DL TDOAFFS: the values (>1). FFS: whether to have a value=1 to indicate UE Rx timing errors is well calibratedIf UE supports this capability with the values > 1, the UE supports including 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. |

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| Samsung [7] |  |
| Intel Corporation [8] |

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| 7-x1 | Mitigation of UE Rx timing errors | The maximum number of UE-RxTEG per UE, which is supported and reported by UE for DL TDOA and Multi-RTT positioningValues: up to [8] |

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| Qualcomm Incorporated [9] | Split in 4 separate feature groups:* Support of Rx-TEG reporting feature for UE-assisted DL-TDOA
* Support of Rx-TEG reporting for RTT
* Maximum number of Rx-TEGs for RTT
* Maximum number of Rx-TEGs for UE-assisted DL-TDOA

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|  27. NR\_pos\_enh | 27-x1a | Support of UE-RxTEG for UE-assisted DL-TDOA | Support of UE-RxTEG reporting for UE-assisted DL TDOA |  | No |  | Reporting of UE-RxTEG is not supported for UE-assisted DL-TDOA | 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-x1b | Maximum number of UE-RxTEG for UE-assisted DL-TDOA | The maximum number of UE-RxTEG, which is supported and can be reported by the UE for UE-assisted DL TDOA* Values: {1,2,4,6,8,12,16,24,32}
 | 27-x1a | No |  |  | Per UE | 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-x1c | Support of UE-RxTEG for Multi-RTT | Support of UE-RxTEG reporting for Multi-RTT |  | No |  | Reporting of UE-RxTEG is not supported for Multi-RTT | 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-x1d | Maximum number of UE-RxTEG for Multi-RTT | The maximum number of UE-RxTEG, which is supported and can be reported by the UE for Multi-RTT* Values: {1,2,4,6,8,12,16,24,32}
 | 27-x1c | No |  |  | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

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| Nokia/Nokia Shanghai Bell [10] | Add FG 13-3 as pre-requisite, as this is an enhancement to Rel-16 DL-TDOA |
| Ericsson [11] | For UE Tx TEG reporting, the following agreement was made RAN1#104bis-e::

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| Agreement:* Support the following for mitigating TRP Tx timing errors and/or UE Rx timing errors for DL TDOA
	+ Support a UE to provide the association information of RSTD measurements with UE Rx TEG(s) to the LMF when the UE reports the RSTD measurements to the LMF if the UE has multiple TEGs
	+ Support a TRP providing the association information of DL PRS resources with Tx TEGs to the LMF if the TRP has multiple TEGs
	+ Support the LMF to provide the association information of DL PRS resources with Tx TEGs to a UE for UE-based positioning if the TRP has multiple TEGs
	+ FFS: the details of the signaling, procedures, and UE capability
* Send an LS to RAN4 to check if there is any issue to support the above enhancements
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From the above agreement, UE Rx TEG reporting is only relevant if the UE has multiple Rx TEGs. Hence, when the UE reports the capability for ‘(27x1) Mitigation of UE Rx timing delays’, there is no need to include the value of 1 for the maximum number of UE Rx TEGs. Hence, we suggest to remove ‘FFS: whether to have a value=1 to indicate UE Rx timing errors is well calibrated’.Furthermore, the reporting of maximum number of UE Rx TEGs is applicable to multi-RTT positioning as well. Hence, we suggest to add multi-RTT positioning to the top level component description (i.e., The maximum number of UE-RxTEG per UE, which is supported and reported by UE for DL TDOA and/or Multi-RTT positioning)As for capability reporting of the maximum number of UE Rx TEGs, we do not see the need to report different values for DL TDOA and Multi-RTT positioning. Hence, we suggest to remove ‘FFF: whether to have separate values for DL TDOA and/or Multi-RTT positioning’Our suggested changes are summarized below:

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| 27. NR\_pos\_enh | 27-x1 | Mitigation of UE Rx timing delays | The maximum number of UE-RxTEG per UE, which is supported and reported by UE for DL TDOA and/or Multi-RTT positioningFFS: the values (>1).  |

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|  27. NR\_pos\_enh | 27-x2 | Mitigation of UE Tx timing delays | The maximum number of UE-TxTEG per UE, which is supported and reported by UE for UL TDOA and/or Multi-RTT positioningFFS; the values (>1).FFS: whether to have a value=1 to indicate UE Tx timing errors is well calibratedFF: whether a UE supports different values for UL TDOA and/or Multi-RTT positioning |  | FFS |  | Mitigation of UE Tx timing delays is not supported | FFS: Per UE or per band | n/a | n/a | n/a | Need for location server to know if the feature is supported.FFS: whether gNB needs to know if the feature is supported. | Optional with capability signaling |

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| Company | Summary |
| ZTE [2] | Similarly, for the mitigation of UE TX timing delays, the following aspects should be considered for the maximum number of UE-TxTEGs supported by UE.* UL transmissions from different bands may experience different timing errors since the group delay is frequency dependent. Hence, this UE feature should at least be provided per band.
* The number of the UE-TxTEG should be considered from both frequency domain and spatial domain, e.g., UE can support up to 8 contiguous CCs per band and up to 4 ports per UE. So, the candidate values can be {1, 2, 4, 8, 16, 32}
* Value=1 is to indicate that the timing error differences between all UL transmissions are within a certain margin
* The positioning SRS is irrelevant to which positioning method is used. So, there is no need to have separate values for DL TDOA and/or Multi-RTT positioning.

**Proposal: For the mitigation of UE TX timing delays, maximum number of UE-RxTEG supported by UE is defined as following,*** **This UE feature is provided per band**
* **The candidate values are {1, 2, 4, 8, 16, 32}**
* **Value=1 is to indicate that the timing error differences between all UL transmissions are within a certain margin**
* **There is no need to have separate values for DL TDOA and/or Multi-RTT positioning.**
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| Vivo [3] | * + FFS: whether to have a value=1 to indicate UE Rx timing errors is well calibrated
* We can support a value of 1, but we don’t think the value of 1 represents ‘well calibrated’. We think value=1 only represents that all the timing errors for UE Rx (e.g., based on RF chains and antenna panel) is grouped in the same group such that timing error difference in the same group is within a certain margin, rather than ‘well calibrated’. Even if some UEs cannot be ‘well calibrated’, they may support Rx TEG number of 1.
* In addition to UE Rx TEG, we share the similar view for ‘FFS’ in UE Tx TEG and RxTx TEG.
	+ Regarding the UE capability of the maximum number of UE-RxTEG per UE, FFS: whether to have separate values for DL TDOA and/or Multi-RTT positioning
* Our answer is no. The UE capability is up to RF design such as RF chains or panel, we don’t see the need to differentiate to different values of the same feature for different positioning method.
* In addition to UE Rx TEG, we share the similar view for ‘FFS’ in UE Tx TEG.
	+ Regarding the UE capability of the maximum number of UE Tx TEG per UE, FFS: Per UE or per band
* Our preference is per band. The UE capability is up to RF design which is band/frequency dependent. For example, we don’t think the TEG capabilities are the same in FR1 and FR2.
* Similarly, in addition to Tx TEG, the types of UE capability for UE Rx TEG and RxTx TEG should also be changed to ‘per band’.
	+ FFS: whether gNB needs to know if the feature (the maximum number of UE Tx TEG per UE) is supported.
* Our answer is no. From our point of view, the UE Tx TEG information is determined by the UE and there is no use for the serving gNB to obtain this information.
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| OPPO [4] |  |
| Huawei/HiSilicon [5] | In the FG 27-x1, FG 27-x2, and FG 27-x3, there were FFS on the number of 1 to indicate UE timing error being well calibrated. We believe that should be the case, and it should be different from Rel-16.In Rel-16, there is no TEG reporting, which means that identification of timing error is not supported, regardless of whether UE makes any calibration effort. From the network perspective, LMF should not assume any TEG information. Note that RAN4 also considered some sort of remaining calibration error, however, we think at least the margin and target accuracy is not for Rel-17.Then in Rel-17, UE could report support of single TEG, which means that UE supports the TEG feature, and after calibration, UE claims to have a single TEG. From the network perspective, LMF should assume a single TEG at UE side, and may not request UE to report TEG ID during the follow-up localization.We think that the value = 1 should be kept.**Proposal: Keep the value = 1 for the number of TEGs that UE supports.**For FG 27-x2, the Tx TEG feature mainly relies on the UE chain distribution when it comes to CA configuration, similar to the SRS resource capability (which is reported per FS/per band in a band combination).We think a straightforward way is also to report Tx TEG number per band in a band combination to the gNB. If this is reported to LMF, the number should be reported per band for configured CA band combination.**Proposal: FG 27-x2 should be reported per FS to the gNB and per band for the currently configured CA band combination to the LMF.** |
| CATT [6] |

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|  27. NR\_pos\_enh | 27-x2 | The maximum number of UE-TxTEGs for UL TDOA | The maximum number of UE-TxTEG per UE, which is supported and reported by UE for UL TDOA and/or Multi-RTT positioningFFS; the values (>1).FFS: whether to have a value=1 to indicate UE Tx timing errors is well calibratedIf UE supports this capability with the values > 1, the UE supports to provide the association information of UL SRS resources for positioning with Tx TEGs to the LMF.* FFS: Whether the association information is sent directly from UE to LMF, or is first provided to gNB and then forwarded to LMF.
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| Samsung [7] |  |
| Intel Corporation [8] |

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| 27-x2 | Mitigation of UE Tx timing errors | The maximum number of UE-TxTEG per UE, which is supported and reported by UE for UL TDOA and Multi-RTT positioningValues: up to [8] |

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| Qualcomm Incorporated [9] | Split in 4 separate feature groups:* Support of Tx-TEG reporting feature for UL-TDOA
* Support of Tx-TEG reporting for RTT
* Maximum number of Tx-TEGs for UL-TDOA
* Maximum number of Tx-TEGs for RTT

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|  27. NR\_pos\_enh | 27-x2a | Support of UE-TxTEG for Multi-RTT | Support of UE-TxTEG reporting for Multi-RTT |  | No |  | Reporting of UE-TxTEG is not supported for Multi-RTT | 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-x2b | Support of UE-TxTEG for UL-TDOA | Support of UE-TxTEG reporting for UL-TDOA |  | No |  | Reporting of UE-TxTEG is not supported for UL-TDOA | 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-x2c | Maximum number of UE-TxTEG per UE for UL-TDOA positioning | The maximum number of UE-TxTEG per UE, which is supported and reported by UE for UL TDOA positioning | 27-x2a | FFS |  |  | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported.FFS: whether gNB needs to know if the feature is supported. | Optional with capability signaling |
|  27. NR\_pos\_enh | 27-x2d | Maximum number of UE-TxTEG per UE for Multi-RTT positioning | The maximum number of UE-TxTEG per UE, which is supported and reported by UE for Multi-RTT positioning | 27-x2c | FFS |  |  | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported.FFS: whether gNB needs to know if the feature is supported. | Optional with capability signaling |

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| Nokia/Nokia Shanghai Bell [10] | Add FG 13-4, 13-8 as pre-requisite, as this requires SRS resources for positioning |
| Ericsson [11] | The following was agreed in RAN1#106e:

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| Agreement:Support the following for mitigating UE Tx timing errors and/or TRP Rx timing errors for UL TDOA* Support a TRP to provide the association information of RTOA measurements with TRP Rx TEG(s) to the LMF when the TRP reports the RTOA measurements to the LMF if the TRP has multiple Rx TEGs
* Support a UE to provide under capability the association information of UL SRS resources for positioning with Tx TEGs to the LMF if the UE has multiple Tx TEGs
	+ FFS: Whether to support a UE to provide the association information of UL SRS resources for MIMO with Tx TEGs to the LMF if the UE has multiple Tx TEGs
	+ FFS: Whether the association information is sent directly from UE to LMF, or is first provided to gNB and then forwarded to LMF
* FFS: the details of the Signaling, procedures, and UE capability
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From the above agreement, UE Tx TEG association with UL SRS is only relevant if the UE has multiple Tx TEGs. Hence, when the UE reports the capability for ‘(27x2) Mitigation of UE Tx timing delays’, there is no need to include the value of 1 for the maximum number of UE Tx TEGs. Hence, we suggest to remove ‘FFS: whether to have a value=1 to indicate UE Tx timing errors is well calibrated’As for capability reporting of the maximum number of UE Tx TEGs, we do not see the need to report different values for DL TDOA and Multi-RTT positioning. Hence, we suggest to remove ‘FF: whether a UE supports different values for UL TDOA and/or Multi-RTT positioning’

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| 27. NR\_pos\_enh | 27-x2 | Mitigation of UE Tx timing delays | The maximum number of UE-TxTEG per UE, which is supported and reported by UE for UL TDOA and/or Multi-RTT positioningFFS; the values (>1). |

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|  27. NR\_pos\_enh | 27-x3 | Mitigation of UE RxTx timing delays | The maximum number of UE-RxTxTEG per UE, which is supported and reported by UE for Multi-RTT positioningFFS; the values (>1)FFS: whether to have a value=1 to indicate UE RxTx timing errors is well calibrated |  | No |  | Mitigation of UE RxTx timing delays is not supported | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

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| Company | Summary |
| ZTE [2] | For the mitigation of UE Rx+TX timing delays, the following aspects should be considered for the maximum number of UE-RxTxTEG supported by UE.* DL measurements and UL transmissions from different bands may experience different timing errors since the group delay is frequency dependent. So, this UE feature should be provided per band.
* The candidate values should take into account DL measurements and UL transmissions, which at least should be larger than the number of UE-RxTEG and UE-TxTEG. So, the candidate values can be {1, 2, 4, 8, 16, 32, 64, [128]}
* Value=1 is to indicate that the ‘Rx timing error+Tx timing error’ differences between all combinations of measurement and transmission are within a certain margin

**Proposal: For the mitigation of UE RX+TX timing delays, maximum number of UE-RxTxTEG supported by UE is defined as followings,*** **This UE feature is provided per band**
* **The candidate values are {1, 2, 4, 8, 16, 32, 64, [128]}**
* **Value=1 is to indicate that the ‘Rx timing error+Tx timing error’ differences between all combinations of measurement and transmission are within a certain margin**
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| Vivo [3] | * + FFS: whether to have a value=1 to indicate UE Rx timing errors is well calibrated
* We can support a value of 1, but we don’t think the value of 1 represents ‘well calibrated’. We think value=1 only represents that all the timing errors for UE Rx (e.g., based on RF chains and antenna panel) is grouped in the same group such that timing error difference in the same group is within a certain margin, rather than ‘well calibrated’. Even if some UEs cannot be ‘well calibrated’, they may support Rx TEG number of 1.
* In addition to UE Rx TEG, we share the similar view for ‘FFS’ in UE Tx TEG and RxTx TEG.
	+ Regarding the UE capability of the maximum number of UE-RxTEG per UE, FFS: whether to have separate values for DL TDOA and/or Multi-RTT positioning
* Our answer is no. The UE capability is up to RF design such as RF chains or panel, we don’t see the need to differentiate to different values of the same feature for different positioning method.
* In addition to UE Rx TEG, we share the similar view for ‘FFS’ in UE Tx TEG.
	+ Regarding the UE capability of the maximum number of UE Tx TEG per UE, FFS: Per UE or per band
* Our preference is per band. The UE capability is up to RF design which is band/frequency dependent. For example, we don’t think the TEG capabilities are the same in FR1 and FR2.
* Similarly, in addition to Tx TEG, the types of UE capability for UE Rx TEG and RxTx TEG should also be changed to ‘per band’.
	+ FFS: whether gNB needs to know if the feature (the maximum number of UE Tx TEG per UE) is supported.
* Our answer is no. From our point of view, the UE Tx TEG information is determined by the UE and there is no use for the serving gNB to obtain this information.
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| OPPO [4] |  |
| Huawei/HiSilicon [5] | In the FG 27-x1, FG 27-x2, and FG 27-x3, there were FFS on the number of 1 to indicate UE timing error being well calibrated. We believe that should be the case, and it should be different from Rel-16.In Rel-16, there is no TEG reporting, which means that identification of timing error is not supported, regardless of whether UE makes any calibration effort. From the network perspective, LMF should not assume any TEG information. Note that RAN4 also considered some sort of remaining calibration error, however, we think at least the margin and target accuracy is not for Rel-17.Then in Rel-17, UE could report support of single TEG, which means that UE supports the TEG feature, and after calibration, UE claims to have a single TEG. From the network perspective, LMF should assume a single TEG at UE side, and may not request UE to report TEG ID during the follow-up localization.We think that the value = 1 should be kept.**Proposal: Keep the value = 1 for the number of TEGs that UE supports.** |
| CATT [6] |

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|  27. NR\_pos\_enh | 27-x3 | The maximum number of UE-RxTxTEGs for Multi-RTT | The maximum number of UE-RxTxTEG per UE, which is supported and reported by UE for Multi-RTT positioningFFS; the values (>1)FFS: whether to have a value=1 to indicate UE RxTx timing errors is well calibratedIf a UE support this capability with the values > 1, the UE supports reporting of UE RxTx TEG ID with UE Rx-Tx time difference measurements for Multi-RTT positioning. |
|  27. NR\_pos\_enh | 27-x3a | The maximum number of UE-RxTEGs for Multi-RTT | The maximum number of UE-RxTEG per UE, which is supported and reported by UE for Multi-RTT positioningFFS: the values (>1)FFS: whether to have a value=1 to indicate UE Rx timing errors is well calibratedIf a UE support this capability with the values > 1, the UE supports reporting of UE Rx TEG ID with UE Rx-Tx time difference measurements for Multi-RTT positioning. |
|  27. NR\_pos\_enh | 27-x3b | The maximum number of UE-TxTEGs for Multi-RTT | The maximum number of UE-TxTEG per UE, which is supported and reported by UE for Multi-RTT positioningFFS: the values (>1)FFS: whether to have a value=1 to indicate UE Tx timing errors is well calibratedIf a UE support this capability with the values > 1, the UE supports reporting of UE Tx TEG ID with UE Rx-Tx time difference measurements for Multi-RTT positioning. |

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| Samsung [7] |  |
| Intel Corporation [8] |

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| 27-x3 | Mitigation of UE RxTx timing errors | The maximum number of UE-RxTxTEG per UE, which is supported and reported by UE for Multi-RTT positioningValues: up to [8] |

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| Qualcomm Incorporated [9] | Split in 2 separate feature groups:* Support of RxTxTEGs for RTT
* Maximum number of RxTxTEGs for RTT

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|  27. NR\_pos\_enh | 27-x3a | Support of UE-RxTxTEG for Multi-RTT | Support of UE-RxTxTEG reporting for Multi-RTT |  | No |  | Reporting of UE-RxTxTEG is not supported for Multi-RTT | 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-x3 | Maximum number of UE-RxTxTEG for Multi-RTT | The maximum number of UE-RxTxTEG per UE, which is supported and reported by UE for Multi-RTT positioningValues: {1,2,4,6,8,12,16,24,32}FFS: whether to have a value=1 to indicate UE RxTx timing errors is well calibrated | 27-x3a | No |  | Mitigation of UE RxTx timing delays is not supported | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

 |
| Nokia/Nokia Shanghai Bell [10] | Add FG 13-4, 13-8 as pre-requisite, as this requires SRS resources for positioning |
| Ericsson [11] |  |

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| 27. NR\_pos\_enh | 27-x4 | The maximum Number of UE Rx TEGs for measuring the same DL PRS resource | The maximum number of different UE-RxTEGs that a UE can support to measure the same DL PRS of a TRP.FFS; The values (>1). | 27-x1 | No |  | Mitigation of UE Rx timing delays by using different Rx TEGs are not supported | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. |  |

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| Company | Summary |
| ZTE [2] |  |
| Vivo [3] | * + FFS: whether to have a value=1 to indicate UE Rx timing errors is well calibrated
* We can support a value of 1, but we don’t think the value of 1 represents ‘well calibrated’. We think value=1 only represents that all the timing errors for UE Rx (e.g., based on RF chains and antenna panel) is grouped in the same group such that timing error difference in the same group is within a certain margin, rather than ‘well calibrated’. Even if some UEs cannot be ‘well calibrated’, they may support Rx TEG number of 1.
* In addition to UE Rx TEG, we share the similar view for ‘FFS’ in UE Tx TEG and RxTx TEG.
	+ Regarding the UE capability of the maximum number of UE-RxTEG per UE, FFS: whether to have separate values for DL TDOA and/or Multi-RTT positioning
* Our answer is no. The UE capability is up to RF design such as RF chains or panel, we don’t see the need to differentiate to different values of the same feature for different positioning method.
* In addition to UE Rx TEG, we share the similar view for ‘FFS’ in UE Tx TEG.
	+ Regarding the UE capability of the maximum number of UE Tx TEG per UE, FFS: Per UE or per band
* Our preference is per band. The UE capability is up to RF design which is band/frequency dependent. For example, we don’t think the TEG capabilities are the same in FR1 and FR2.
* Similarly, in addition to Tx TEG, the types of UE capability for UE Rx TEG and RxTx TEG should also be changed to ‘per band’.
	+ FFS: whether gNB needs to know if the feature (the maximum number of UE Tx TEG per UE) is supported.
* Our answer is no. From our point of view, the UE Tx TEG information is determined by the UE and there is no use for the serving gNB to obtain this information.
	+ Regarding UE feature in ‘27-x4’, the type of the related UE capability should also be changed to ‘per band’.
 |
| OPPO [4] |  |
| Huawei/HiSilicon [5] | FG 27-x4 is included out of the following agreement made in RAN1#106-e.

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

However, it is not clear from our side, why we need a separate number of TEGs for this feature. The capability by the term “subject to UE capability” in the agreement could refer to the capability in FG 27-x1. Some justification is needed, e.g. if the number can be smaller than what is reported in FG 27-x1.**Justification would be required why FG 27-x4 is needed separately from FG 27-x1 and what difference will be from the one reported in FG 27-x1.** |
| CATT [6] |  |
| Samsung [7] |  |
| Intel Corporation [8] |

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| 27-x4 | The maximum Number of UE Rx TEGs for measuring the same DL PRS resource | The maximum number of different UE-RxTEGs that a UE can support to measure the same DL PRS of a TRP.Values: up to [8] |

 |
| Qualcomm Incorporated [9] | Split in 2 separate feature groups:* Support of measuring the same PRS resource with multiple RxTEGs
* The maximum number of different UE-RxTEGs that a UE can support to measure the same DL PRS of a TRP

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| 27. NR\_pos\_enh | 27-x4 | Support measuring the same DL PRS of a TRP with different UE-RxTEGs | Support measuring the same DL PRS of a TRP with different UE-RxTEGs  |  | No |  | Measuring the same DL PRS of a TRP with different UE-RxTEGs is not supported | 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-x4b | The maximum Number of UE Rx TEGs for measuring the same DL PRS resource | The maximum number of different UE-RxTEGs that a UE can support to measure the same DL PRS of a TRP.Values:{2,3,4,6,8} | 27-x4 | No |  |  | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

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| Nokia/Nokia Shanghai Bell [10] |  |
| Ericsson [11] |  |

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| 27. NR\_pos\_enh | 27-z1 | Support of PRS RSRP of the first path | UE’s capability to support providing the PRS RSRP of the first path |  | No |  |  | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

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| Company | Summary |
| ZTE [2] | Support to keep with the following details,∙ Provided per UE∙ Need for location server to know if these two features are supported. |
| Vivo [3] |  |
| OPPO [4] | Rel-17 supports PRS RSRP measurement of the first path for DL-AoD as in the following agreement:

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| 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
 |

During the Rel-17 dicussion, the PRS RSRP measurement of the first path was discussed and agreed only for the DL-AoD positioning method, but not for DL-DTOA or multi-RTT. However, in the positioning measurement result reporting, the UE can also report PRS RSRP result in measurement reporting of DL-DTOA and Multi-RTT. In our view, because the initial motivation for RSRP of the first path was DL-AoD method and it was discussed and agreed only for DL-AoD. Therefore, we shall not request the UE to support it for other positioning method. In UE feature, we shall only define the UE capability of PRS RSRP measurement of the first path for the DL-AoD positioning method. Proposal: In UE feature, the UE capability of PRS RSRP measurement of the first path is only defined for DL-AoD positioning method |
| Huawei/HiSilicon [5] |  |
| CATT [6] |  |
| Samsung [7] |  |
| Intel Corporation [8] |

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| 27-z1 | Support of DL PRS RSRP of the first path | UE’s capability to support providing the PRS RSRP of the first pathNote: Applicable for DL-TDOA and Multi-RTT  |

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| Qualcomm Incorporated [9] | * Change the Title to “Support of PRS RSRP of the first path for DL-AoD”
* Per band reporting

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| 27. NR\_pos\_enh | 27-z1 | Support of PRS RSRP of the first path for DL-AoD | Support measuring and reporting the PRS RSRP of the earliest path for DL-AoD Positioning |  | No |  |  | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

 |
| Nokia/Nokia Shanghai Bell [10] | Add ”13-2 or 13-3” as pre-requisite, as it requires PRS reception for DL-AoD or DL-TDOA |
| Ericsson [11] |  |

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| 27. NR\_pos\_enh | 27-z2 | Support of DL PRS RSRP reporting for more than 8 measurements. | UE capability to support reporting K> 8 DL PRS RSRP measurements per TRP.FFS: the values of K•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. Note: Additional capability may be added:•FFS: Limit the maximum number of DL PRS RSRP associated with the same Rx beam index |  | No |  | UE report of more than 8 DL PRS-RSRP is not supported.  | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

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| Company | Summary |
| ZTE [2] | Support to keep with the following details,∙ Provided per UE∙ The candidate values of 27-z2 are {12, 16}∙ Need for location server to know if these two features are supported. |
| Vivo [3] |  |
| OPPO [4] |  |
| Huawei/HiSilicon [5] | For FG 27-z2, the support of more than 8 RSRP measurements per TRP is currently reported per UE in the feature list. However, we observe that for FR1, only 8 PRS resources per PRS resource set are allowed. “need of FR1/FR2 differentiation” with “n/a” would imply the feature is applicable for both FR1 and FR2. If it is the case, would UE capable of reporting more than 8 RSRPs per TRP in FR1 mean that UE may report the PRS-RSRP from more than one PRS resources for a TRP? In addition, when the feature of path RSRP reporting is introduced, how the number of RSRPs is counted needs further discussion.**Proposal: Clarify on FG 27-z2, that****● Whether the feature is intended to be applicable to FR1, and****● How the number is counted when path RSRP reporting is supported.** |
| CATT [6] |  |
| Samsung [7] |  |
| Intel Corporation [8] |  |
| Qualcomm Incorporated [9] | Split in 2 separate feature groups: * Support reporting K> 8 DL PRS RSRP measurements per TRP
* Additional number beyond 8 of DL PRS RSRP measurements per TRP supported by the UE

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| 27. NR\_pos\_enh | 27-z2b | Support of DL PRS RSRP reporting for more than 8 measurements. | Support reporting K> 8 DL PRS RSRP measurements per TRP.FFS: the values of K |  | No |  | UE report of more than 8 DL PRS-RSRP is not supported.  | 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-z2c | Additional number beyond 8 of DL PRS RSRP measurements per TRP supported by the UE | Additional number beyond 8 of DL PRS RSRP measurements per TRP supported by the UEFFS: the values of K | 27-z2b | No |  |  | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

 |
| Nokia/Nokia Shanghai Bell [10] | Add FG 13-5 as pre-requisite as this extends the Rel-16 parameter space |
| Ericsson [11] |  |

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| 27. NR\_pos\_enh | 27-u1 | Support of M-sample measurements. | The capability to support providing a measurement based on measuring M samples (instances) of a DL PRS resurce setM=[1, 4]. FFS: other values. If the UE does not provide the capability, the UE is assume to support M=4 only. |  | No |  |  | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

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| Company | Summary |
| ZTE [2] | Support to keep 27-u1 with the following details∙ This UE feature is provided per UE∙ The candidate values are {1, 2, 3, 4}∙ Need for location server to know if the feature is supported. |
| Vivo [3] |  |
| OPPO [4] | To reduce the NR positioning measurement and reporting latency, the issue of M (< 4)- sample PRS processing was discussed. From the perspective of RAN1, by assuming that RAN4 agrees to support the M-sample measurement, it was agreed to support M-sample measurement as UE capability:

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| Agreement:Subject to UE capability, support LMF to explicitly request UE to report the measurement with either M-sample or 4-sample, if RAN4 has supported M-sample measurement.* FFS signalling details.
 |

Supporting M-sample measurement is a UE capability. A dedicated UE capability shall be introduced for this feature. The UE can report if the UE supports the M-sample measurement and the UE can also report the values of M that the UE can support. M = 1 shall be a candidate value.Proposal: Introduce a new UE capability for supporting M-sample measurement* the UE reports the supported M value. M = 1 is one candidate value.

Furthermore, for a UE supporting M-sample measurement, the LMF can indicate the UE to report a result based on M-sample measurement. From the UE perspective, it is not feasible that the LMF indicate different M-sample measurements for different simultaneous NR positioning measurements. For instance, the following case shall not happen: the LMF indicates the UE to report DL TDOA measurement result based on M-sample measurement and requests the UE to report DL AoD measurement based on 4-sample measurement.**Proposal: In UE feature, we shall clarify that the UE expects the LMF to indicate same M-sample or 4-sample measurement for all the NR positioning measurement at the same time.** |
| Huawei/HiSilicon [5] |  |
| CATT [6] |  |
| Samsung [7] |  |
| Intel Corporation [8] |

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| 27-u1 | Support of M-sample measurements. | The capability to support providing a measurement based on measuring M samples (instances) of a DL PRS resource setM = [1, 4]. FFS: other values. If the UE does not provide the capability, the UE supports M = 4 only. |

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| Qualcomm Incorporated [9] | Per band reporting

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| 27. NR\_pos\_enh | 27-u1 | Support of single-sample measurements. | Support reporting a measurement based on measuring single sample (instance) of a DL PRS resource setM=1. If the UE does not provide the capability, the UE is assume to support M=4 only. |  | No |  |  | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

 |
| Nokia/Nokia Shanghai Bell [10] | Add FG 13-1 as pre-requisite |
| Ericsson [11] |  |

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| 27. NR\_pos\_enh | 27-u5 | PRS measurement outside MG | 1. Supported PRS processing types subject to the UE determining that DL PRS to be higher priority for PRS measurement outside MG.Candidate values: {Type 1A, Type 1B, Type 2}.Note:* Type 1A refers to DL PRS being prioritized over other DL signals/channels in all OFDM symbols within the PRS processing priority window. The DL signals/channels from all DL CCs (per UE) are affected.
* Type 2B refers to DL PRS being prioritized over other DL signals/channels in all OFDM symbols within the PRS processing priority window. The DL signals/channels from certain DL CCs are affected.
* Type 2C refers to DL PRS being prioritized over other DL signals/channels only in DL PRS symbols within the PRS processing priority window.

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 options.  |  | No |  |  | FFS: Per UE or per band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

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| Company | Summary |
| ZTE [2] | For 27-u5, we suggest the following update to clarify that DL PRS with higher priority for PRS measurement should be contained in a PRS processing priority window. Further, within a PRS processing window, UE measurement should be inside the active DL BWP with PRS having the same numerology as the active DL BWP.

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| 27-u5 | PRS measurement outside MG **and in a PRS processing priority window** | 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 priority window**.Candidate values: {Type 1A, Type 1B, Type 2}.Note:* Type 1A refers to DL PRS being prioritized over other DL signals/channels in all OFDM symbols within the PRS processing priority window. The DL signals/channels from all DL CCs (per UE) are affected.
* Type 2B refers to DL PRS being prioritized over other DL signals/channels in all OFDM symbols within the PRS processing priority window. The DL signals/channels from certain DL CCs are affected.
* Type 2C refers to DL PRS being prioritized over other DL signals/channels only in DL PRS symbols within the PRS processing priority window.

Note **1**: 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 options. **Note 2: Within a PRS processing window, UE measurement is inside the active DL BWP with PRS having the same numerology as the active DL BWP** |

* This UE feature is provided per UE
* Need for location server to know if the feature is supported.
* FFS: Whether this feature should also be provided to gNB
 |
| Vivo [3] |

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| --- |
| Working assumption:Subject to UE capability, support PRS measurement outside the MG, within a PRS processing window, and UE measurement inside the active DL BWP with PRS having the same numerology as the active DL BWP.* Inside the PRS processing window, subject to the UE determining that DL PRS to be higher priority, support the following UE capabilities:
	+ Capability 1: PRS prioritization over all other DL signals/channels in all symbols inside the window.
		- Cap. 1A: The DL signals/channels from all DL CCs (per UE) are affected.
		- Cap. 1B: Only the DL signals/channels from a certain band/CC are affected.
			* FFS: band or CC
	+ Capability 2: PRS prioritization over other DL signals/channels only in the PRS symbols inside the window
	+ A UE shall be able to declare a PRS processing capability outside MG.
		- FFS: Details of capability signalling (e.g., per UE or per band, etc.)
* For the purpose of this feature, PRS-related conditions are expected to be specified, with the following to be down-selected:
	+ Alt. 1: Applicable to serving cell PRS only
	+ Alt. 2: Applicable to all PRS under conditions to PRS of non-serving cell.
* 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 options.
 |

In our view, based on the above work assumption, some capability has been mentioned. First, a UE shall be able to declare a PRS processing capability outside MG. It includes multiple candidate types, for example {Type 1A, Type 1B, Type 2} in the preliminary RAN1 UE features list. And we share the same view that Type 1A is per UE capability and Type 1B is per cc/band capability. But we observe there is no granularity definition for Type 2. So, at least, we think Type 2 should illustrate which is per UE or per CC capability. Besides, consider the symmetry of Type 1 and Type 2, we propose Type 2 is divided into Type 2A and Type 2B based on the granularity (i.e., per UE or per cc).

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| 27. NR\_pos\_enh | 27-u5 | PRS measurement outside MG | 1. Supported PRS processing types subject to the UE determining that DL PRS to be higher priority for PRS measurement outside MG.Candidate values: {Type 1A, Type 1B, Type 2}.Note:* Type 1A refers to DL PRS being prioritized over other DL signals/channels in all OFDM symbols within the PRS processing priority window. The DL signals/channels from all DL CCs (per UE) are affected.
* Type 1~~2~~B refers to DL PRS being prioritized over other DL signals/channels in all OFDM symbols within the PRS processing priority window. The DL signals/channels from certain DL CCs are affected.
* Type 2~~C~~ refers to DL PRS being prioritized over other DL signals/channels only in DL PRS symbols within the PRS processing priority window.

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 options.  |  | No |  |  | FFS: Per UE or per band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

* **For UE capability related to PRS processing window (27-u5), to divide Type 2 into Type 2A and Type 2B based on the granularity (i.e., per UE or per cc)**
	+ **Type 2A refers to DL PRS being prioritized over other DL signals/channels only in DL PRS symbols within the PRS processing priority window. The DL signals/channels from all DL CCs (per UE) are affected.**
	+ **Type 2B refers to DL PRS being prioritized over other DL signals/channels only in DL PRS symbols within the PRS processing priority window. The DL signals/channels from certain DL CCs are affected.**
 |
| OPPO [4] |  |
| Huawei/HiSilicon [5] | For FG 27-u5 where the “-u5” can be revised to “-u2”, the entry “Need for the gNB to know if the feature is supported” is marked with “No”. In our view, gNB should be aware of the feature, since the processing window configuration is supposedly provided by the gNB, and there is also scheduling restriction within the processing window with higher priority of PRS being determined by the UE at different levels (all carriers within the entire window, certain carrier/band within the entire window, symbol level). Without knowing which type UE supports, it is not possible for the gNB to schedule UE properly and explore the UE processing potential for type 1B and type 2.**Proposal: For FG 27-u5, gNB needs to know the UE capability.** |
| CATT [6] |  |
| Samsung [7] | The above UE capability covers a current RAN1 working assumption in the RAN1 agreements. This should be reflected in the text describing the capability up until (and if) the working assumption is confirmed. We are okay to discuss this possible UE features for it now, “under the condition that this is supported.”In addition, there are typos in the notes, which should use Type 1A, 2B, 2 as in the candidate value in the main bullets.**Proposal: If PRS processing window is supported, correct “Type 2B” “Type 2C” to be “Type 1B” “Type 2”** |
| Intel Corporation [8] |

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| 27-u5 | DL PRS measurement outside MG | []  |

 |
| Qualcomm Incorporated [9] | Split in 3 separate feature groups:* Support MG-less PRS with Type 1A processing
	+ Per UE
* Support MG-less PRS with Type 1B processing
	+ Per Band
* Support MG-less PRS with Type 2 processing
	+ Per band

Introduce a separate “PRS processing capability” feature group for each one of the 3 Types of MG-less PRS processing

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| 27. NR\_pos\_enh | 27-u2a | PRS measurement outside MG for a Type 1A capability | Support of PRS processing outside MG for a Type 1A capability.Note:* Type 1A refers to DL PRS being prioritized over other DL signals/channels in all OFDM symbols within the PRS processing priority window. The DL signals/channels from all DL CCs (per UE) are affected.
 |  | No |  |  | per UE | 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-u2b | PRS Processing Capability for PRS outside MG for Type 1A capability | 1. DL PRS buffering capability: Type 1 or Type 2a) 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 UE.a) Type 1 – sub-slot/symbol level bufferingb) N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms3. Max number of DL PRS resources that UE can process in a slot under ita) FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHzb) FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz | 27-u2a | No |  |  | Per band | n/a |  |  | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-u3a | PRS measurement outside MG for a Type 1B capability | Support of PRS processing outside MG for a Type 1B capability.Note:Type 2B refers to DL PRS being prioritized over other DL signals/channels in all OFDM symbols within the PRS processing priority window. The DL signals/channels from certain DL CCs are affected. |  | No |  |  | 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-u3b | PRS Processing Capability for PRS outside MG for Type 1B capability | 1. DL PRS buffering capability: Type 1 or Type 2a) 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 UE.a) Type 1 – sub-slot/symbol level bufferingb) N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms3. Max number of DL PRS resources that UE can process in a slot under ita) FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz* b) FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz
 | 27-u3a | No |  |  | Per Band | n/a |  |  | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-u4 | PRS measurement outside MG for a Type 2 capability | Support of PRS processing outside MG for a Type 2 capability.Note:* Type 2 refers to DL PRS being prioritized over other DL signals/channels only in DL PRS symbols within the PRS processing priority window.
 |  | No |  |  | 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-u4a | PRS Processing Capability for PRS outside MG for Type 2 capability | 1. DL PRS buffering capability: Type 1 or Type 2a) 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 UE.a) Type 1 – sub-slot/symbol level bufferingb) N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms3. Max number of DL PRS resources that UE can process in a slot under ita) FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHzb) FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz | 27-u4b | No |  |  | Per Band | n/a |  |  | Need for location server to know if the feature is supported. | Optional with capability signaling |

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| Nokia/Nokia Shanghai Bell [10] | Add FG 13-1 as pre-requisitePer UE capability, the processing itself can be a per band indication |
| Ericsson [11] |  |

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| 27. NR\_pos\_enh | 27-u6 | PRS Processing Capability outside MG | 1. DL PRS buffering capability: Type 1 or Type 2a) 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 UE.a) Type 1 – sub-slot/symbol level bufferingb) N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms3. Max number of DL PRS resources that UE can process in a slot under ita) FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHzb) FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz | 27-u5 | No |  |  | Per band | n/a |  |  | FFS |  |

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| Company | Summary |
| ZTE [2] | As shown in the formula in TS 38.133 for measurement period of a location information report, the component Tlast is the measurement duration for the last PRS sample, including the sampling time and processing time,Tlast = Ti + Tavailable\_PRS,iThe Tlast is to consider the cases that PRS resources from different sets are not concentrated on the same MG instance or PRS resources appear in the end of the processing window. This component leads to additional latency for the sampling and processing of the last PRS sample. As we are trying to reduce the latency as much as possible, it’s not acceptable to take additional time after the end of the PRS processing window. We propose not to reuse the UE DL PRS processing capability inside measurement gap as shown below,

|  |  |  |
| --- | --- | --- |
| 27-u6 | PRS Processing Capability outside MG | 1. DL PRS buffering capability: Type 1 or Type 2a) 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 UE.a) Type 1 – sub-slot/symbol level bufferingb) N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms3. Max number of DL PRS resources that UE can process in a slot under ita) FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHzb) FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz |

In order to reduce the latency for DL PRS measurement in the PRS processing window, the location information report should be ready right after the end of the PRS processing window. That is, UE has to finish all the DL PRS receiving and computation in the PRS processing window to make full use of its resources. For Type 1 PRS processing capability showing in the Figure 1 below, a PRS processing window is divided into PRS buffering window and PRS computation window. UE is only expected to receive the DL PRS in the PRS buffering window. Then, based on the buffered DL PRS, UE can compute/process the DL PRS in PRS computation window to get ready for a location information report by the end of PRS processing window as shown in Fig. 1. According to this understanding, UE has to report its capability with at least one combination of {R, P} considering the following.* A PRS processing window is divided into PRS buffering window and PRS computation window. The PRS computation window starts right after the end of the PRS buffering window. UE is only expected to receive the DL PRS in the PRS buffering window.
* UE shall take P msec of time (the length of PRS computation window) to process up to N msec of symbols containing PRS resources expected to be received by the UE in the PRS buffering window

Fig. 1 Type 1 PRS processing capabilityThere could be another UE implementation (Type 2 PRS processing capability). UE may not need to buffer all the DL PRS before starting processing the DL PRS. That is, UE can do DL PRS receiving and processing simultaneously as shown in Fig. 2. Therefore, UE only needs to reserve enough time to process the latest DL PRS resource used for the location information report, which is quite similar to the CSI reference resource defined for CSI report. PRS computation time (T) is understood by the following,* A time span (the value of N shown below) is calculated from an end of the latest DL PRS resource in the PRS processing window that is used for a location information report to the end of the PRS processing window
* The value of N is not expected to be smaller than the PRS computation time (T) .

Fig. 2 Type 2 PRS processing capability**Proposal: For the UE capability design for DL PRS measurements in a PRS processing window, at least consider one of the following Types,*** **Type 1 PRS processing capability: UE reports its capability with at least one combination of {R, P},**
* **A PRS processing window is divided into PRS buffering window and PRS computation window. The PRS computation window starts right after the end of the PRS buffering window. UE is only expected to receive the DL PRS in the PRS buffering window.**
* **UE shall take P msec of time (the length of PRS computation window) to process up to R msec of symbols containing PRS resources expected to be received by the UE in the PRS buffering window**
* **Type 2 PRS processing capability: UE reports its capability of PRS computation time (T)**
* **A time span (N) is calculated from an end of the latest DL PRS resource in the PRS processing window that is used for a location information report to the end of the PRS processing window**
* **The value of N is not expected to be smaller than the PRS computation time (T).**
 |
| Vivo [3] |  |
| OPPO [4] |  |
| Huawei/HiSilicon [5] | For FG 27-u6, the entry is not correct for the second component. Following what is captured in R1-2108679 for Rel-16 UE feature maintenance, the bullet can be revised as below.

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| PRS Processing Capability outside MG | 1. DL PRS buffering capability: Type 1 or Type 2a) 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 UE.a) T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} msb) N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms3. Max number of DL PRS resources that UE can process in a slot under ita) FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHzb) FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz |

**Proposal: Replace subbullet a) of component 2 of FG 27-u6 with*** **a) T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms**
 |
| CATT [6] |  |
| Samsung [7] | In R16, the corresponding part for a) in point 2, “Type 1 – sub-slot/symbol level buffering” is following:a) T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} msSimilarly, there should be a set of values for T with smaller values than that in R16 for bullet a).**Proposal: If PRS processing window is supported, a set of values T should be configured for it as well.** |
| Intel Corporation [8] |

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| 27-u6 | DL PRS Processing Capability outside MG |  |

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| Qualcomm Incorporated [9] | See 27-u5 |
| Nokia/Nokia Shanghai Bell [10] |  |
| Ericsson [11] |  |

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| 27. NR\_pos\_enh | 27-v1 | LOS/NLOS Indicator | UE’s capability to support reporting LoS/NLoS indicator to LMF for RSTD and UE Rx-Tx time difference measurements to LMF for DL and DL+UL positioning.FFS: whether to have separate capability component for RSTD and UE Rx-Tx time difference measurements. |  | No |  |  | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

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| Company | Summary |
| ZTE [2] | We have the following suggestions on 27-v1.**Proposal: Support to keep 27-v1 with the following details.****∙ This UE feature is provided per UE.****∙ Have separate capability components for RSTD and UE Rx-Tx time difference measurements.****∙ Need for location server to know if the feature is supported.** |
| Vivo [3] | In the preliminary RAN1 UE features list, the capability of LOS/NLOS indicator has been captured as following.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 27. NR\_pos\_enh | 27-v1 | LOS/NLOS Indicator | UE’s capability to support reporting LoS/NLoS indicator to LMF for RSTD and UE Rx-Tx time difference measurements to LMF for DL and DL+UL positioning.FFS: whether to have separate capability component for RSTD and UE Rx-Tx time difference measurements. |  | No |  |  | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

In the last RAN1 #106 meeting, the following agreements for LoS/NLoS indicators has been achieved.

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| 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.
* FFS: Other kinds of positioning assistance data enhancements
* For LoS/NLoS detection method(s), there is no additional measurement IEs or assistance data outside of LoS/NloS indicator reporting (i.e., Option 6 from prior agreement).
* Note 1: No RAN4 requirements are expected for the LoS/NLoS indicators in RAN1’s understanding
* Note 2: LoS/NLoS indicators can be complementary to outlier rejection algorithms.
 |

It has already been agreed that LoS/NLoS indicators reporting is supported for DL and DL+UL positioning measurements taken at UE. That is, whether the LoS/NLoS indicators is for RSTD (which is the measurement in DL positioning) and for UE Rx-Tx time difference (which is the measurement in DL+UL positioning), it should be both supported. However, it has also been agreed that for LoS/NLoS detection method(s), there is no additional measurement IEs or assistance data outside of LoS/NloS indicator reporting (i.e., Option 6 from prior agreement). That is to say, how UE determines LoS/NloS indicator completely depends on UE implementation, if a UE can do LoS/NLoS detection for DL positioning, it can also do LoS/NLoS detection for DL+UL positioning. Therefore, we think there is no need to have separate capability component for RSTD and UE Rx-Tx time difference measurements.* **For UE’s capability to support reporting LoS/NLoS indicator:**
* **No need to have separate capability component for RSTD and UE Rx-Tx time difference measurements**

For LoS/NLoS indicators, it has been agreed that a single-indicator can be reported and the supported values are a discrete set in the interval [0, 1], which does not preclude using binary values only which is up to UE/TRP implementation.

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| Agreement:For LoS/NLoS indicators, a single-indicator can be reported and the supported values are a discrete set in the interval [0, 1]. * FFS: the number of discrete values to be supported
* Note: This does not preclude using binary values only which is up to UE/TRP implementation
* Note: Single-indicator means that one value in the interval [0, 1] is used for the LoS/NLoS indication
 |

It may lead to some ambiguousness. For example, UE1 is supportive of reporting LoS/NLoS indicator using binary values and UE2 is supportive of reporting LoS/NLoS indicator using discrete set, but there is no capability to indicate to gNB or LMF what type of LoS/NLoS indicator the UE is supportive. When UE1 and UE2 both report a LoS/NLoS indicator of 0, for UE1, it only means the link is detected as NLoS but the confidence is unknown; but for UE2, it means the link is detected as NLoS and the confidence is very high. However, the LMF cannot know the confidence information and may assume the two indicators are the same as they are both 0 and further use them in the same way, which is obvious unreasonable.Therefore, to deal with the above ambiguousness, we think the additional UE capability of which type of LoS/NLoS indicators the UE is supportive should be supported. When gNB or LMF receives different UE capability, it can identify the meaning of 0 and 1 according to the different capability. * **Support UE capability of which type of LoS/NLoS indicators the UE is supportive.**
 |
| OPPO [4] | In Rel-17, the UE can report a single NLOS/LOS indicator for DL and DL+UL positioning measurement. As agreed, this feature is subject to UE capability. For the candidate value of the single NLOS/LOS indicator reported by the UE shall be 0 and 1 which are used to indicate whether the positioning measurement is from a NLOS or LOS path. **Proposal: In UE capability, the candidate value of the NLOS/LOS indicator is 0 and 1** |
| Huawei/HiSilicon [5] |  |
| CATT [6] |  |
| Samsung [7] | According to RAN1 agreement, the LOS/NLOS indicator was agreed for all the positioning methods, Thus, we suggest using the wording in the agreement for the explanation.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.
* FFS: Other kinds of positioning assistance data enhancements
* For LoS/NLoS detection method(s), there is no additional measurement IEs or assistance data outside of LoS/NloS indicator reporting (i.e., Option 6 from prior agreement).
* Note 1: No RAN4 requirements are expected for the LoS/NLoS indicators in RAN1’s understanding
* Note 2: LoS/NLoS indicators can be complementary to outlier rejection algorithms.

In addition, as we discussed in the corresponding tdoc, we think it is necessary to separate the UE capability for supporting the soft or the hard indication.**Proposal: Adopt the following change:**“UE’s capability to ~~support reporting LoS/NLoS indicator to LMF for RSTD and UE Rx-Tx time difference measurements to LMF for DL and DL+UL positioning~~ ssupport 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.FFS: whether to have separate capability component for RSTD and UE Rx-Tx time difference measurements.FFS: whether to have separate capability component for hard and soft indication” |
| Intel Corporation [8] |

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| --- | --- | --- |
| 27-v1 | LOS/NLOS Indicator | UE’s capability to support reporting LoS/NLoS indicator to LMF for RSTD and UE Rx-Tx time difference measurements to LMF for DL and DL+UL positioning.Values: [0:0.1:1] |

 |
| Qualcomm Incorporated [9] | * Split the support into 2 separate feature groups for RSTD and Rx-Tx separately.
* Per Band reporting

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 27. NR\_pos\_enh | 27-v1a | Support of LOS/NLOS Indicator reporting for UE-assisted DL-TDOA | Support reporting LoS/NLoS indicator to LMF for RSTD measurements to LMF for UE-assisted DL-TDOA positioning. |  | No |  |  | 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-v1b | Support of LOS/NLOS Indicator reporting for multi-RTT | Support reporting LoS/NLoS indicator to LMF for UE Rx-Tx time difference measurements to LMF for multi-RTT positioning. |  | No |  |  | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

 |
| Nokia/Nokia Shanghai Bell [10] | Need to add corresponding Rel-16 FGs on measurement reports, as this is an add-on |
| Ericsson [11] |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 27. NR\_pos\_enh | 27-w1 | Support of on-demand PRS | UE’s capability to support UE-initiated on-demand PRS. |  | No |  |  | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

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| Company | Summary |
| ZTE [2] | Due to the feature of UE initiated on-demand PRS contains two aspects and they can work independently based on UE’s implementations. Hence we have the following proposal.**Proposal: For UE’s capability reporting to support UE-initiated on-demand PRS*** **Separate the UE features for UE-initiated on-demand PRS on pre-configured DL PRS and UE-initiated on-demand PRS to request the parameters of DL PRS**
* **These two UE features are provided per UE.**
* **Need for location server to know if these two feature is supported.**
* **Based on the above understanding, we suggest to revise 27-w1 to the following.**

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| --- | --- | --- |
| 27-w1-1 | Support of on-demand PRS on pre-configured DL PRS | UE’s capability to support UE-initiated on-demand PRS on pre-configured DL PRS. |
| 27-w1-2 | Support of on-demand PRS to request the parameters of DL PRS | UE’s capability to support UE-initiated on-demand PRS to request the parameters of DL PRS |

 |
| Vivo [3] |  |
| OPPO [4] |  |
| Huawei/HiSilicon [5] | The current FG 27-w1 includes the UE capability of supporting UE-initiated on-demand PRS, and it needs the location server to know whether the feature is supported. We think that this feature should be checked by RAN2, since UE may initiate on-demand PRS without capability exchange at all.We understand that LMF knowing UE supporting this feature could help LMF providing the predefined configuration to the UE, but standalone on-demand PRS initiation is also an open alternative.**Observation: The functionality of UE initiated on-demand PRS can be supported without LMF knowing the UE capability.** |
| CATT [6] |  |
| Samsung [7] |  |
| Intel Corporation [8] |

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| 27-w1 | Support of on-demand PRS | UE’s capability to support UE-initiated on-demand DL PRS request signalling |

 |
| Qualcomm Incorporated [9] | Main feature group: “Support of on-demand PRS”Introduce separate feature groups for each UE-initiated on-demand parameter:* Support UE-initiated demand of PRS bandwidth
* Support UE-initiated demand of PRS QCL Information
* Support UE-initiated demand of PRS periodicity

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| 27. NR\_pos\_enh | 27-w1 | Support of on-demand PRS | Support UE-initiated on-demand PRS |  | No |  |  | Per Band  | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

 |
| Nokia/Nokia Shanghai Bell [10] | Add FG 13-1 as pre-requisite |
| Ericsson [11] |  |

**Other comments**

|  |  |
| --- | --- |
| Company | Summary |
| ZTE [2] |  |
| Vivo [3] |

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| Agreement:For the beam/antenna information to be optionally provided to the LMF by the gnodeB, decide to support one of the following options:* Option 2.1: The gNB reports quantized version of the relative Power/Angle response per PRS resource per TRP
	+ The relative power is defined with respect to the peak power of that resource
	+ FFS: How many relative power levels can be included (e.g., single -3 dB power-levels, multiple power-levels, etc).
* Option 2.2: The gNB reports quantized version of the relative Power between PRS resources per angle per TRP.
	+ The relative power is defined with respect to the peak power in each angle
	+ For each angle, at least two PRS resources are reported.
* FFS: support of multiple levels of quantization
* FFS: how the report is constructed
* FFS: overhead reduction mechanisms, including reusing of associated-dl-PRS-ID as a way of signaling that 2 TRPs have the same beam information
* The gNB beam/antenna information can optionally be provided to the UE by the LMF
* Note: Up to RAN2 & RAN3 the signaling/procedures on how the LMF receives this information from the gNBs
* Send an LS to RAN2 & RAN3 with this agreement
 |

In RAN1#106-e meeting, the following agreement has been reached. It can be found the gNB beam/antenna information can be optionally be provided to UE, we would like to confirm by the majority whether the “optionally” is dependent on UE capability. That is only when the UE can use the beam information in positionings, the LMF can provide the gNB beam/antenna information to UE in unicast. If it is, a new capability or assistance data request information is needed to be introduced. For example*Nr-AoD-enhancementWithBeamInformation ENUMERATED {supported}***Proposal: Discuss whether to introduce a new UE capability for UE to request the gNB beam/antenna information from UE to the LMF**Potential new UE capabilities for PRS measurement need to be considered for inactive state positioning, which should include the following at least:* DL PRS processing capability in inactive state.

In inactive state, in order to save power, the UE may turn off some functions and modules, so the PRS processing capability may be limited. For example, the maximum supported PRS bandwidth per frequency layer may be smaller than connected state; the maximum number of supported frequency layers may be smaller than connected state; the *durationOfPRS-Processing* capability (*N*, *T*) for any $P(\geq T)$ time window may also be different with connected state, etc. In addition, considering PRS processing capability in connected state is defined assuming measurement gap is configured, while in inactive state, there may be no measurement gap is assumed, so that the PRS processing capability without measurement gap should be considered in inactive state. Therefore, the structure of DL PRS processing capability outside MG (feature 27-u6) in connected state can be reused for inactive state, but the specific values may be different. In addition, regarding whether to reuse the UE capability of ‘PRS measurement outside MG’ (feature 27-u5), our view is not to reuse it. The reason is that in inactive state, other DL signals are important signals (e.g. SSB, SIB1, COREST0, MSG2/MSGB, paging, etc.) for initial access which should be treated as high priority, it is weird to introduce a capability based on ‘higher priority for PRS measurement’ in inactive state.* DL PRS resource capability in inactive state. This capability is related to the number of TRPs, PRS resources, set, frequency layers to be supported. The following table is an example. We think we can reuse the structure in connected state, but the specific values may be different.

|  |
| --- |
| NR-DL-PRS-ResourcesCapability-r16 ::= SEQUENCE { maxNrOfDL-PRS-ResourceSetPerTrpPerFrequencyLayer-r16  INTEGER (1..2), maxNrOfTRP-AcrossFreqs-r16 ENUMERATED { n4, n6, n12, n16, n32, n64, n128, n256, ...}, maxNrOfPosLayer-r16 INTEGER (1..4), dl-PRS-ResourcesCapabilityBandList-r16 SEQUENCE (SIZE (1..nrMaxBands-r16)) OF DL-PRS-ResourcesCapabilityPerBand-r16, dl-PRS-ResourcesBandCombinationList-r16 DL-PRS-ResourcesBandCombinationList-r16, ...} |

* DL PRS QCL processing capability in inactive state. This capability is related to QCL information support, e.g. whether support of SSB from neighbor cell as QCL source of a DL PRS. If QCL procedure in connected state is reused in inactive state, this capability can also be reused.
* DL measurements capability in inactive state. This capability is related to PRS measurement and report, e.g. the maximum number of DL RSTD/RSRP per pair of TRPs. We think we can reuse the structure in connected state, but the specific values may be different.

However, based on previous RAN2’s conclusion, the UE state (connected or inactive) is transparent to LMF, and whether UE capability for DL positioning is useful to LMF is unclear. We think whether to support reporting the capability to LMF is more like a RAN2 issue and better for RAN2 to discuss first. Then, based on RAN2’s conclusion, the detailed components can be discussed by RAN1.**Proposal: It is up to RAN2 to determine whether to include DL positioning capability in inactive state in UE feature list.**Different from DL positioning, in UL or UL+DL positioning, the use of gNB to obtain the SRS transmission capability of UE in the inactive state is clear. Therefore, for UL and DL+UL positioning, firstly, the capability of SRS for positioning transmission in inactive state should be support and reported to the serving gNB. In addition, the general capability of SRS in connected state can be reused. However, regarding the capability of aperiodic SRS and semi-persistent SRS, as mentioned in our companion contribution [3], ‘it is up to RAN2 to determine whether to support semi-persistent/aperiodic SRS for positioning in inactive state based on certain scenarios or procedures’, so that we can wait for RAN2 to determine whether to add capability of aperiodic/semi-persistent SRS in inactive state.Besides, considering the UE state is transparent to LMF, similar to DL positioning, whether to report this capability to LMF is more like a RAN2 issue and better decided by RAN2.**Proposal:** * **For UE capability related to UL positioning in inactive state, support to reuse UE capability structure of SRS for positioning transmission in connected state except capability of aperiodic/semi-persistent SRS.**
* **It is up to RAN2 to decide whether to support capability of aperiodic/semi-persistent SRS in inactive state.**
* **The capability should be reported to the serving gNB at least, and whether to report this capability to LMF is up to RAN2.**
* **The specific values of UE capability of SRS for positioning in inactive state may be different from connected state.**

On-demand DL-PRS is not supported for UEs in Rel-15, Rel-16 and earlier versions. In Rel-17, for those UEs support on-demand DL-PRS, they need report their capabilities to network, so that network can distinguish which UE is supportive of on-demand DL-PRS. And these UEs can be configured and take measurements with on-demand DL-PRS. For on-demand DL-PRS, the UE capability can include the following aspects.* The new UE capability to suppport new LPP assistance data IE for on-demand DL-PRS configurations and potential new PRS parameters
* The new UE capability to support providing UE preferred parameters for UE-initiated on-demand PRS.

From our point of view, the 2nd UE capability has already been captured in the preliminary RAN1 UE feature list as following.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 27. NR\_pos\_enh | 27-w1 | Support of on-demand PRS | UE’s capability to support UE-initiated on-demand PRS. |  | No |  |  | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

Therefore, we propose.* **Adding following new UE capability related to on-demand PRS in UE feature list**
* **The new capability to suppport new LPP assistance data IE for on-demand DL-PRS configurations and potential new PRS parameters**
 |
| OPPO [4] | In Rel-17, in order to mitigate the Tx and Rx timing errors, a new concept of TEG (timing error group) is introduced. Based on TEGs, several enhanced solutions are introduced for DL TDOA, UL TDOA and multi-RTT positioning methods. In Rel-17, three types of TEGs are introduced, i.e., Rx TEG, Tx TEG and RxTx TEG. Thus, we should define the UE capability signaling to support UE to report it corresponding capabilities. **Proposal: UE can signal its support of Tx TEGs for NR timing-based positioning** * **FFS: whether or not to report the number of Tx TEGs**

**Proposal: UE can signal its support of Rx TEGs for NR timing-based positioning*** **FFS: whether or not to report the number of Rx TEGs**

**Proposal: UE can signal its support of RxTx TEGs for NR timing-based positioning*** **FFS: whether or not to report the number of RxTx TEGs**

Rel-17 positioning enhancement also introduced multiple measurement instances in a single measurement report for DL TDOA and multi-RTT positioning methods. Since the measurements for DL RSTD and UE Rx-Tx time different are different from the perspective of UE implementation, two independent UE capabilities should be introduced as below: **Proposal: UE can signal its support multiple measurement instances in a single measurement report for NR DL-TDOA positioning****Proposal: UE can signal its support multiple measurement instances in a single measurement report for NR multi-RTT positioning** |
| Huawei/HiSilicon [5] | In this section, we would like to share our understanding on the principles of the UE positioning capabilities, since it may be different from other features as it involves gNB and LMF at the same time.First, we think for each FG, whether gNB needs to know and LMF needs to know if UE supports the feature needs to be carefully checked. Note that we are developing features that would require coordination between LMF and gNB, e.g. MG activation, PRS processing window configuration for MG-less PRS measurement. One controversial aspect is on UE support of INACTIVE state PRS measurement, which is discussed in our companion paper [2] where we present such capability should be reported to gNB instead of LMF.Second, different reporting type (per UE/band/FS) to gNB and LMF could be discussed. This is because LMF may not be aware of the UE CA configuration, which makes all capabilities that are reported per FS in RRC signaling differently be reported in LPP. In addition, we should keep the boundary between RAN and core network and avoid core network from involving too many activities that should only be decided by RAN.**Proposal: Comply with the following principle for UE feature discussion:****● Whether gNB needs to know and LMF needs to know if UE supports the feature needs to be carefully checked.****● The boundary between RAN and core network should be kept.**For PRS measurement in INACTIVE state, we think that support of the feature should be reported to the gNB.**Proposal: Support of PRS measurement in RRC\_INACTIVE should be reported to gNB.**For positioning SRS capabilities in RRC\_CONNECTED state, they include* Spatial relation and open-loop power control reported per band
* SRS resource capability reported per FS
* Simultaneous transmission of two SRS for intra-band and inter-band CA reported per band and per BC

We understand that the UE may support different positioning SRS capabilities in RRC\_INACTIVE than those in RRC\_CONNECTED, and some capabilities reported per FS/BC in RRC\_CONNECTED may require discussion on the fallback behavior to RRC\_INACTIVE (without CA configuration), it is thus preferred to introduce a separate SRS capabilities for RRC\_INACITVE state.The simultaneous transmission feature is not applicable to UE in RRC\_INACTIVE since there is no CA configuration, while the remaining two can be adapted to per band.**Proposal: Support separate UE SRS capabilities in RRC\_INACTIVE state from the RRC\_CONNECTED, including*** **SRS resource capabilities**
* **Spatial relation capabilities**
* **Open loop power control capabilities**
* **The capabilities are reported per band to the gNB only.**

In addition, for SRS transmission in RRC\_INACTIVE, if a separate SRS bandwidth configuration from the BWP#0 is adopted, this can also be a new UE capability. Details can be subject to progress on that aspect.**Proposal: Support a capability reporting for a separate UE SRS bandwidth from the BWP#0 per band to the gNB, if the feature is supported.** |
| CATT [6] | Add a new feature group:

|  |  |  |  |
| --- | --- | --- | --- |
|  27. NR\_pos\_enh | 27-x5 | Support of reporting of an additional UL Timestamp associated to a UE Rx-Tx measurement or Timing Adjustment (TA) change information | The capability to support one of the following alternatives related to the UE Rx-Tx time difference (decision to be made in RAN1#106b):* Option 1: report an additional UL Timestamp associated to a UE Rx-Tx measurement, corresponding to the timing of the uplink subframe of a positioning SRS.
* Option 2: report Timing Adjustment (TA) change information.
* Option 3: report an additional UL Timestamp associated to a UE Rx-Tx measurement, corresponding to the timing of the uplink subframe of a positioning SRS.
* Other options are not precluded.
 |

Add a new feature group:

|  |  |  |  |
| --- | --- | --- | --- |
| 27. NR\_pos\_enh | 27-z3 | Support of enhancements of PRS resource(s) measurement and (for UE-A) reporting. | The capability to support the following enhancements for both UE-B and UE-A DL-AOD positioning method:* Enhancements of PRS resource(s) measurement and (for UE-A) reporting.
* FFS: The following options:
* Option 1: Enhancing the reporting to include the measurements of adjacent beams PRS resources that related with each other indicated by the assistance data.
* Option 2: UE can be requested to measure and report on specific PRS resources.
 |

 |
| Samsung [7] |  |
| Intel Corporation [8] | In Rel.17, the support for NR positioning for RRC\_INACTIVE UEs has been added. The corresponding FGs need to be added to UE feature list.In Rel.16, the FGs for DL PRS resources, SRS for positioning resources for various NR positioning techniques were defined. We assume that the same FGs are applicable for R17 UEs supporting NR positioning enhancements including RRC-INACTIVE UEs.In Rel.16 the UE feature groups have been defined for measurement reports for each positioning technique. The same principle can be applied for RRC\_INACTIVE UEs. * + **Add the following FGs for NR positioning measurement reports by UEs in RRC\_INACTIVE state:**
		- **Support of DL PRS Measurement Report for DL-AoD in RRC\_INACTIVE state**
		- **Support of DL PRS Measurement Report for DL-TDoA in RRC\_INACTIVE state**
		- **Support of UE Rx-Tx Measurement Report for Multi-RTT in RRC\_INACTIVE state**
		- **Support of SS-RSRP RRM measurements for NR E-CID Positioning in RRC\_INACTIVE state**
		- **Support of SS-RSRQ RRM measurements for NR E-CID Positioning in RRC\_INACTIVE state**
		- **Support of CSI-RSRP RRM measurements for NR E-CID Positioning in RRC\_INACTIVE state**
		- **Support of CSI-RSRQ RRM measurements for NR E-CID Positioning in RRC\_INACTIVE state**
		- **Support of simultaneous DL-AoD and DL-TDoA processing in RRC\_INACTIVE state**
		- **Support of simultaneous DL-AoD and Multi-RTT processing in RRC\_INACTIVE state**

The potential alternative way for Rel.17 UEs could be to extend relevant Rel.16 FGs for support by RRC\_INACTIVE UEs.RAN1 has agreed on SRS for positioning transmission by RRC\_INACTIVE UEs. The discussion on type of SRS for positioning to be supported (except periodic SRS for positioning) is still open. The support of OLPC and spatial relationship was agreed to be reused from Rel.16. The support of SRS for positioning by RRC\_INACTIVE UEs should be reflected in UE features.* + **Add the following FGs for SRS for positioning transmission by UEs in RRC\_INACTIVE state, i.e.:**
		- **Support of periodic SRS for positioning resources by UE in RRC\_INACTIVE UEs**
		- **[Support of semi-persistent SRS for positioning resources by UE in RRC\_INACTIVE UEs]**
		- **[Support of aperiodic SRS for positioning resources by UE in RRC\_INACTIVE UEs]**
		- **OLPC for SRS for positioning based on DL PRS from serving cell**
		- **OLPC for SRS for positioning based on DL PRS from neighboring cells**
		- **OLPC for SRS for positioning based on SSB from serving cells**
		- **Pathloss maintenance**
		- **Spatial relation for SRS for positioning based on SSB from serving cell**
		- **Spatial relation for SRS for positioning based on CSI-RS from serving cell**
		- **Spatial relation for SRS for positioning based on DL PRS from serving cell**
		- **Spatial relation for SRS for positioning based on SSB from non-serving cells**
		- **Spatial relation for SRS for positioning based on DL PRS from non-serving cells**
		- **Spatial relation maintenance**

The potential alternative way for Rel.17 UEs that could be discussed is to extend relevant Rel.16 FGs for support by RRC\_INACTIVE UEs.In addition, we have the following proposals and corrections to the table with a preliminary input:* + **Add FG for support of DL PRS measurement with low-latency MG mechanism**
		- **27-y [Support of DL PRS measurements with low-latency measurement gap allocation mechanism]**
	+ **Remove details for UE DL PRS processing outside measurement gaps as those were not agreed**
 |
| Qualcomm Incorporated [9] | Observations: * The feature group for the support of a feature should be separated from the feature group for values associated to the feature (as it was done in NR Rel-16 UE feature discussion).
* UE capabilities related to RRC Inactive Positioning are missing: SRS tranmsision, PRS processing, RSTD measurement, UE Rx-Tx measurement in RRC Inactive.
* Any additional information in the assistance data should be associated with a UE capability so that the LMF would know that the UE can accept the new assistance data.

**Proposal: Unless otherwise stated, the type for a UE feature should be at least per band (if not with finer granularity type), given the potential UE testing differentiation among licensed, unlicensed, and NTN band.**Add the following new feature groups:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 27. NR\_pos\_enh | 27-x5 | Timing margin values associated to the supported RxTEG, TxTEG, RxTxTEGs | 1. Timing margin value for RxTEG
	1. Values FFS
2. Timing margin value for TxTEG
	1. Values FFS
3. Timing margin value for RxTxTEG
	1. Values FFS
 |  | No |  | Timing margin for the RxTEG, TxTEG, or RxTxTEG is not known | 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-z1b | Maximum number of the first path PRS RSRP measurements on different PRS resources from the same TRP supported by the UE | Maximum number K of the first path PRS RSRP measurements on different PRS resources from the same TRP supported by the UEFFS: the values of K | 27-z1 | No |  |  | 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-v2a | Additional path reporting N>2 for multi-RTT | Support N>2 additional path reporting for Multi-RTT* FFS: Values
 |  | No |  |  | 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-v2b | Additional path reporting N>2 for UE-assisted DL-TDOA | Support N>2 additional path reporting for UE-assisted DL-TDOA* FFS: Values
 |  | No |  |  | 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-v2e | Support of path-RSRP reporting for additional Paths for Multi-RTT | Support of path-RSRP reporting for additional Paths for Multi-RTT | 27-v2b  | No |  |  | 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-v2e | Support of path-RSRP reporting for additional Paths for UE-assisted DL-TDOA | Support of path-RSRP reporting for additional Paths for UE-assisted DL-TDOA | 27-v2b  | No |  |  | 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-c1 | Support of Transmission of periodic SRS in RRC Inactive State | Support of Transmission of periodic SRS in RRC Inactive State |  | No |  |  | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported.Need for gNB to know if the feature is supported. | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-c2 | Support of Transmission of Semi-persistent SRS in RRC Inactive State | Support of Transmission of Semi-persistent SRS in RRC Inactive State |  | No |  |  | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported.Need for gNB to know if the feature is supported. | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-c3 | Support of PRS processing in RRC inactive state | Support of PRS processing in RRC inactive state |  | No |  |  | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported.Need for gNB to know if the feature is supported. | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-c4b | DL PRS processing capabilities in RRC inactive state | 1. DL PRS buffering capability: Type 1 or Type 2a) 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 UE.a) Type 1 – sub-slot/symbol level bufferingb) N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms3. Max number of DL PRS resources that UE can process in a slot under ita) FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHzb) FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz |  | No |  |  | 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-c4c | Support of DL RSTD measurement in RRC Inactive state | Support of DL RSTD measurement in RRC Inactive state |  | No |  |  | 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-c4c | Support of UE Rx-Tx measurement in RRC Inactive state | Support of UE Rx-Tx measurement in RRC Inactive state |  | No |  |  | 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-d4 | Support beam Information in the Assistance Data for UE-based DL-AoD | Support beam Information in the Assistance Data for UE-based DL-AoD |  | No |  |  | Per UE | 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-d5 | Support of LOS/NLOS indicators in the Assistance Data for UE-based DL-AoD | Support of LOS/NLOS indicators in the Assistance Data for UE-based DL-AoD |  | No |  |  | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

 |
| Nokia/Nokia Shanghai Bell [10] |  |
| Ericsson [11] | The following agreement was made at RAN1#106e:

|  |
| --- |
| 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
	+ FFS: Definition of additional paths for N>2
	+ FFS: Whether power is additionally reported and if reported whether power is relative to first detected path or total power
* Support one of the following options for maximum value of N at RAN1#106-b (any further criteria for selection to be discussed during RAN1#106):
	+ Option 1: N = 4
	+ Option 2: N = 8
	+ Option 3: N = 16
	+ Option 4: N = 32
 |

Since the maximum number of additional path is a UE capability, the following feature is proposed to be added:

|  |  |  |  |
| --- | --- | --- | --- |
| 27. NR\_pos\_enh | 27-v2 | Multipath reporting | UE’s capability to support up to N>2 additional path relative timing reporting for DL-TDOA and multi RTTFFS: value of NFFS: whether to have separate capability component for DL-TDOA and UE multi-RTT additional path relative timing reportingtime difference measurements.FFS: additional capability to also include power reporting.  |

The following agreement was made at RAN1#106e:

|  |
| --- |
| Agreement:From RAN1 perspective, it is feasible to support transmission of SRS for positioning by UEs in RRC \_INACTIVE state for UL and DL+UL positioning under certain validation criteria* FFS: Type(s) of SRS for positioning (i.e., periodic, semi-persistent, aperiodic)
* FFS: Details of validation criteria which may also be discussed in RAN2
* Send LS to RAN2 informing them of this agreement
 |

The transmission of the SRS in RRC\_INACTIVE should be a UE capability, since it requires a specific RRC release message to be supported. The following feature is proposed to be added:

|  |  |  |  |
| --- | --- | --- | --- |
| 27. NR\_pos\_enh | 27-w2 | Support of SRS in RRC\_INACTIVE state | UE’s capability to support transmission of the SRS for positioning in RRC\_INACTIVE stateFFS: which SRS type (periodic, aperiodic, semi persistent) |

 |

# Discussion/Approval Items during RAN1 #106bis-e

After review of contributions submitted to RAN1 #106bis-e in this agenda item, the following topics were identified by the moderator for discussion/approval during RAN1 #106bis-e. Companies submitted the following views on the moderator’s proposals.

# FG 27-x1: Mitigation of UE Rx timing delays

The preliminary RAN1 NR UE feature list in [1] was submitted to RAN1 #106-e for information only. It is important that during RAN1 #106bis-e, we agree a formal baseline for RAN1 #107-e. The focus of this meeting is thus to agree on the number of rows/FGs whereas the details of each row/FG can further be discussed at RAN1 #107-e. There seems to be consensus that this FG is needed, although one company prefers splitting the row into separate FGs. Regarding the FFS points, only those should be discussed during RAN1 #106bis-e whose resolution may result in the introduction of new feature groups/rows.

**Proposal:**

**Alt. 1: Agree the following feature group incl. any changes highlighted in red as baseline for further discussions during RAN1 #107-e**

* **FFS points whose resolution may result in the introduction of new feature groups can be discussed during RAN1 #106bis-e**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  27. NR\_pos\_enh | 27-x1 | ~~Mitigation of UE Rx timing delays~~ Maximum number of UE-RxTEGs for DL TDOA | The maximum number of UE-RxTEG per UE, which is supported and reported by UE for DL TDOA [and/or Multi-RTT positioning]FFS: the values (>1). FFS: whether to have a value=1 to indicate UE Rx timing errors is well calibratedFFF: whether to have separate values for DL TDOA and/or Multi-RTT positioning[If UE supports this capability with the values > 1, the UE supports including 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] | [13-3] | No |  | Mitigation of UE Rx timing delays is not supported | FFS: Per UE or per band | n/a | n/a | n/a | [The candidate values are {1, 2, 4, 8, 16}]Need for location server to know if the feature is supported. | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Huawei, HiSilicon | We prefer to have separate capabilities for DL-TDOA and Multi-RTT, as in the current LPP framework, but we can live with “and/or Multi-RTT” being put in the bracket.Do we need the third “FFF”?FFF: whether to have separate values for DL TDOA and/or Multi-RTT positioning |
| vivo | Firstly, we wonder why separate capabilities for DL-TDOA and Multi-RTT are needed since it is Rx related.Secondly, why the firth column is “The maximum number of UE-RxTEG per UE”, and there are also an FFS for per UE or per band? |
| Qualcomm | * Candidates value should include up to 32: 4 PFLs for up to 8 Rx -> 32 Rx TEGs. : {1,2,4,6,8,12,16,24,32}.
* The title of the feature needs to to have “UE-assisted”. This is not applicable to UE-based DL-TDOA.
* We support to have separate row for MRTT, and not include it in this one.
* A separate row is needed that is used by the UE to declare the support of the feature. As it was done in NR Rel-16, we think it is useful to have one FG to declare a binary support of a feature, and then separate rows to declare potential values associated to aspects related to the feature. The maximum number of TEGs is reported per UE; however whether the feature is supported should be reported per band (since this is an RF-related issue and a UE may not have performed the calibration/mitigation in all the bands). For example, a UE may support reporting RxTEGs for a specific band, but may no support this feature to another band. This will be useful for LMF to know so that it can decide what band to use to configured PRS. In other word, we suggest to add the following row, which is reported per band:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Support of UE-RxTEG for UE-assisted DL-TDOA | Support of UE-RxTEG reporting for UE-assisted DL TDOA |  | No |  | Reporting of UE-RxTEG is not supported for UE-assisted DL-TDOA | Per band |  |

 |
| ZTE | We are OK for this FG. To align the third and the forth column, the third column should be revised as ‘Maximum number of UE-RxTEGs for DL TDOA [and/or Multi-RTT positioning]’ |
| Nokia, NSB | We support the FL proposal |
| OPPO | * Share the same view as vivo. The RxTEGs are the same for DL TDOA and Mutli-RTT. No need to report this capacity for different positioning methods
* We support “per band” reporting since the RxTEGs are related to hardware implementation and different hardware may be used in different frequency bands
* The maximal number of UE-RxTEGs for one PFL should be reported
 |
| Ericsson | We do not think separate capabilities are needed for DL-TDOA and Multi-RTT, as the maximum number of UE Rx TEGs should be applicable to DL TDOA and/or Multi-RTT positioning. So, we support to keep [and/or Multi-RTT positioning] here, and remove ‘FFF: whether to have separate values for DL TDOA and/or Multi-RTT positioning’. We suggest to remove ‘for DL TDOA’ from the name of this FG.It is agreed in Rel-17 that UE Rx TEG reporting is only relevant if the UE has multiple Rx TEGs. Hence, when the UE reports the capability for ‘(27x1)’, there is no need to include the value of 1 for the maximum number of UE Rx TEGs. Hence, we suggest to remove ‘FFS: whether to have a value=1 to indicate UE Rx timing errors is well calibrated’. |

# FG 27-x2: Mitigation of UE Tx timing delays

The preliminary RAN1 NR UE feature list in [1] was submitted to RAN1 #106-e for information only. It is important that during RAN1 #106bis-e, we agree a formal baseline for RAN1 #107-e. The focus of this meeting is thus to agree on the number of rows/FGs whereas the details of each row/FG can further be discussed at RAN1 #107-e. There seems to be consensus that this FG is needed, although one company prefers splitting the row into separate FGs. Regarding the FFS points, only those should be discussed during RAN1 #106bis-e whose resolution may result in the introduction of new feature groups/rows.

**Proposal:**

**Alt. 1: Agree the following feature group incl. any changes highlighted in red as baseline for further discussions during RAN1 #107-e**

* **FFS points whose resolution may result in the introduction of new feature groups can be discussed during RAN1 #106bis-e**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  27. NR\_pos\_enh | 27-x2 | ~~Mitigation of UE Tx timing delays~~ Maximum number of UE-TxTEGs for UL TDOA | The maximum number of UE-TxTEG per UE, which is supported and reported by UE for UL TDOA and/or Multi-RTT positioningFFS: the values (>1).FFS: whether to have a value=1 to indicate UE Tx timing errors is well calibratedFFS: whether a UE supports different values for UL TDOA and/or Multi-RTT positioning[If UE supports this capability with the values > 1, the UE supports to provide the association information of UL SRS resources for positioning with Tx TEGs to the LMF.* FFS: Whether the association information is sent directly from UE to LMF, or is first provided to gNB and then forwarded to LMF]
 | [13-4, 13-8] | FFS |  | Mitigation of UE Tx timing delays is not supported | FFS: Per UE or per band or per FS | n/a | n/a | n/a | [The candidate values are {1, 2, 4, 8, 16, 32}]Need for location server to know if the feature is supported.~~FFS: whether gNB needs to know if the feature is supported.~~ | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Huawei, HiSilicon | We think that support of UL TEG feature could be reported to LMF, but the detailed number of UE Tx TEGs should be reported to gNB.So we suggest to have the following two FGs27-x2a Maximum number of UE-TxTEG for UL-TDOA Need for gNB to know FFS: Per UE or per band or per FS [The candidate values are {1, 2, 4, 8, 16, 32}] and no need for the location server to know27-x2b Support of UE-TxTEG reporting for UL-TDOA No need for gNB to know FFS: Per UE or per band [The candidate values are {supported}] and need for the location server to know |
| vivo | We would like to know why LMF needs to know the UL TEG feature and gNB not, and then why the maximum number only need to be gNB to know |
| Qualcomm | * Similar to previous feature, there needs to be a separate row that is “per band” that the UE can use to inform the “Support of UE-TxTEG reporting for UL-TDOA“. The maximum number of TxTEGs could then be per UE. Both capabilities need to ne known to the LMF.

Separate row for “Support of UE-TxTEG reporting for MRTT”, and a separate row for the “maximum number of TxTEGs for RTT” |
| ZTE | We are OK for this FG. To align the third and the forth column, the third column should be revised as ‘Maximum number of UE-TxTEGs for UL TDOA and/or Multi-RTT positioning’ |
| Nokia, NSB | We support the FL proposal |
| OPPO | Support in principle. We prefer per band reporting |
| Ericsson | In Rel-17, UE Tx TEG association with UL SRS is only relevant if the UE has multiple Tx TEGs. Hence, when the UE reports the capability for ‘(27x2)’, there is no need to include the value of 1 for the maximum number of UE Tx TEGs. Hence, we suggest to remove ‘FFS: whether to have a value=1 to indicate UE Tx timing errors is well calibrated’we do not see the need to report different values for DL TDOA and Multi-RTT positioning. Hence, we suggest to remove ‘FFS: whether a UE supports different values for UL TDOA and/or Multi-RTT positioning’ |

# FG 27-x3: Mitigation of UE RxTx timing delays

The preliminary RAN1 NR UE feature list in [1] was submitted to RAN1 #106-e for information only. It is important that during RAN1 #106bis-e, we agree a formal baseline for RAN1 #107-e. The focus of this meeting is thus to agree on the number of rows/FGs whereas the details of each row/FG can further be discussed at RAN1 #107-e. There seems to be consensus that this FG is needed, although two companies prefer splitting the row into separate FGs. Regarding the FFS points, only those should be discussed during RAN1 #106bis-e whose resolution may result in the introduction of new feature groups/rows.

**Proposal:**

**Alt. 1: Agree the following feature group incl. any changes highlighted in red as baseline for further discussions during RAN1 #107-e**

* **FFS points whose resolution may result in the introduction of new feature groups can be discussed during RAN1 #106bis-e**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  27. NR\_pos\_enh | 27-x3 | ~~Mitigation of UE RxTx timing delays~~ Maximum number of UE-RxTxTEGs for Multi-RTT | The maximum number of UE-RxTxTEG per UE, which is supported and reported by UE for Multi-RTT positioningFFS: the values (>1)FFS: whether to have a value=1 to indicate UE RxTx timing errors is well calibrated[If a UE support this capability with the values > 1, the UE supports reporting of UE RxTx TEG ID with UE Rx-Tx time difference measurements for Multi-RTT positioning] | [13-4, 13-8] | No |  | Mitigation of UE RxTx timing delays is not supported | FFS: Per UE or per band | n/a | n/a | n/a | [The candidate values are {1, 2, 4, 8, 16, 32, 64, [128]}]Need for location server to know if the feature is supported. | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| vivo | Whether additional capability “Support of UE- RxTxTEG reporting for Multi-RTT positioning” is needed since choosing option1 or option 2 is up to UE capabilityAgreement:Make the following modification of the previous agreement:For mitigating UE Tx/Rx timing errors for DL+UL positioning, a UE ~~may~~ should support, up to UE capability, either one or both of the following options:* Option 1: Reporting of UE RxTx TEG ID ~~is supported by the UE~~
	+ FFS: Further details on how the UE RxTx TEG IDs are related/associated to UE Tx TEG IDs and/or UE Rx TEG IDs and to the UE Rx-Tx measurements.
* Option 2: Reporting of ~~UE RxTx TEG ID is not supported by the UE; reporting of~~ UE Rx TEG ID and UE Tx TEG ID ~~is supported~~.
* In either option, a UE Tx TEG ID is associated with (downselection needed)
	+ Alt. 1: an UL SRS resource for positioning corresponding to the Tx timing of the UE Rx-Tx measurement
	+ Alt. 2: the Tx timing of the UE Rx-Tx measurement
	+ Alt. 3: one or more UL SRS resources for positioning
* Note: An UE Rx TEG ID is associated with one DL PRS resource (or more DL PRS resources) corresponding to the Rx time of the measurement
* FFS: How to resolve potential mismatch between UE and gNB Rx-Tx time difference measurements (e.g. UE provides the UE Rx-Tx measurements associated with a Tx TEG with SRS1, while gNB provides the gNB Rx-Tx measurements with a Rx TEG associated with SRS2).
* FFS: The potential impact and modification on the definition of Rx-Tx time difference measurements
 |
| CATT | According to the following agreement, UE should support one or both of the Option 1 and Option 2. However, current FG 27-x3 only mentioned maximum number of UE-RxTxTEGs for Multi-RTT(corresponding to Option1), and missed maximum number of UE-RxTEGs and UE-TxTEGs for Multi-RTT(corresponding to Option2), therefore, we prefer to add two FG 27-x3a and 27-x3b as follows.

|  |
| --- |
| Agreement:Make the following modification of the previous agreement:For mitigating UE Tx/Rx timing errors for DL+UL positioning, a UE ~~may~~ should support, up to UE capability, either one or both of the following options:* Option 1: Reporting of UE RxTx TEG ID ~~is supported by the UE~~
	+ FFS: Further details on how the UE RxTx TEG IDs are related/associated to UE Tx TEG IDs and/or UE Rx TEG IDs and to the UE Rx-Tx measurements.
* Option 2: Reporting of ~~UE RxTx TEG ID is not supported by the UE; reporting of~~ UE Rx TEG ID and UE Tx TEG ID ~~is supported~~.
* In either option, a UE Tx TEG ID is associated with (downselection needed)
	+ Alt. 1: an UL SRS resource for positioning corresponding to the Tx timing of the UE Rx-Tx measurement
	+ Alt. 2: the Tx timing of the UE Rx-Tx measurement
	+ Alt. 3: one or more UL SRS resources for positioning
* Note: An UE Rx TEG ID is associated with one DL PRS resource (or more DL PRS resources) corresponding to the Rx time of the measurement
* FFS: How to resolve potential mismatch between UE and gNB Rx-Tx time difference measurements (e.g. UE provides the UE Rx-Tx measurements associated with a Tx TEG with SRS1, while gNB provides the gNB Rx-Tx measurements with a Rx TEG associated with SRS2).
* FFS: The potential impact and modification on the definition of Rx-Tx time difference measurements
 |

|  |  |  |  |
| --- | --- | --- | --- |
| 27. NR\_pos\_enh | 27-x3a | The maximum number of UE-RxTEGs for Multi-RTT | The maximum number of UE-RxTEG per UE, which is supported and reported by UE for Multi-RTT positioningFFS: the values (>1)FFS: whether to have a value=1 to indicate UE Rx timing errors is well calibratedIf a UE support this capability with the values > 1, the UE supports reporting of UE Rx TEG ID with UE Rx-Tx time difference measurements for Multi-RTT positioning. |
|  27. NR\_pos\_enh | 27-x3b | The maximum number of UE-TxTEGs for Multi-RTT | The maximum number of UE-TxTEG per UE, which is supported and reported by UE for Multi-RTT positioningFFS: the values (>1)FFS: whether to have a value=1 to indicate UE Tx timing errors is well calibratedIf a UE support this capability with the values > 1, the UE supports reporting of UE Tx TEG ID with UE Rx-Tx time difference measurements for Multi-RTT positioning. |

 |
| Qualcomm | * Separate row for “Support of UE-RxTxTEG reporting for Multi-RTT“ which is per band-combination: One band will correspond to PRS, the other on the SRS, and this capability will inform the LMF whether the UE supports mittgation of RxTx timing delays between the PRS in one band and the SRS in the other band. When the band-combo has single band, it corresponds to the case of PRS and SRS on the same band.
* In the value list we would like to add the 6,12,24 values also.
* The maximum number of RxTxTEGs can be per UE assuming that the “support of the feature” has a separate per band-combo reporting
 |
| ZTE | OK for this FG |
| Nokia, NSB | We support the FL proposal |
| OPPO | Support in principle  |

# FG 27-x4: The maximum Number of UE Rx TEGs for measuring the same DL PRS resource

The preliminary RAN1 NR UE feature list in [1] was submitted to RAN1 #106-e for information only. It is important that during RAN1 #106bis-e, we agree a formal baseline for RAN1 #107-e. The focus of this meeting is thus to agree on the number of rows/FGs whereas the details of each row/FG can further be discussed at RAN1 #107-e. There seems to be consensus that this FG is needed, although one company prefers splitting the row into separate FGs and another wants to merge the row with FG 27-x1. Regarding the FFS points, only those should be discussed during RAN1 #106bis-e whose resolution may result in the introduction of new feature groups/rows.

**Proposal:**

**Alt. 1: Agree the following feature group incl. any changes highlighted in red as baseline for further discussions during RAN1 #107-e**

* **FFS points whose resolution may result in the introduction of new feature groups can be discussed during RAN1 #106bis-e**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 27. NR\_pos\_enh | 27-x4 | The maximum Number of UE Rx TEGs for measuring the same DL PRS resource | The maximum number of different UE-RxTEGs that a UE can support to measure the same DL PRS of a TRP.FFS; The values (>1) | 27-x1 | No |  | Mitigation of UE Rx timing delays by using different Rx TEGs are not supported | FFS: Per UE or per band | n/a | n/a | n/a | [The candidate values are {1, 2, 4, 8}]Need for location server to know if the feature is supported. | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Qualcomm | * Add a separate per-band capability for the support of the feature: “Support measuring the same DL PRS of a TRP with different UE-RxTEGs”
* Keep the “maximum number of RxTEGs” as per band.
 |
| ZTE | We prefer to have another FG or a new component under this FG for UE to use different UE Rx TEGs for measuring the same DL PRS resource simultaneously.

|  |  |
| --- | --- |
| The maximum Number of UE Rx TEGs for measuring the same DL PRS resource simultaneously | The maximum number of different UE-RxTEGs that a UE can support to measure the same DL PRS of a TRP at the same timeFFS: the values. |

 |
| Nokia, NSB | Firstly we should clarify if this FG means that the UE measures the same instance of the DL PRS with multiple RX TEGs or it is across instances. If the later then no FG is needed from our point of view. |
| OPPO | Support to make a clarification firstly as Nokia suggested.  |

# FG 27-z1: PRS RSRP of the first path

The preliminary RAN1 NR UE feature list in [1] was submitted to RAN1 #106-e for information only. It is important that during RAN1 #106bis-e, we agree a formal baseline for RAN1 #107-e. The focus of this meeting is thus to agree on the number of rows/FGs whereas the details of each row/FG can further be discussed at RAN1 #107-e. There seems to be consensus that this FG is needed. Regarding the FFS points, only those should be discussed during RAN1 #106bis-e whose resolution may result in the introduction of new feature groups/rows.

**Proposal:**

**Alt. 1: Agree the following feature group incl. any changes highlighted in red as baseline for further discussions during RAN1 #107-e**

* **FFS points whose resolution may result in the introduction of new feature groups can be discussed during RAN1 #106bis-e**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 27. NR\_pos\_enh | 27-z1 | ~~Support of~~ DL PRS RSRP of the first path [for DL-AoD] | ~~UE’s capability to~~ Support ~~providing the~~ of [measuring and reporting the] PRS RSRP of the first path [for DL-AoD positioning method][Note: Applicable for DL-TDOA and Multi-RTT] | [13-2 or 13-3] | No |  |  | FFS: Per UE or per band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| vivo | As PRS RSRP is only supported for DL-AoD now, we propose to delete the ‘Note’ here. |
| Qualcomm | * The “DL-AoD” needs to be kept in the title. This feature was supported for DL-AoD. For multipath positioning (TDOA, RTT), separate rows can be added if/when having path-RSRP for those features is agreed. Either way, it should be separate features since these are separate methods.

Add “UE-assisted” since this says “measuring and reporting”. In UE-based AoD there is no reporting of path-RSRP |
| ZTE | Additional path RSRP measurement has been agreed as well for both DL and DL+UL positioning method. Hence, this FG should be generalized for path RSRP including first path and additional path RSRP. If UE can support first path PRS RSRP, it should support additional path RSRP as well. There is no extra UE complexity needed. Here is our suggestion for the third column:“DL PRS RSRP of the first **or additional** path ~~[for DL-AoD]~~” |
| Qualcomm2 | To ZTE: Up to now we have only agreed on earliest path-RSRP for DL-AoD. I agree that it is likely to be agreed to have additinlal path path-RSRP for MRTT, TDOA, but i don’t think it will be agreed for Dl-AoD . So overall, its different features:* Earliest path-RSRP for AoD
* Earliest & additional Path-RSRP for TDOA
* Earliest & additional Path-RSRP for MRTT
 |
| Nokia, NSB | OK in principle, but maybe in the title of the FG first should be in brackets. RAN1 is still discussing if the measurement will apply to both first and additional paths. |
| Lenovo, Motorola Mobility | Supportive of FL’s proposal based on the previous agreement of first path RSRP measurement and reporting (only in case of UE-assisted). Additional paths are still open at this stage.  |
| OPPO | Support in principle. Regarding the TDoA and multi-RRT: it is ok to leave them in [] for further discussion. |
| Ericsson | We prefer to keep the note and remove AoD as we believe the measurement capability should be generic to DL methods.  |

# FG 27-z2: Support of DL PRS RSRP reporting for more than 8 measurements

The preliminary RAN1 NR UE feature list in [1] was submitted to RAN1 #106-e for information only. It is important that during RAN1 #106bis-e, we agree a formal baseline for RAN1 #107-e. The focus of this meeting is thus to agree on the number of rows/FGs whereas the details of each row/FG can further be discussed at RAN1 #107-e. There seems to be consensus that this FG is needed, although one company prefers splitting the row into separate FGs. Regarding the FFS points, only those should be discussed during RAN1 #106bis-e whose resolution may result in the introduction of new feature groups/rows.

**Proposal:**

**Alt. 1: Agree the following feature group incl. any changes highlighted in red as baseline for further discussions during RAN1 #107-e**

* **FFS points whose resolution may result in the introduction of new feature groups can be discussed during RAN1 #106bis-e**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 27. NR\_pos\_enh | 27-z2 | ~~Support of~~ DL PRS RSRP reporting for more than 8 measurements | ~~UE capability to~~ Support reporting K> 8 DL PRS RSRP measurements per TRP.FFS: the values of KNote: Multiple RSRPs corresponding to same or different Rx Beam index should be able to be reported for a given PRS resource for different timestamps. ~~Note: Additional capability may be added:~~FFS: Additional capability may be added to limit the maximum number of DL PRS RSRP associated with the same Rx beam indexFFS: How the number is counted when path RSRP reporting is supported | [13-5] | No |  | UE report of more than 8 DL PRS-RSRP is not supported.  | FFS: Per UE or per band | n/a | ~~n/a~~ FFS | n/a | [The candidate values are {12, 16}]Need for location server to know if the feature is supported. | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Qualcomm | * “Per band” reporting.
* This feature is for “UE-assisted DL-AoD positioning” and needs to be added in the title
* Suggest to add candidate values: 32, 64 also.
 |
| Nokia, NSB | We support the FL proposal |
| Lenovo, Motorola Mobility | Supportive of FL’s baseline FG. |
| OPPO | Ok in principle |
| Ericsson | The FFS on the limiting the maximum number of DL PRS RSRP associated with the same Rx beam index can be removed. It will be a separate feature row if it is introduced.  |

# FG 27-u1: Support of M-sample measurements

The preliminary RAN1 NR UE feature list in [1] was submitted to RAN1 #106-e for information only. It is important that during RAN1 #106bis-e, we agree a formal baseline for RAN1 #107-e. The focus of this meeting is thus to agree on the number of rows/FGs whereas the details of each row/FG can further be discussed at RAN1 #107-e. There seems to be consensus that this FG is needed. Regarding the FFS points, only those should be discussed during RAN1 #106bis-e whose resolution may result in the introduction of new feature groups/rows.

**Proposal:**

**Alt. 1: Agree the following feature group incl. any changes highlighted in red as baseline for further discussions during RAN1 #107-e**

* **FFS points whose resolution may result in the introduction of new feature groups can be discussed during RAN1 #106bis-e**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 27. NR\_pos\_enh | 27-u1 | ~~Support of~~ M-sample measurements | ~~The capability to~~ Support ~~providing~~ reporting a measurement based on measuring M samples (instances) of a DL PRS resource setM=[1, 4]. FFS: other values. If the UE does not provide the capability, the UE [is assume to] supports M=4 only. | [13-1] | No |  |  | FFS: Per UE or per band | n/a | n/a | n/a | [The candidate values are {1, 2, 3, 4}]Need for location server to know if the feature is supported. | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Huawei, HiSilicon | Do we need M=4, since this is already mandated in Rel-16. |
| Qualcomm | * “per-band” reporting
* Candidate values only M=1. If not reported, it corresponds to the M=4 (legacy Rel-16).
 |
| ZTE | M = 1 should be supported in this FG by default. M = 2 or 3 can be in bracket for FFS |
| Nokia, NSB | M=4 is the Rel-16 baseline and does not need a capability. Only 1 should be there.  |
| Lenovo, Motorola Mobility | Supportive of FL’s baseline FG provided that M=[1], 4, be updated since M=4 is already supported. |
| OPPO | We might not need M = 4 since it is supported in legacy spec. |
| Ericsson | Agree with Huawei, M=4 is a Rel-16 feature.  |

# FG 27-u5: PRS measurement outside MG

The preliminary RAN1 NR UE feature list in [1] was submitted to RAN1 #106-e for information only. It is important that during RAN1 #106bis-e, we agree a formal baseline for RAN1 #107-e. The focus of this meeting is thus to agree on the number of rows/FGs whereas the details of each row/FG can further be discussed at RAN1 #107-e. There seems to be consensus that this FG is needed, although one company prefers splitting the row into separate FGs. Regarding the FFS points, only those should be discussed during RAN1 #106bis-e whose resolution may result in the introduction of new feature groups/rows.

**Proposal:**

**Alt. 1: Agree the following feature group incl. any changes highlighted in red as baseline for further discussions during RAN1 #107-e**

* **FFS points whose resolution may result in the introduction of new feature groups can be discussed during RAN1 #106bis-e**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 27. NR\_pos\_enh | 27-u5 | DL PRS measurement outside MG [and in a PRS processing priority 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 priority window].Candidate values: {Type 1A, Type 1B, Type 2}.Note:* Type 1A refers to DL PRS being prioritized over other DL signals/channels in all OFDM symbols within the PRS processing priority window. The DL signals/channels from all DL CCs (per UE) are affected.
* Type ~~2~~1B refers to DL PRS being prioritized over other DL signals/channels in all OFDM symbols within the PRS processing priority window. The DL signals/channels from certain DL CCs are affected.
* Type 2~~C~~ refers to DL PRS being prioritized over other DL signals/channels only in DL PRS symbols within the PRS processing priority window.

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 options. [Note: 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] | ~~No~~ FFS |  |  | FFS: Per UE or per band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Qualcomm | * Different rows for each of the “Type-1A, Type-1B, Type-2” processing type. (Total: 3 rows)
* Per-band reporting
 |
| Nokia, NSB | We support the FL proposal |

# FG 27-u6: PRS measurement outside MG

The preliminary RAN1 NR UE feature list in [1] was submitted to RAN1 #106-e for information only. It is important that during RAN1 #106bis-e, we agree a formal baseline for RAN1 #107-e. The focus of this meeting is thus to agree on the number of rows/FGs whereas the details of each row/FG can further be discussed at RAN1 #107-e. There seems to be consensus that this FG is needed, although one company prefers splitting the row into separate FGs. Regarding the FFS points, only those should be discussed during RAN1 #106bis-e whose resolution may result in the introduction of new feature groups/rows.

**Proposal:**

**Alt. 1: Agree the following feature group incl. any changes highlighted in red as baseline for further discussions during RAN1 #107-e**

* **FFS points whose resolution may result in the introduction of new feature groups can be discussed during RAN1 #106bis-e**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 27. NR\_pos\_enh | 27-u6 | DL PRS Processing Capability outside MG - buffering capability | 1. DL PRS buffering capability: Type 1 or Type 2a) 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 UE.a) ~~Type 1 – sub-slot/symbol level buffering~~ T: [{8, 16, 20, 30, 40, 80, 160, 320, 640, 1280}] msb) N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms3. Max number of DL PRS resources that UE can process in a slot under ita) FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHzb) FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz | 27-u5 | No |  |  | Per band | n/a |  |  | FFS | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Qualcomm | For each processing type, add a separate row of the processing capabilities (total 3 rows) |
| ZTE | We prefer not to reuse the UE processing capability inside MG defined in Rel-16 directly. We propose for UE to finish all the measurements in a PRS processing window. At least one of the following UE capability can be considered,* *Type 1 PRS processing capability( as shown in the Figure below): UE has to report its capability with at least of the combination {R, P},*
* *A PRS processing window is divided into PRS buffering window and PRS computation window. The PRS computation window starts right after the end of the PRS buffering window. UE is only expected to receive the DL PRS in the PRS buffering window.*
* *UE shall take P msec of time (the length of PRS computation window) to process up to R msec of symbols containing PRS resources expected to be received by the UE in the PRS buffering window*
* *FFS: the value of R and P*

* *Type 2 PRS processing capability( as shown in the Figure below): UE has to report its capability of PRS computation time (T)*
* *A time span (N) is calculated from an end of the latest DL PRS resource in the PRS processing window that is used for a location information report to the end of the PRS processing window*
* *The value of N is not expected to be smaller than the PRS computation time (T).*
* *FFS: the value of T*

 |
| Nokia, NSB | Support. In addition we understand having smaller values of T is beneficial for this as it is mostly a low latency feature, hence 1,2,4 ms should be added for component 2a. |
| Lenovo, Motorola Mobility | Supportive of FL’s proposal, Smaller T values are currently being discussed and should be FFS  |
| OPPO | Support in principle. |
| Ericsson | Support |

# FG 27-v1: LOS/NLOS Indicator

The preliminary RAN1 NR UE feature list in [1] was submitted to RAN1 #106-e for information only. It is important that during RAN1 #106bis-e, we agree a formal baseline for RAN1 #107-e. The focus of this meeting is thus to agree on the number of rows/FGs whereas the details of each row/FG can further be discussed at RAN1 #107-e. There seems to be consensus that this FG is needed, although one company prefers splitting the row into separate FGs. Regarding the FFS points, only those should be discussed during RAN1 #106bis-e whose resolution may result in the introduction of new feature groups/rows.

**Proposal:**

**Alt. 1: Agree the following feature group incl. any changes highlighted in red as baseline for further discussions during RAN1 #107-e**

* **FFS points whose resolution may result in the introduction of new feature groups can be discussed during RAN1 #106bis-e**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 27. NR\_pos\_enh | 27-v1 | LOS/NLOS Indicator | ~~UE’s capability to~~ Support reporting LoS/NLoS indicator to LMF for RSTD and UE Rx-Tx time difference measurements to LMF for DL and DL+UL positioning.FFS: whether to have separate capability component for RSTD and UE Rx-Tx time difference measurements.FFS: whether to have separate capability component for hard and soft indication |  | No |  |  | FFS: Per UE or per band | n/a | n/a | n/a | [The candidate value are [0:0.1:1]]Need for location server to know if the feature is supported. | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Qualcomm | * Add the word UE-assisted: “for UE-assisted positioning”
* Per band reporting.
* The values is {0,1}. This is just a capability on the support of the feature; having a deciman value does not make sense
* Split in 2 rows: One for UE-assisted DL-TDOA and another for M-RTT
 |
| ZTE | OK to have this FG. However, we think this FG can also be used to support of LoS/NLoS indicator associated assistance data for UE based positioning.  |
| Qualcomm2 | To ZTE: These are 2 different things, they cannot have the same capability* With one capability the UE can declare that it supports accepting the new assistance data information
* With the capability shown here, the UE can declare whether it can report LOS/NLOS back to the LMF.
 |
| Nokia, NSB | Support. DL PRS-RSRP should be there in the list of measurements. It is clearly part of the RAN1 agreement. |
| Lenovo, Motorola Mobility | Supportive of FL’s proposal, Also agree that DL PRS RSRP should also be included as a supported measurement. |
| OPPO | Add the candidate value for step size of LOS/NLOS indicator: one candidate value is 1, i.e., the UE only supports reporting 0 or 1. |
| Ericsson | We have not agreed to have separate capability per methods. We think the los/nlos indication capability should be generic. |

# FG 27-w1: Support of on-demand PRS

The preliminary RAN1 NR UE feature list in [1] was submitted to RAN1 #106-e for information only. It is important that during RAN1 #106bis-e, we agree a formal baseline for RAN1 #107-e. The focus of this meeting is thus to agree on the number of rows/FGs whereas the details of each row/FG can further be discussed at RAN1 #107-e. There seems to be consensus that this FG is needed, although two companies prefer splitting the row into separate FGs. Regarding the FFS points, only those should be discussed during RAN1 #106bis-e whose resolution may result in the introduction of new feature groups/rows.

**Proposal:**

**Alt. 1: Agree the following feature group incl. any changes highlighted in red as baseline for further discussions during RAN1 #107-e**

* **FFS points whose resolution may result in the introduction of new feature groups can be discussed during RAN1 #106bis-e**

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| 27. NR\_pos\_enh | 27-w1 | ~~Support of~~ On-demand PRS | UE’s capability to support UE-initiated on-demand DL PRS [request signalling] | [13-1] | No |  |  | Per UE | n/a | n/a | n/a | FFS: Need for location server to know if the feature is supported. | Optional with capability signaling |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| Qualcomm | The location server needs to know if the feature is supported: If not, how would it know whether the UE may do a UE-iniatiated request or not?  |
| ZTE | Separate components can be used for UE-initiated on-demand PRS on pre-configured DL PRS and UE-initiated on-demand PRS to request the parameters of DL PRS |
| Nokia, NSB | Support |
| Lenovo, Motorola Mobility | Supportive of FL’s proposal |
| OPPO | Support |
| Ericsson | We wonder if this means there should be a separate capability for the UE receiving the updated configuration post-request? If not, we suggest to remove the bracket.  |

# Additional feature groups in the 27-x family of positioning features

The following new feature group in the 27-x family of positioning features was proposed by one or more companies during RAN1 #106bis-e. Please indicate in the table below whether you agree with the introduction of such a new row/FG.

***At this point, it is not important whether you agree with the exact details of the proposed new FG. Rather you should indicate whether you see the need for introducing such a feature group in principle.***

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| 27. NR\_pos\_enh | 27-? | Beam/antenna information request | Support to request gNB beam/antenna information from UE to the LMF |  |  |  |  |  |  |  |  |  |  |

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| Company | Comments/Questions/Suggestions |
| Huawei, HiSilicon | No need for per-parameter capability. A general UE initiated on-demand PRS capability is sufficient as in FG 27-w1.This is on-demand PRS. We think if UE does not support a parameter, it will not request the parameter in the first place. |
| Qualcomm | * Support of the feature. Generally, any new assistance data information needs a separate capability.
* Suggest to change the title to: “Support beam Information in the Assistance Data for UE-based DL-AoD”
* Per-UE reporting
 |
| ZTE | No need this FG as LMF will inform UE the beam/antenna information as assistance data. However, we think this FG can be used to report support of assistance data receiving of Beam/antenna information for UE based UE-based DL-AoD.  |
| Nokia, NSB | We do not support the proposed FG, need is not clear. |

The following new feature group in the 27-x family of positioning features was proposed by one or more companies during RAN1 #106bis-e. Please indicate in the table below whether you agree with the introduction of such a new row/FG.

***At this point, it is not important whether you agree with the exact details of the proposed new FG. Rather you should indicate whether you see the need for introducing such a feature group in principle.***

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| 27. NR\_pos\_enh | 27-? | On-demand PRS configuration | Suppport new LPP assistance data IE for on-demand DL-PRS configurations and potential new PRS parameters |  |  |  |  |  |  |  |  |  |  |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| Huawei, HiSilicon | This capability should be covered by FG 27-w1. We can use NCE in broadcast system data so that UE will not process the pos-SIB containing the on-demand PRS configuration. |
| vivo | Yes. We think it is needed once ‘on-demand PRS configuration’ is carried in new LPP assistance data. |
| Qualcomm | Needs more discussion on the difference of this capability from the 27-w1 shown above.  |
| ZTE | No need this FG. The feature can be covered by FG 27-w1 as Huawei mentioned |
| Nokia, NSB | It is too early to decide if this is needed. RAN2 is still debating how the feature will work in general and it is unclear if this new IE will be needed or not. |
| Lenovo, Motorola Mobility | Also agree that this may be under the scope of FG 27-w1. |

The following new feature group in the 27-x family of positioning features was proposed by one or more companies during RAN1 #106bis-e. Please indicate in the table below whether you agree with the introduction of such a new row/FG.

***At this point, it is not important whether you agree with the exact details of the proposed new FG. Rather you should indicate whether you see the need for introducing such a feature group in principle.***

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| 27. NR\_pos\_enh | 27-? | SRS bandwidth reporting | Support reporting a separate UE SRS bandwidth from the BWP#0 |  |  |  |  |  |  |  |  |  |  |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| Huawei, HiSilicon | Support. |
| vivo | If SRS transmission in a separate BWP in inactive state is agreed, this feature group is needed. |
| Qualcomm | I assume this is related to SRS transmission in RRC Inactive right? If yes, then, we need first to add the basic features that say:* Support of Transmission of periodic SRS in RRC Inactive State
* Support of Transmission of Semi-persistent SRS in RRC Inactive State

Then, we could be positive on adding the more specific feature shown above.  |
| ZTE | The motivation is unclear. If this is for RRC inactive, we think this is for support of SRS transmission in RRC inactive |
| Nokia, NSB | Do not support. It is unclear which RAN1 agreement this FG is referring to. |
| Ericsson | Support. The SRS in inactive state will not be transmitted in a BWP in our understanding.  |

The following new feature group in the 27-x family of positioning features was proposed by one or more companies during RAN1 #106bis-e. Please indicate in the table below whether you agree with the introduction of such a new row/FG.

***At this point, it is not important whether you agree with the exact details of the proposed new FG. Rather you should indicate whether you see the need for introducing such a feature group in principle.***

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| 27. NR\_pos\_enh | 27-? | Additional UL Timestamp associated to a UE Rx-Tx measurement or Timing Adjustment (TA) change information | The capability to support one of the following alternatives related to the UE Rx-Tx time difference (decision to be made in RAN1#106b):* Option 1: report an additional UL Timestamp associated to a UE Rx-Tx measurement, corresponding to the timing of the uplink subframe of a positioning SRS.
* Option 2: report Timing Adjustment (TA) change information.
* Option 3: report an additional UL Timestamp associated to a UE Rx-Tx measurement, corresponding to the timing of the uplink subframe of a positioning SRS.
* Other options are not precluded.
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| Company | Comments/Questions/Suggestions |
| Huawei, HiSilicon | OK. This should be included in Multi-RTT capability. |
| Qualcomm | Support this capability, if the feature is eventually agreed to be supported.  |
| ZTE | Fine with this FG. But we can wait for the progress in AI 8.5.1. It’ better to put some texts in bracketAdditional UL Timestamp associated to [a UE Rx-Tx measurement or Timing Adjustment (TA) change information] |
| Nokia, NSB | RAN1 is still discussing if any of these options will be added. It is too early to say if the FG is needed or not. |

The following new feature group in the 27-x family of positioning features was proposed by one or more companies during RAN1 #106bis-e. Please indicate in the table below whether you agree with the introduction of such a new row/FG.

***At this point, it is not important whether you agree with the exact details of the proposed new FG. Rather you should indicate whether you see the need for introducing such a feature group in principle.***

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| 27. NR\_pos\_enh | 27-? | Wnhancements of PRS resource(s) measurement and (for UE-A) reporting | * Enhancements of PRS resource(s) measurement and (for UE-A) reporting.
* FFS: The following options:
* Option 1: Enhancing the reporting to include the measurements of adjacent beams PRS resources that related with each other indicated by the assistance data.
* Option 2: UE can be requested to measure and report on specific PRS resources.
 |  |  |  |  |  |  |  |  |  |  |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| Huawei, HiSilicon | OK. Typo: Enhancements of PRS resource(s) measurement and (for UE-A) reporting |
| Qualcomm | Support this capability, if the feature is eventually agreed to be supported. |
| ZTE | Not support for now. Wait for the progress in AI 8.5.3. |
| Nokia, NSB | RAN1 is still discussing if any of these options will be added. It is too early to say if the FG is needed or not. |
| Lenovo, Motorola Mobility | This aspect is still an FFS point. |
| Ericsson | No need to mention the options, but we agree to have a feature for enhanced reporting for PRS. the two options are the same in the current discussion (the specific PRS resources to be measured are indicated in the assistance data as adjeacent beams / PRS subsets).  |

The following new feature group in the 27-x family of positioning features was proposed by one or more companies during RAN1 #106bis-e. Please indicate in the table below whether you agree with the introduction of such a new row/FG.

***At this point, it is not important whether you agree with the exact details of the proposed new FG. Rather you should indicate whether you see the need for introducing such a feature group in principle.***

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| 27. NR\_pos\_enh | 27-? | Support of DL PRS measurements with low-latency measurement gap allocation mechanism |  |  |  |  |  |  |  |  |  |  |  |

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| Company | Comments/Questions/Suggestions |
| Huawei, HiSilicon | OK. |
| Qualcomm | Support this capability, if the feature is eventually agreed to be supported.  |
| ZTE | Too vague for now, does it mean DCI or MAC CE? Wait for the progress in AI 8.5.4. |
| Nokia, NSB | Do not support, it is not clear what the FG is referring to. |

in the 27-x family of positioning features was proposed by one or more companies during RAN1 #106bis-e. Please indicate in the table below whether you agree with the introduction of such a new row/FG.

***At this point, it is not important whether you agree with the exact details of the proposed new FG. Rather you should indicate whether you see the need for introducing such a feature group in principle.***

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| 27. NR\_pos\_enh | 27-? | Multipath reporting | UE’s capability to support up to N>2 additional path relative timing reporting for DL-TDOA and multi RTTFFS: value of NFFS: whether to have separate capability component for DL-TDOA and UE multi-RTT additional path relative timing reportingtime difference measurements.FFS: additional capability to also include power reporting.  |  |  |  |  |  |  |  |  |  |  |

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| Company | Comments/Questions/Suggestions |
| Huawei, HiSilicon | OK. In general we think the capability should be separate for DL-TDOA and for Multi-RTT following the current LPP framework. |
| Qualcomm | * Split the features into 2 rows, one for DL-TDOA and one for M-RTT
* Separate capability row for path-RSRP reporting, one for DL-TDOA and another for M-RTT
 |
| ZTE | OK. But it’s better to define per positioning method basis. |
| Nokia, NSB | Support |
| Ericsson | Ok |

in the 27-x family of positioning features was proposed by one or more companies during RAN1 #106bis-e. Please indicate in the table below whether you agree with the introduction of such a new row/FG.

***At this point, it is not important whether you agree with the exact details of the proposed new FG. Rather you should indicate whether you see the need for introducing such a feature group in principle.***

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| 27. NR\_pos\_enh | 27-x5 | Timing margin values associated to the supported RxTEG, TxTEG, RxTxTEGs | 1. Timing margin value for RxTEG
	1. Values FFS
2. Timing margin value for TxTEG
	1. Values FFS
3. Timing margin value for RxTxTEG
	1. Values FFS
 |  | No |  | Timing margin for the RxTEG, TxTEG, or RxTxTEG is not known | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Huawei, HiSilicon | Do not support. Whether a margin can be fixed in the specification or reported by UE is still under RAN4 discussion. |
| Qualcomm | Support: This will enable to have different types of UEs that support this feature with different level of timing margins and calibrations.  |
| ZTE | Not support. If the timing margin is known at UE side, UE can just compensate it. Further, It is unclear how UE get these values and how LMF use these values.  |
| Qualcomm2 | The timing error is NOT known at the UE. The UE knows by construction an “range” of the timing error. The UE gets these when it is being built by characterizing the components. The LMF uses these values to decide how useful can this feature be and how much it should weight down or up the timing errors in the positioning engine.Different UEs have different ways of being built. If we fix these margins in RAN4, then the margins will likely be loose; worst case scenario will be RAN4 will not be able to relax the margins of rel-16 in any significant way due to UE vendors not being comfortable having aggressive numbers. Then, the whole feature may be less useful. Instead, if there are UE capabilities on what are the timing margins, depending on different product cycles, UE vendors, and business needs, different UEs, with different calibration capabilities may be supported.  |
| Nokia, NSB | OK in principle, but details still need to be clarified. |
| Ericsson | Do not support. This is still under RAN4 discussion. |

in the 27-x family of positioning features was proposed by one or more companies during RAN1 #106bis-e. Please indicate in the table below whether you agree with the introduction of such a new row/FG.

***At this point, it is not important whether you agree with the exact details of the proposed new FG. Rather you should indicate whether you see the need for introducing such a feature group in principle.***

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| 27. NR\_pos\_enh | 27-? | Beam Information Assistance Data for UE-based DL-AoD | Support beam Information in the Assistance Data for UE-based DL-AoD |  | No |  |  | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| Huawei, HiSilicon | OK. |
| Qualcomm | * This is the same feature as the one shown 2 pages above:

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| 27. NR\_pos\_enh | 27-? | Beam/antenna information request | Support to request gNB beam/antenna information from UE to the LMF |  |  |  |  |  |  |  |  |  |  |

 |
| ZTE | We think this FG should be combined with the above one for beam/antenna information request |
| Nokia, NSB | OK |
| Huawei, HiSilicon | We think that they are difference. In general, we do not think we need FGs each associated with the parameter for on-demand PRS. We support this, but does not support the capability for beam information in on-demand PRS. |
| Ericsson | Ok. |

in the 27-x family of positioning features was proposed by one or more companies during RAN1 #106bis-e. Please indicate in the table below whether you agree with the introduction of such a new row/FG.

***At this point, it is not important whether you agree with the exact details of the proposed new FG. Rather you should indicate whether you see the need for introducing such a feature group in principle.***

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 27. NR\_pos\_enh | 27-d5 | LOS/NLOS indicators Assistance Data for UE-based DL-AoD | Support of LOS/NLOS indicators in the Assistance Data for UE-based DL-AoD |  | No |  |  | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Huawei, HiSilicon | OK |
| Qualcomm | Support. General comment: any new assistance data needs to have a separate UE capability.  |
| ZTE | Not support. This FG should be combined with FG 27-v1 |
| Nokia, NSB | It is unclear if this is strictly needed, and then also why it would be only for DL-AoD and not for DL-TDOA.  |
| Lenovo, Motorola Mobility | Generally supportive but some additional details need to further clarified and should be extended to all UE-Based methods.. |
| Ericsson | Not sure what is required for the UE? The AD request can include a bit to request or not the LOS indicator but that is not a capability.  |

in the 27-x family of positioning features was proposed by one or more companies during RAN1 #106bis-e. Please indicate in the table below whether you agree with the introduction of such a new row/FG.

***At this point, it is not important whether you agree with the exact details of the proposed new FG. Rather you should indicate whether you see the need for introducing such a feature group in principle.***

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| 27. NR\_pos\_enh | 27-c4c | Support of DL RSTD measurement in RRC Inactive state | Support of DL RSTD measurement in RRC Inactive state |  | No |  |  | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| Qualcomm | * Support
 |
| ZTE | Don’t support. We have agreed RRC state is transparent to LMF |
| Qualcomm2 | The fact that RRC state is transparent, does NOT mean that there should NOT be capabilities. Please see below several reasons: * Reason 1: There can be an LMF message to serving gNB that says: “keep the UE in RRC connected”. This does NOT mean that the RRC state is known at the LMF, so we don’t violate the previous RAN2 agreement. Such assistance information from the LMF to the gNB could help the gNB to make the right decisions into keeping the UE in the most appropriate state. LMF can only help the gNB if it knows what UE capabilities the UE has in RRC inactive state.
* Reason 2: RAN4 requirements may be different for this case, so it will be useful to have these capabilities to be able to test this UE. A UE may have different calibration margins when it is in RRC inactive, since it is in a different power state. A UE may be have smaller PRS processing capabilities when it is in RRC inactive state.
* Reason 3: At least for testing & IODTs, it will be important to have a UE feature to understand what each UE supports.
 |
| Nokia, NSB | This FG was not provided by the moderator, and we do not support the discussion on it at this point.  |
| Huawei, HiSilicon | We think the capability of DL-PRS processing should at least be reported to gNB, so that gNB can release UE from RRC\_CONNECTION. In other words, gNB should not release UE from CONNECTION if UE does not support the feature.We do not see the need to only limit it to DL RSTD; DL PRS-RSRP should also be included, or general DL PRS measurement would be fine. |

In the 27-x family of positioning features was proposed by one or more companies during RAN1 #106bis-e. Please indicate in the table below whether you agree with the introduction of such a new row/FG.

***At this point, it is not important whether you agree with the exact details of the proposed new FG. Rather you should indicate whether you see the need for introducing such a feature group in principle.***

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| 27. NR\_pos\_enh | 27-c4c | Support of UE Rx-Tx measurement in RRC Inactive state | Support of UE Rx-Tx measurement in RRC Inactive state |  | No |  |  | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Qualcomm | * Support
 |
| ZTE | Don’t support. We have agreed RRC state is transparent to LMF |
| Qualcomm2 | The fact that RRC state is transparent, does NOT mean that there should NOT be capabilities. Please see below several reasons: * Reason 1: There can be an LMF message to serving gNB that says: “keep the UE in RRC connected”. This does NOT mean that the RRC state is known at the LMF, so we don’t violate the previous RAN2 agreement. Such assistance information from the LMF to the gNB could help the gNB to make the right decisions into keeping the UE in the most appropriate state. LMF can only help the gNB if it knows what UE capabilities the UE has in RRC inactive state.
* Reason 2: RAN4 requirements may be different for this case, so it will be useful to have these capabilities to be able to test this UE. A UE may have different calibration margins when it is in RRC inactive, since it is in a different power state. A UE may be have smaller PRS processing capabilities when it is in RRC inactive state.
* Reason 3: At least for testing & IODTs, it will be important to have a UE feature to understand what each UE supports.
 |
| Nokia, NSB | This FG was not provided by the moderator, and we do not support the discussion on it at this point.  |
| Huawei, HiSilicon | We think if it should at least be reported to gNB. |

In the 27-x family of positioning features was proposed by one or more companies during RAN1 #106bis-e. Please indicate in the table below whether you agree with the introduction of such a new row/FG.

***At this point, it is not important whether you agree with the exact details of the proposed new FG. Rather you should indicate whether you see the need for introducing such a feature group in principle.***

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 27. NR\_pos\_enh | 27-c3 | Support of PRS processing in RRC inactive state | Support of PRS processing in RRC inactive state |  | No |  |  | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported.Need for gNB to know if the feature is supported. | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Qualcomm | * Support
 |
| ZTE | Don’t support. We have agreed RRC state is transparent to LMF |
| Qualcomm2 | The fact that RRC state is transparent, does NOT mean that there should NOT be capabilities. Please see below several reasons: * Reason 1: There can be an LMF message to serving gNB that says: “keep the UE in RRC connected”. This does NOT mean that the RRC state is known at the LMF, so we don’t violate the previous RAN2 agreement. Such assistance information from the LMF to the gNB could help the gNB to make the right decisions into keeping the UE in the most appropriate state. LMF can only help the gNB if it knows what UE capabilities the UE has in RRC inactive state.
* Reason 2: RAN4 requirements may be different for this case, so it will be useful to have these capabilities to be able to test this UE. A UE may have different calibration margins when it is in RRC inactive, since it is in a different power state. A UE may be have smaller PRS processing capabilities when it is in RRC inactive state.

Reason 3: At least for testing & IODTs, it will be important to have a UE feature to understand what each UE supports.  |
| Nokia, NSB | This FG was not provided by the moderator, and we do not support the discussion on it at this point.  |
| Huawei, HiSilicon | This should be reported to gNB at least. |

In the 27-x family of positioning features was proposed by one or more companies during RAN1 #106bis-e. Please indicate in the table below whether you agree with the introduction of such a new row/FG.

***At this point, it is not important whether you agree with the exact details of the proposed new FG. Rather you should indicate whether you see the need for introducing such a feature group in principle.***

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| 27. NR\_pos\_enh | 27-c4b | DL PRS processing capabilities in RRC inactive state | 1. DL PRS buffering capability: Type 1 or Type 2a) 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 UE.a) Type 1 – sub-slot/symbol level bufferingb) N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms3. Max number of DL PRS resources that UE can process in a slot under ita) FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHzb) FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz |  | No |  |  | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Qualcomm | * Support
 |
| ZTE | Don’t support. We have agreed RRC state is transparent to LMF. The existing Rel-16 capability can be reused. |
| Qualcomm2 | The fact that RRC state is transparent, does NOT mean that there should NOT be capabilities. Please see below several reasons: * Reason 1: There can be an LMF message to serving gNB that says: “keep the UE in RRC connected”. This does NOT mean that the RRC state is known at the LMF, so we don’t violate the previous RAN2 agreement. Such assistance information from the LMF to the gNB could help the gNB to make the right decisions into keeping the UE in the most appropriate state. LMF can only help the gNB if it knows what UE capabilities the UE has in RRC inactive state.
* Reason 2: RAN4 requirements may be different for this case, so it will be useful to have these capabilities to be able to test this UE. A UE may have different calibration margins when it is in RRC inactive, since it is in a different power state. A UE may be have smaller PRS processing capabilities when it is in RRC inactive state.

Reason 3: At least for testing & IODTs, it will be important to have a UE feature to understand what each UE supports.  |
| Nokia, NSB | This FG was not provided by the moderator, and we do not support the discussion on it at this point.  |
| Huawei, HiSilicon | This needs further discussion. |

In the 27-x family of positioning features was proposed by one or more companies during RAN1 #106bis-e. Please indicate in the table below whether you agree with the introduction of such a new row/FG.

***At this point, it is not important whether you agree with the exact details of the proposed new FG. Rather you should indicate whether you see the need for introducing such a feature group in principle.***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 27. NR\_pos\_enh | 27-c4b | New granularity in the response time of Location request | Support of New granularity in the response time of Location request |  | No |  |  | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Qualcomm | * Support
* Justification: It was agreed to have a new granularity for the response time. The response time is a mandatory IE in the location request, and the LMF would not know whether the UE is an older UE, or a new UE that doesn’t support this feature, or a new that supports this feature.
 |
| ZTE | Support |
| Qualcomm2 | The fact that RRC state is transparent, does NOT mean that there should NOT be capabilities. Please see below several reasons: * Reason 1: There can be an LMF message to serving gNB that says: “keep the UE in RRC connected”. This does NOT mean that the RRC state is known at the LMF, so we don’t violate the previous RAN2 agreement. Such assistance information from the LMF to the gNB could help the gNB to make the right decisions into keeping the UE in the most appropriate state. LMF can only help the gNB if it knows what UE capabilities the UE has in RRC inactive state.
* Reason 2: RAN4 requirements may be different for this case, so it will be useful to have these capabilities to be able to test this UE. A UE may have different calibration margins when it is in RRC inactive, since it is in a different power state. A UE may be have smaller PRS processing capabilities when it is in RRC inactive state.
* Reason 3: At least for testing & IODTs, it will be important to have a UE feature to understand what each UE supports.
 |
| Nokia, NSB | This FG was not provided by the moderator, and we do not support the discussion on it at this point.  |
| Huawei, HiSilicon | This should be discussed by RAN2. In fact, they are discussing the applicable positioning methods for the new response time. |

In the 27-x family of positioning features was proposed by one or more companies during RAN1 #106bis-e. Please indicate in the table below whether you agree with the introduction of such a new row/FG.

***At this point, it is not important whether you agree with the exact details of the proposed new FG. Rather you should indicate whether you see the need for introducing such a feature group in principle.***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 27. NR\_pos\_enh | 27-c4b | Support of [expectedAoD/AoA] in the Assistance Data | Support of [expectedAoD/AoA] in the Assistance Data |  | No |  |  | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Qualcomm | * Support if the feature is eventually agreed to be supported.
* General comment: any new assistance data needs to have a separate UE capability.
 |
| ZTE | OK |
| Nokia, NSB | This FG was not provided by the moderator, and we do not support the discussion on it at this point.  |
| Huawei, HiSilicon | OK if the feature is supported. |

# Conclusion

After further discussion on the RAN1 email reflector the following was agreed as part of this email discussion:

# References

1. R1-2108679, Preliminary RAN1 UE features list for Rel-17 NR, Moderators (AT&T, NTT DOCOMO, INC.)
2. R1-2108885, UE features for NR positioning enhancements, ZTE
3. R1-2109016, Discussion on UE features for NR positioning enhancements, vivo
4. R1-2109057, UE features for NR positioning enhancements, OPPO
5. R1-2109147, Rel-17 UE features for NR positioning enhancements, Huawei/HiSilicon
6. R1-2109205, Discussion on Rel-17 UE features for NR Positioning enhancements, CATT
7. R1-2109528, UE features for NR positioning enhancements, Samsung
8. R1-2109646, UE features for NR positioning enhancement, Intel Corporation
9. R1-2110223, Discussion on Positioning Enhancements Features, Qualcomm Incorporated
10. R1-2110268, On UE features for NR positioning enhancements, Nokia/Nokia Shanghai Bell
11. R1-2110347, Views on NR positioning Enhancements UE features, Ericsson