3GPP TSG-RAN WG2 #109-e Draft R2-2001943

Electronic meeting, 24 February – 6 March 2020

Agenda Item: 6.8.1

Source: Ericsson

**Title: Summary of [AT109e][617][POS] Single positioning method**

Document for: Discussion, Decision

# 1 Introduction

This document is for the following email discussion:

* [AT109e][617][POS] Single positioning method (Ericsson)

 **Status:** Started

**Scope:** Discuss the possible restructuring of 37.355 to use a single NR positioning method.

 **Intended outcome:** Summary of discussion and potential agreements. Summary in R2-2001943.

 **Deadline:** Wednesday 2020-03-04 1300 CET

# 2 Discussion

The discussion on how to represent the RAN1 agreements in RAN2 signalling, based on a single or multiple positioning methods, was summarized prior to the RAN2 #109e-meeting [1]. It concerned comments to the single positioning method LPP CR [2]. Only two companies provided input, each with different preference. However, during the online session, there was a larger number of companies with a preference for a multiple positioning method representation. Therefore, it seems more efficient to use this email discussion to capture what can be adopted from the single positioning method discussion [1] and CR [2] into the running CR [3], already with multiple positioning methods.

We would like to ask companies to express their view about a few aspects from the single positioning methods CR:

1. Consider adding a separate positioning method for hybrid NR positioning to ensure matching timings of measurements, based on the single positioning method CR
2. Consider adding a reference TRP time of arrival quality metric to the DL-TDOA reference TRP signal measurement IE
3. Consider adding a reference TRP UE RxTx measurement and associated quality metric to the DL-TDOA reference TRP signal measurement IE
4. Consider adding a DL-PRS RSRP quality metric for positioning methods featuring RSRP measurements
5. Anything else to consider from the single positioning method CR

Comments are collected in the following sub-sections:

###### **2.1 Addition of a separate positioning method for hybrid NR positioning**

One concern raise related to the configuration of multiple positioning methods in parallel is that measurements might be performed at different times for different positioning methods, when it could have been possible to derive the per positioning method measurements from the same fundamental measurement (such as the DL-PRS cross-correlation function). A possible way to address this is to introduce a separate hybrid positioning method based on the single positioning method set of messages and IEs.

**Question** 1**: Companies are requested to express their view on introducing a separate method/set of messages/set of subsections for hybrid NR positioning.**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| **Huawei/HiSilicon** | No need to explicitly introduce separate method for hybrid positioning |
| **OPPO** | We agree to apply different positioning methods at different time, but do not agree to introduce a separate method for hybrid NR positioning. The UE can select different positioning method by its implementation. If it is unnecessary, a special condition can be configured in each configuration for multiple positioning methods, which can be used for positioning method selection. |
| **CATT** | No. The assistant data, capabilities and location info can be sent in the existed structure when there is hybrid NR positioning. The Q3 in offline discussion [615] also discussed the enhancement of existed data structure when hybrid NR positioning. |
| **Ericsson** | No need to introduce a separate method for hybrid, but it can be highly relevant to include a text about reusing the same measurements and when possible if multiple methods are configured simultaneously |
|  |  |

In case a hybrid positioning method is not preferred, there are some important attributes to consider from the single positioning method CR.

###### **2.2 Addition of an attribute for reference TRP TOA quality metric as part of the DL-TDOA method**

DL-TDOA is based on RSTD measurements of neighbour TRPs/resource sets/resources in relation to a reference TRP, producing a set of measurement equations. Each measurement equation corresponds to the reference signal time difference (here translated to meters by multiplication of the speed of light) between the signal from a neighbour TRP/resource sets/resources at location *p2* .. *pM* to the UE position *pm* and the signal from the reference TRP at location *p1* to the UE position. Assuming perfectly synchronized base stations and denoting the time of arrival estimation error of the reference signal *k* by *eTOA,k*, where E{ *e*2*TOA,k* } = **2*k*., Measurement equations in meters:

$$y\_{21}=\left|p\_{2}-p\_{m}\right|-\left|p\_{1}-p\_{m}\right|+e\_{TOA,2}-e\_{TOA,1}$$

…

$$y\_{M1}=\left|p\_{M}-p\_{m}\right|-\left|p\_{1}-p\_{m}\right|+e\_{TOA,M}-e\_{TOA,1}$$

These measurement equations, given the error vector ***e****=[(eTOA,k - eTOA,1)]k=2:M* and an assumption of independent TOA errors, have the following error covariance matrix,

$$R=E\left\{e^{T}e\right\}=\left[\begin{matrix}σ\_{2}^{2}+σ\_{1}^{2}&σ\_{1}^{2}&…&σ\_{1}^{2}\\σ\_{1}^{2}&σ\_{3}^{2}+σ\_{1}^{2}&…&σ\_{1}^{2}\\\vdots &\vdots &\ddots &\vdots \\σ\_{1}^{2}&σ\_{1}^{2}&…&σ\_{M}^{2}+σ\_{1}^{2}\end{matrix}\right]$$

The error covariance matrix R is crucial in estimating the UE position based on the RSTD measurements. The elements of the diagonal of the R matrix **2*k* + **2*1* is the variance of the *k*th RSTD measurement, and the off-diagonal elements of the R matrix are all the variance **2*1* of the reference TRP TOA measurement.

Hence, it is crucial to include the reference TRP TOA variance as part of the DL-TDOA signal measurement IE, and the generic timingQualityMetric IE can be used for that purpose.

**Question** 2**: Companies are requested to express their view on providing reference the TRP TOA quality metric as part of the DL-TDOA method measurement report.**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| **Huawei/HiSilicon** | We provided our view in our RAN1 t-doc, and it is recommended by the RAN1 feature lead [R1-2000932] that it should be discussed by RAN2.Our preference would be that RSTD quality means the TOA quality of each TRP, i.e., $σ\_{k}^{2}$, rather than the quality of differential value, so that the reference TRP can also have an generic quality.The same is applicable to multiple method CR. |
| **OPPO** | As we understood, reference TRP TOA quality metric is already as part of TDOA method measurement report. In LTE, the quality metric of RSTD is defined separately for each TRP, where OTDOA-MeasQuality is defined for each cell, e.g., one OTDOA-MeasQuality for RSTD reference cell, and there is an OTDOA-MeasQuality for each RSTD measurement. Thus, we think we can follow the same rule in LTE. |
| **CATT** | This should be discussed for multiple methods CR also. Can we postpone the discussion to next meeting? |
| **Ericsson** | Reference TRP TOA variance/meas quality is needed and the generic timingMeasQuality IE can be used for this purpose |
|  |  |

###### **2.3 Addition of a reference TRP UE RxTx measurement and associated quality metric to DL-TDOA**

Reporting DL-PRS TOA only in relative terms to the reference TRP TOA means that the only (*M-1*) time difference measurements are reported from the original *M* TOA measurements. This implies a loss of dimensionality. A natural way to regain the full dimensionality is to also include a reference TRP UE RxTx measurement in the DL-TDOA measurement report.

**Question** 3**: Companies are requested to express their view on providing reference the TRP UE RxTx and quality as part of the DL-TDOA method measurement report.**

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| --- | --- |
| **Company** | **Comments** |
| **Huawei/HiSilicon** | In case single method (not exist for multiple method), the reference TRP (for DL-TDOA) can also have UE Rx – Tx time difference for sure. However, should the signal measurement information of single positioning method be labelled with DL-TDOA? |
| **OPPO** | As we understood, Reference the TRP UE RxTx is the time difference between DL and UL signaling per cell, which is used for RTT calculation. The purpose is not same. We think there is no need to provide Reference the TRP UE RxTx. |
| **CATT** | Does it mean to support such as a kind of hybrid method?  |
| **Ericsson** | The suggestion is to only introduce an optional Ue RxTx measurement for the reference TRP. This will compensate for the loss of one dimension in the report (M timing measurements, M-1 relative times reported) |
|  |  |

###### **2.4 Addition of DL-PRS RSRP measurement quality metric to positioning methods based on RSRP**

The timing measurements are associated to a generic timing quality metric and is listed among the RAN1 parameters for Rel. 16 NR positioning. However, the RSRP measurements of the positioning methods DL-AoD and also, if RSRP is added to DL-TDOA and Multi-RTT, are not associated to any quality metric, which should be the case for consistency and completeness.

**Question** 4**: Companies are requested to express their view on defining and providing RSRP quality with RSRP in NR positioning methods DL-AoD, DL-TDOA and Multi-RTT.**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| **Huawei/HiSilicon** | We do not think RSRP quality was ever discussed in RAN1. |
| **OPPO** | It should be decided by RAN1 first. |
| **CATT** | Is it a common understanding in RAN1 that different methods may require different RSRP quality? |
| **Ericsson** | The same RSRP meas quality can be used by all methods that are reporting RSRP |
|  |  |

###### **2.5 Any other components from the single positioning method CR that can be considered**

**Question** 5**: Companies are requested to express their view on any other possible components from the single positioning method CR to bring to the baseline CR.**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| **Huawei/HiSilicon** | Our concerns on single positioning method include* It should allow different measurement to be associated with different PRS, e.g., Multi-RTT limited to FR1 intra frequency and DL-AoD limited to FR2 intra/inter frequency at the same time
* Request of PRS-RSRP measurement simultaneously with different modes, with
	+ One request mode without Rx beam restriction with at least one RSRP measurement associated with RSTD/UE Rx – Tx time difference
	+ One request mode with Rx beam restriction for at least two RSRP measurements per TRP
* Report of PRS-RSRP measurement under each Rx beam group for the second request mode
 |
| **CATT** | We have already spent a lot of time on refining current running CR of multiple methods which also supports hybrid methods, perhaps we can focus on the existing running CR in this meeting. |
|  |  |
|  |  |
|  |  |

# 3 Conclusion

From the provided input, we have the following summary of the comments:

* There is no need to also introduce a hybrid method in LPP, separate methods seems to be enough

Based on the discussion in section 2, the following is proposed:

**Proposal 1 Include reference TRP TOA measurement quality in the DL-TDOA signal measurement report**

**Proposal 2 Discuss the inclusion of a reference TRP UE RxTx measurement to DL-TDOA**

# 4 References

1. R2-2002115 Summary of [108#86][NR/Pos] Single positioning method approach in LPP, Ericsson
2. R2-2001278 Single positioning method approach in LPP, Draft CR 37.355, Ericsson
3. R2-2000474 LPP CR Capturing RAN1 parameters for positioning ([108#85][NR Pos]), Intel Corporation

# Appendix A Text Proposal for 37.355 based on [108#85]

The following snippets are only for placing the Additional Path reporting for NR into a context. With the separate positioning method representation, there are several parallel places where the additional path reporting will be included in this representation alternative.

#### 6.x.1.4 NR-DL-TDOA Location Information Elements

#### – *NR-DL-TDOA-SignalMeasurementInformation*

The IE *NR-DL-TDOA-SignalMeasurementInformation* is used by the target device to provide NR-DL TDOA measurements to the location server. The measurements are provided as a list of TRPs, where the first TRP in the list is used as reference TRP in case RSTD measurements are reported. The first TRP in the list may or may not be the reference TRP indicated in the *NR-DL-PRS-AssistanceData*. Furthermore, the target device selects a reference resource per TRP, and compiles the measurements per TRP based on the selected reference resource.

-- ASN1START

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

 dl-PRS-ReferenceInfo-r16 DL-PRS-IdInfo-r16,

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

 ...

}

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

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

 trp-ID-r16 TRP-ID-r16 OPTIONAL,

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

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

 nr-TimeStamp-r16 NR-TimeStamp-r16,

 nr-RSTD-r16 INTEGER (0..ffs), -- FFS on the value range

 nr-RSTD-MeasQuality-r16 NR-TimingMeasQuality-r16,

 nr-PRS-RSRP-Result-r16 INTEGER (FFS) OPTIONAL, -- FFS, value range to be decided in RAN4.

 nr-RSRP-MeasQuality-r16 NR-RSRP-MeasQuality-r16,

nr-UE-RxTxTimeDiff-r16 INTEGER (0..ffs) OPTIONAL, -- Cond RefTRP

 nr-UE-RxTx-MeasQuality-r16 NR-TimingMeasQuality-r16,

 nr-DL-TDOA-AdditionalMeasurements-r16 NR-DL-TDOA-AdditionalMeasurements-r16,

 ...

}

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

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

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

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

 nr-TimeStamp-r16 NR-TimeStamp-r16,

 nr-RSTD-ResultDiff-r16 INTEGER (0..ffs), -- FFS on the value range

 nr-RSTDdiff-MeasQuality-r16 NR-MeasQuality-r16,

 dl-PRS-RSPR-ResultDiff-r16 INTEGER (FFS) OPTIONAL, -- FFS on the value range

 nr-RSRP-MeasQuality-r16 NR-RSRP-MeasQuality-r16,

...

}

nrMaxTRPs INTEGER ::= 256 -- Max TRPs per UE

-- ASN1STOP

*[…]*

#### 6.x.1.5 NR-DL-TDOA Location Information Request

#### – *NR-DL-TDOA-RequestLocationInformation*

The IE *NR-DL-TDOA-RequestLocationInformation* is used by the location server to request NR DL-TDOA location measurements from a target device.

-- ASN1START

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

 nr-DL-PRS-RstdMeasurementInfoRequest-r16 ENUMERATED { true } OPTIONAL, -- Need ON

 nr-RequestedMeasurements-r16 BIT STRING { prsrsrpReq (0)

 } (SIZE(1..8)),

 nr-AssistanceAvailability-r16 BOOLEAN,

 nr-DL-PRS-ReportConfig-r16 NR-DL-PRS-ReportConfig-r16 OPTIONAL, -- Need ON

 ...

}

-- ASN1STOP

*[…]*

#### 6.x.1.6 NR-DL-TDOA Capability Information

#### – *NR-DL-TDOA-ProvideCapabilities*

The IE *NR-DL-TDOA-ProvideCapabilities* is used by the target device to indicate its capability to support NR DL-TDOA and to provide its NR DL-TDOA positioning capabilities to the location server.

-- ASN1START

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

 nr-DL-TDOA-Mode-r16 PositioningModes,

 nr-DL-TDOA-MeasCapability-r16 NR-DL-PRS-MeasCapability-r16 OPTIONAL,

 nr-DL-TDOA-MeasSupported-r16 BIT STRING { prsrsrpSup (0)} (SIZE(1..8)),

 periodicalReporting-r16 ENUMERATED { supported } OPTIONAL,

...

}

-- ASN1STOP

*[…]*

#### 6.y.1.4 NR-DL-AoD Location Information Elements

#### – *NR-DL-AoD-SignalMeasurementInformation*

The IE *NR-DL-AoD-SignalMeasurementInformation* is used by the target device to provide NR DL AoD measurements to the location server. The measurements are provided as a list of TRPs, where the first TRP in the list is used as reference TRP.

-- ASN1START

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

 nr-DL-AoD-MeasList-r16 NR-DL-AoD-MeasList-r16,

 ...

}

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

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

 trp-ID-r16 TRP-ID-r16 OPTIONAL, nr-DL-PRS-ResourceId-r16 NR-DL-PRS-ResourceId-r16 OPTIONAL,

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

 nr-TimeStamp-r16 NR-TimeStamp-r16,

 nr-PRS-RSRP-Result-r16 INTEGER (FFS) OPTIONAL, -- Need RAN4 inputs on value range

 nr-RSRP-MeasQuality-r16 NR-RSRP-MeasQuality-r16,

 nr-DL-PRS-RxBeamIndex-r16 INTEGER (1..8),

 nr-MeasQuality-r16 NR-MeasQuality-r16,

 nr-DL-Aod-AdditionalMeasurements-r16 NR-DL-AoD-AdditionalMeasurements-r16,

 ...

}

NR-DL-AoD-AdditionalMeasurements-r16 ::= SEQUENCE (SIZE (1..7)) OF NR-DL-AoD-AdditionalMeasurementElement-r16

NR-DL-AoD-MeasurementElement-r16 ::= SEQUENCE {

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

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

 nr-TimeStamp-r16 NR-TimeStamp-r16,

 nr-PRS-RSRP-ResultDiff-r16 INTEGER (FFS) OPTIONAL, -- Need RAN4 inputs on value range

 nr-RSRP-MeasQuality-r16 NR-RSRP-MeasQuality-r16,

 nr-DL-PRS-RxBeamIndex-r16 INTEGER (1..8),

 ...

}

nrMaxTRPs INTEGER ::= 256 -- Max TRPs

-- ASN1STOP

*[…]*

#### 6.y.1.5 NR-DL-AoD Location Information Request

#### – *NR-DL-AoD-RequestLocationInformation*

The IE *NR-DL-AoD-RequestLocationInformation* is used by the location server to request NR DL-AoD location measurements from a target device.

-- ASN1START

NR-Dl-AoD-RequestLocationInformation-r16 ::= SEQUENCE {

 nr-AssistanceAvailability-r16 BOOLEAN,

 nr-DL-PRS-ReportConfig-r16 NR-DL-PRS-ReportConfig-r16,

 ...

}

-- ASN1STOP

*[…]*

#### 6.y.1.6 NR-DL-AoD Capability Information

#### – *NR-DL-AoD-ProvideCapabilities*

The IE *NR-DL-AoD-ProvideCapabilities* is used by the target device to indicate its capability to support NR DL-AoD and to provide its NR DL-AoD positioning capabilities to the location server.

-- ASN1START

NR-DL-AoD-ProvideCapabilities-r16 ::= SEQUENCE {

 nr-DL-TDOA-Mode-r16 PositioningModes,

 periodicalReporting-r16 ENUMERATED { supported } OPTIONAL,

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

 ...

}

-- ASN1STOP

*[…]*

#### 6.z.1.4 NR-Multi-RTT Location Information Elements

#### – *NR-Multi-RTT-SignalMeasurementInformation*

The IE *NR-Multi-RTT-SignalMeasurementInformation* is used by the target device to provide NR Multi-RTT measurements to the location server. The measurements are provided as a list of TRPs, where the first TRP in the list is used as reference TRP.

-- ASN1START

NR-Multi-RTT-SignalMeasurementInformation-r16 ::= SEQUENCE {

 nr-Multi-RTT-MeasList-r16 NR-Multi-RTT-MeasList-r16,

 ...

}

NR-Multi-RTT-MeasList-r16 ::= SEQUENCE (SIZE(1.. nrMaxTRPs)) OF NR-Multi-RTT-MeasElement-r16

NR-Multi-RTT-MeasElement-r16 ::= SEQUENCE {

 trp-ID-r16 TRP-ID-r16 OPTIONAL,

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

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

nr-UE-RxTxTimeDiff-r16 INTEGER (0..ffs) OPTIONAL, -- FFS on the value rangenr-TimeStamp-r16 NR-TimeStamp-r16,

 nr-UE-RxTx-MeasQuality-r16 NR-TimingMeasQuality-r16,

 nr-PRS-RSRP-Result-r16 INTEGER (FFS) OPTIONAL, -- FFS, value range to be decided in RAN4.

 nr-RSRP-MeasQuality-r16 NR-RSRP-MeasQuality-r16,

 nr-Multi-RTT-AdditionalMeasurements-r16 NR-Multi-RTT-AdditionalMeasurements-r16,

 ...

}

NR-Multi-RTT-AdditionalMeasurements-r16 ::= SEQUENCE (SIZE (1..3)) OF NR-Multi-RTT-AdditionalMeasurementElement-r16

NR-Multi-RTT-AdditionalMeasurementElement-r16 ::= SEQUENCE {

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

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

 nr-PRS-RSRP-ResultDiff-r16 INTEGER (FFS) OPTIONAL, -- FFS, value range to be decided in RAN4.

 nr-RSRP-MeasQuality-r16 NR-RSRP-MeasQuality-r16,

nr-UE-RxTxTimeDiffAdditional-r16 INTEGER (0..ffs) OPTIONAL, -- FFS on the value rangenr-TimeStamp-r16 NR-TimeStamp-r16,

 ...

}

nrMaxTRPs INTEGER ::= 256 -- Max TRPs

-- ASN1STOP

*[…]*

#### 6.z.1.5 NR-Multi-RTT Location Information Request

#### – *NR-Multi-RTT-RequestLocationInformation*

The IE *NR-Multi-RTT-RequestLocationInformation* is used by the location server to request NR Multi-RTT location measurements from a target device.

-- ASN1START

NR-Multi-RTT-RequestLocationInformation-r16 ::= SEQUENCE {

 nr-RequestedMeasurements-r16 BIT STRING { prsrsrpReq (0)} (SIZE(1..8)),

 nr-AssistanceAvailability-r16 BOOLEAN,

 nr-DL-PRS-ReportConfig-r16 NR-DL-PRS-ReportConfig-r16,

 ...

}

-- ASN1STOP

*[…]*

#### 6.z.1.6 NR-Multi-RTT Capability Information

#### – *NR-Multi-RTT-ProvideCapabilities*

The IE *NR-Multi-RTT-ProvideCapabilities* is used by the target device to indicate its capability to support NR Multi-RTT and to provide its Multi-RTT positioning capabilities to the location server.

-- ASN1START

NR-Multi-RTT-ProvideCapabilities-r16 ::= SEQUENCE {

 nr-DL-PRS-MeasCapability-r16 NR-DL-PRS-MeasCapability-r16,

 nr-UL-SRS-MeasCapability-r16 NR-UL-SRS-MeasCapability-r16,

 nr-Multi-RTT-MeasSupported-r16 BIT STRING { prsrsrpSup (0)} (SIZE(1..8)),

 periodicalReporting-r16 ENUMERATED { supported } OPTIONAL,

 ...

}

-- ASN1STOP

*[…]*

**The TP below would naturally be placed in the common part in section 6.4.3**

*[…]*