3GPP TSG-RAN WG2 Meeting #110-e***R2-200xxxx***

Online, June 01 – 12, 2020

**Agenda item:** x.y.z

**Source:** Ericsson

**Title:** Email discussion report: [Post109bis-e][946][POS] Reference for additional path reporting (Ericsson)

**Document for:**  Discussion and Decision

# 1. Introduction

This document summarizes the following email discussion:

* [Post109bis-e][946][POS] Reference for additional path reporting (Ericsson)

      Scope: Discuss the options for a time reference convention for additional path reporting and conclude a way forward, starting from the text proposal in Annex 1 of R2-2003997.

      Intended outcome: Summary for next meeting

      Deadline:  Long

To allow a discussion of the summary as well, companies are asked to provide comments no later than Tuesday May 19th, 10.00 UTC.

Section 2 lists the different options regarding the reference for additional path reporting as discussed in [1] and [2], and introduces the key issues of the way forward that companies are requested to provide comments to. This is also related to the text proposal in the Annex, based on [1].

## References

[1] R2-2003997, "Email discussion report: [AT109bis-e][610][POS] LPP proposals (Ericsson).

[2] R2-2003061, "Remaining issues with LPP", Huawei, HiSilicon.

[3] R2-20xxxxx, "RAN2 Chairman’s Notes", RAN2#109bis-e.

# 2. Discussion

The current definition in LPP for the additional path reporting is ambiguous/unclear; in particular together with the additional measurement reporting capability. The figure below was originally provided in [2], but is here refined to also illustrate the third report representation brought forward during the email discussion reported in [1]. It illustrates the different path timing possibilities (for different resources of two exemplary TRPs):

The black line illustrates the "main RSTD", *nr-RSTD* measurement.

Reference Path

Reference TRP

Path#1

Neighbouring TRP

Path#2

Path#2

Path#1

Path#1

Path#2

Path#2

Path#1

Path#1

Path#2

Path#2

Resource#0

Resource#1

Resource#2

Resource#0

Resource#1

Resource#2

RSTD

The blue line illustrates the *nr-RSTD-ResultDiff* (provided in IE *NR-DL-TDOA-AdditionalMeasurementElement*).

The red line illustrates the *nr-AdditionalPathList* for the "main RSTD" (outside the *NR-DL-TDOA-AdditionalMeasurementElement*).

The green, orange and purple dashed curves are the candidates for the *nr-AdditionalPathList*for *NR-DL-TDOA-AdditionalMeasurementElement* according to [2] and the discussion in [1].

The proposal in [2] and the discussion in [1 ]is to clarify the definition of the time reference of the additional paths, with the following three options:

**Option 1.** The additional path time reference is the first path of the resource (the reference path) illustrated in “orange” in the figure

**Option 2.** The additional path time reference is the first path of the resource used to determine RSTD illustrated in “green” in the figure.

**Option 3.** The additional measurements (blue – reference TRP and dashed blue – neighbour TRP) and additional path (dashed purple) time reference is the detected reference TRP path used to determine the RSTD value

A few things shall be noted:

* The time reference ***is only about reporting – the actual path timing measurements are the same for all options and it is possible in post-processing to go between the representations***. For the reference cell with path timings tr00 and tr01 of resource 0 and tr10 and tr11 of resource 1, where resource 0 path timing tr00 is used to determine RSTD,
	+ option 1 reports additional measurements (tr10-tr00) and additional paths (tr01-tr00) and (tr11-tr10)
	+ option 2 reports additional measurements (tr10-tr00) and additional paths (tr01-tr00) and (tr11-tr00) – note that the same information as in option 1 is retrieved in post-processing by (tr11-tr00) - (tr10-tr00) = (tr11-tr10)
	+ option 3 is the same as option 2 for the reference cell
* The resources are typically configured with beam sweeping and therefore corresponds to different DL-PRS transmission times. Therefore, definitions need to acknowledge this difference in transmission time.
* If there eventually will be RAN4 requirements for these relative RSTD and addional path timing reports, this can have an impact on how these are defined, if requirements are believed to be defined in relation to what has been reported, not measured.

Companies are asked to provide comments and a preference of option in the table below

|  |  |
| --- | --- |
| Company | Comments |
| Huawei/HiSilicon | We prefer do go with Option 2. First Option 2 is aligned with the current RSTD report field description.

| *NR-DL-TDOA-SignalMeasurementInformation* field descriptions |
| --- |
| ***nr-PRS-RSRP-Result***This field specifies the reference signal received power (RSRP) measurement, as defined in TS 38.331 [35]. |
| ***nr-AdditionalPathList***This field specifies one or more additional detected path timing values for the TRP or resource, relative to the path timing used for determining the *nr-RSTD* value. If this field was requested but is not included, it means the UE did not detect any additional path timing values. |
| ***nr-RSTD***This field specifies the relative timing difference between this neighbour TRP and the PRS reference TRP, as defined in FFS. Mapping of the measured quantity is defined as in FSS. |
| ***nr-TimingMeasQuality***This field specifies the target device′s best estimate of the quality of the measurement. |

Second, considering differential timing reporting, we perfer to use a single reference TOA for all “intra-TRP differential TOA measurements”.In addition, the measurement for the same path observed under different beams can be easily identified via the same intra-TRP differential TOA measurement, which may be a little bit awkward for Option 1.We do not see the need for Option 3. |
| OPPO | Although mathematically all options conveies the same information, Option-3 is the cleanest way with a single reference for all measurement. |
| CATT | Support Option2 which is the legacy of LTE report. Option2 follows the current RSTD description. Option2 won’t bring confusion on additional path in LTE and NR. But Option3 will bring confusion when comparing NR and LTE. |
| Ericsson | Option 1 or 2 seems better aligned with LTE, which makes the definition more intuitive.In any case, the beam sweeping needs to be properly addressed so that the the definition can tolerate additional paths associated to different DL-PRS resources.  |
| MediaTek | Option 2. We generally agree with Huawei’s comment above and we see it as clearer to have a single reference timing for the TRP; it also aligns with the single reference timing described in 38.214. |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

**Summary:**

Two companies are in favour of Option 2, one company in favour of either Option 1 or 2, and one company in favour of Option 3.The text proposal in the Annex has been changed based on Option 2 instead.

**Draft proposal: RAN2 to define additional path reporting based on Option 2.**

The text proposal in the Annex of [1] is used as baseline for the discussion here, see Annex. Companies are asked to provide comments to the text proposal

|  |  |
| --- | --- |
| Company | Comments |
| Huawei/HiSilicon | We don’t see the need of additional ASN.1 change.If we go with Option 2, the following field description change is needed.

| *NR-AdditionalPath* field descriptions |
| --- |
| ***nr-relativeTimeDifference***This field specifies the additional detected path timing relative to the detected path timing used for *nr-RSTD* or *nr-UE-RxTxTimeDiff*. A positive value indicates that the particular path is later in time than the detected path of the reference; a negative value indicates that the particular path is earlier in time than the detected path of the reference. |

| *NR-Multi-RTT-SignalMeasurementInformation* field descriptions |
| --- |
| ***nr-PRS-RSRP-Result***This field specifies the reference signal received power (RSRP) measurement, as defined in TS 38.331 [35]. |
| ***nr-UE-RxTxTimeDiff***This field specifies the UE Rx–Tx time difference measurement, as defined in FFS.  |
| ***nr-AdditionalPathList***This field specifies one or more additional detected path timing values for the TRP or resource, relative to the path timing used for determining the *nr-UE-RxTxTimeDiff* value. If this field was requested but is not included, it means the UE did not detect any additional path timing values. |

 |
| OPPO | We do not see the need of this heavy ASN.1 change either.The wording suggested by rapporteur on option-3 *For Option 3, the text should be changed to “the detected path timing of the reference TRP used for determining the nr-RSTD value.”*Can be applied to the field description of *nr-AdditionalPathList / NR-AdditionalPath*directly |
| Ericsson | We need a field description that can be generically applied to RSTD, relative RSTD, UE RxTx Diff and the relative UE RxTx Diff. Therefore, we believe it is more clear to introduce the notion of a reference resource, and then explain in each of the field descriptions, what is meant. |
| Spirent | Suggested changes in ASN.1 |
| MediaTek | We understand the main impact of the proposed ASN.1 change is to introduce the additional paths and additional measurements for the reference TRP in DL-TDOA. The added fields seem redundant given that the first TRP in the list is the reference TRP as indicated in the IE description, so we tend to agree that clarifying the definition of nr-relativeTimeDifference and nr-AdditionalPathList is all that’s needed. |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

**Summary:**

We do not have consensus yet concerning the text proposal, but the ambition is to end up with an agreeable text proposal.

**Draft proposal: RAN2 to agree to the text proposal in the Annex**

# 3. Conclusion

# Annex 1, Text proposal to 3GPP TS 37.355 for Additional path representation

#### 6.5.10.4 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-AdditionalPathListRef-r16 NR-AdditionalPathList-r16 OPTIONAL,

 nr-DL-TDOA-AdditionalMeasurementsRef-r16 NR-DL-TDOA-AdditionalMeasurements-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-AdditionalPathListNeighbor-r16 NR-AdditionalPathList-r16 OPTIONAL,

 nr-TimingMeasQuality-r16 NR-TimingMeasQuality-r16,

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

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

 ...

}

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

NR-AdditionalPathList-r16 ::= SEQUENCE (SIZE(1..2)) OF NR-AdditionalPath-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 to be decided in RAN4

 dl-PRS-RSRP-ResultDiff-r16 INTEGER (FFS) OPTIONAL, -- FFS on the value range to be decided in RAN4

 nr-AddMeasAdditionalPathList-r16 NR-AdditionalPathList-r16 OPTIONAL,

...

}

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

-- ASN1STOP

| ***NR-DL-TDOA-SignalMeasurementInformation* field descriptions** |
| --- |
| ***nr-PRS-RSRP-Result***This field specifies the reference signal received power (RSRP) measurement, as defined in TS 38.331 [35]. |
| ***nr-AdditionalPathListRef***This field specifies one or more additional detected path timing values for the reference TRP, relative to the path timing used for determining the *nr-RSTD* value (the reference path timing). If this field was requested but is not included, it means the UE did not detect any additional path timing values. |
| ***nr-AdditionalPathListNeighbor***This field specifies one or more additional detected path timing values for the neighbour TRP, relative to the path timing used for determining the *nr-RSTD* value (the reference path timing). If this field was requested but is not included, it means the UE did not detect any additional path timing values. |
| ***nr-RSTD***This field specifies the relative timing difference between this neighbour TRP and the PRS reference TRP, as defined in FFS. Mapping of the measured quantity is defined as in FSS. |
| ***nr-TimingMeasQuality***This field specifies the target device′s best estimate of the quality of the measurement. |
| ***nr-RSTD-ResultDiff***This field specifies the relative time difference between the detected path timing of this DL-PRS resource relative to the path timing used for determining the *nr-RSTD* value (the reference path timing), compensated for the difference in DL-PRS transmission timing.  |
| ***nr-AddMeasAdditionalPathList***This field specifies one or more additional detected path timing values of this DL-PRS resource, relative to the detected path timing used for determining the nr-RSTD value (the reference path timing). If this field was requested but is not included, it means the UE did not detect any additional path timing values. |

*[…]*

6.5.12.4 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 range to be decided in RAN4

 nr-AdditionalPathList-r16 NR-AdditionalPathList-r16 OPTIONAL,

 nr-TimeStamp-r16 NR-TimeStamp-r16,

 nr-TimingMeasQuality-r16 NR-TimingMeasQuality-r16,

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

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

 ...

}

NR-AdditionalPathList-r16 ::= SEQUENCE (SIZE(1..2)) OF NR-AdditionalPath-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-UE-RxTxTimeDiffAdditional-r16 INTEGER (0..ffs) OPTIONAL, -- FFS on the value range

 nr-AddMeasAdditionalPathList-r16 NR-AdditionalPathList-r16 OPTIONAL,

 nr-TimeStamp-r16 NR-TimeStamp-r16,

 ...

}

nrMaxTRPs INTEGER ::= 256 -- Max TRPs

-- ASN1STOP

| ***NR-Multi-RTT-SignalMeasurementInformation* field descriptions** |
| --- |
| ***nr-PRS-RSRP-Result***This field specifies the reference signal received power (RSRP) measurement, as defined in TS 38.331 [35]. |
| ***nr-UE-RxTxTimeDiff***This field specifies the UE Rx–Tx time difference measurement, as defined in FFS.  |
| ***nr-AdditionalPathList***This field specifies one or more additional detected path timing values for the TRP, relative to the path timing used for determining the *nr-UE-RxTxTimeDiff* valuevalue (the reference path timing). If this field was requested but is not included, it means the UE did not detect any additional path timing values. |
| ***nr-AddMeasAdditionalPathList***This field specifies one or more additional detected path timing values of this DL-PRS resource, relative to the detected path timing used for determining the *nr-UE-RxTxTimeDiffAdditional* value (the reference path timing). If this field was requested but is not included, it means the UE did not detect any additional path timing values. |

*[…]*

*– NR-AdditionalPath*

The IE *NR-AdditionalPath* is used by the target device to provide information about additional paths associated with the path timing measurements for NR positioning in the form of a relative time difference and a quality value. The additional path *nr-relativeTimeDifference* is the detected path timing relative to the reference path timing used for determining the positioning measurements, and each additional path can be associated with a quality value *nr-path-Quality.*

-- ASN1START

NR-AdditionalPath-r16 ::= SEQUENCE {

 nr-relativeTimeDifference-r16 INTEGER (FFS),--FFS to be decided in RAN4

 nr-path-Quality-r16 NR-TOAMeasQuality-r16 OPTIONAL,

 ...

}

-- ASN1STOP

| ***NR-AdditionalPath* field descriptions** |
| --- |
| ***nr-relativeTimeDifference***This field specifies the additional detected path timing relative to the reference path timing. If the additional detected path timings and the reference path timing are associated with different DL-PRS transmission timings, the device subtracts the transmission timing difference from the value. A positive value indicates that the particular path is later in time than the reference path timing; a negative value indicates that the particular path is earlier in time than the reference path timing. |
| ***nr-path-Quality***This field specifies the target device′s best estimate of the quality of the detected timing of the additional path. |