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

Online, June 01 – 12, 2020

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

**Source:** Qualcomm Incorporated

**Title:** Email discussion report: [Post109bis-e][948][POS] LPP ASN.1 review (Qualcomm)

**Document for:**  Discussion and Decision

# 1. Introduction

This document summarizes the following email discussion:

* [Post109bis-e][948][POS] LPP ASN.1 review (Qualcomm)

      Scope: Gather and discuss issues and develop a running CR for ASN.1 corrections, with R2-2003981 as a baseline.

      Intended outcome: Open issues list and CR to next meeting

      Deadline:  Long

Section 2 lists the open issues identified during RAN2#109bis-e [1], [2], [3].

Section 3 collects companies’ views on the open issues. If there were possible options for a solution already identified at RAN2#109bis-e, the options are listed.

Section 4 is for collection of any additional ASN.1 issues. Note, R2-2003981 [4] should be used as baseline for any new issue.

## References

[1] R2-2003982, "Email discussion report: [AT109bis-e][601][POS] LPP ASN.1 issue gathering and easy agreements", Qualcomm.

[2] R2-2003983, "Email discussion report: [AT109bis-e][602][POS] LPP ASN.1 structural issues", Ericsson.

[3] R2-2003805, "Report of session on Rel-15 and -16 LTE and NR positioning", Session Chair (MediaTek).

[4] R2-2003981, "LPP Clean-Up", Qualcomm Incorporated.

[5] R1-20xxxxx, "RAN1 Chairman’s Notes", RAN1#100bis-e.

# 2. Open Issues List

During RAN2 #109bis-e, the following open issues have been identified [1], [2], [3]:

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|  | Reference | Issue #  (digits before -x refer to LPP section) | Brief Description / Headline |
| 1 | Sec. 2.2 in [1] | 6.4.1-2 | The definition of NR-PhysCellId-r16 may fit better in the new collapsed 6.4.3  The new IE RelativeLocation-r16 may fit better in the common section 6.4.1 |
| 2 | Sec. 3.1 in [1] | 6.4.3-1 | Consider renaming the IE NR-TimingMeasQuality. |
| 3 | Sec. 3.2.1 in [1] | 6.4.3-2 | Reference TRP Information. The current LPP is unclear about the definition/signalling of "assistance data reference TRP" and "RSTD reference TRP".  Includes also potential issues on nr-DL-PRS-ReferenceInfo and nr-DL-PRS-SFN0-Offset fields, as described. |
| 4 | Sec. 3.2.2a in [1] | 6.4.3-4 | Currently, the field *dl-PRS-ResourceRepetitionFactor* is mandatory within *DL-PRS-ResourceSet*. While should be possible that the field is not configured and there is no repetition. The same rationale also goes for *dl-PRS-ResourceTimeGap.*  Also, check if nr-DL-PRS-expectedRSTD-r16 and nr-DL-PRS-expectedRSTD-uncerainty-r16 need to be mandatory. |
| 5 | Sec. 3.2.2b in [1] | 6.4.3-5 | For the indication of SSB as PRS QCL, currently the field PCI is mandatory, however, it is unnecessary when the SSB and PRS locate on the same frequency layer. |
| 6 | Sec. 3.2.5 in [1] | 6.4.3-8 | Need codes are currently missing in IE TRP-ID and the existing condition is confusing/wrong.  Issue depends on the conclusion related to TRP-ID. |
| 7 | Sec. 3.2.6 in [1] | 6.4.3-9 | Conditional presence of trp-id field in IE NR-TimeStamp is confusing/wrong. |
| 8 | Sec. 3.3 in [1]  Sec. 2.4 in [2] | 6.4.3-10 | The IE NR-PositionCalculationAssistance may not be needed. It may be better moved to the IE definitions of NR-UEB-TRP-LocationData and NR-UEB-TRP-RTD-Info from 7.4.2 to 6.4.3. |
| 9 | Sec. 3.3 in [1] | 6.4.3-11 | The description of ‘nr-DL-PRS-SFN0-Offset’ should be modified for UE-assisted positioning. |
| 10 | Sec. 2.2 in [2] | 6.4.3-12 | Representation of beam directions: (a) 0.1 degrees resolution (current spec.) (b) 1 degree resolution with an optional refinement to 0.1 degrees. |
| 11 | Sec. 4.1.2 in [1] | 6.5.9-2 | The TRP-ID in the IE NR-ECID-SignalMeasurementInformation is currently optional present. However, an identifier of the TRP/cell for which the measurements are applicable is always needed.  The systemFrameNumber can usually only be included if the NR-MeasuredResultsElement is provided for a serving cell. |
| 12 | Sec. 5.1 in [1]  Sec. 2.5 in [2] | 6.5.10-1 | There is currently no complete description/explanation for the sharing of the assistance data provided in IE NR DL PRS AssistanceData and NR-SelectedDL-PRS-IndexList.  DL-PRS AssistanceData placement in the LPP message structure. |
| 13 | Sec. 5.3.1 in [1] | 6.5.10-3 | DL-PRS RSRP measurements can optionally be provided for DL-TDOA positioning. However, there is currently confusion, since RSTD is a measurement for a pair of TRPs, but the RSRP is a single TRP measurement only. |
| 14 | Sec. 5.3.2 in [1] | 6.5.10-4 | The IE NR-TimingMeasQuality is used to provide the quality of the RSTD measurement. However, the quality of the reference TRP TOA used for RSTD cannot be provided. Further, the quality of the additional RSTD measurements per TRP pair (up to 3) can also not be provided. |
| 15 | Sec. 5.3.5 in [1] | 6.5.10-7 | The IE NR-DL-TDOA-MeasElement provides the RSTD measurements for up to 256 TRPs. However, since the RSTD measurement is between a pair of TRPs, only up to 255 report elements for IE NR-DL-TDOA-MeasElement are possible. |
| 16 | Sec. 5.4.1 in [1] | 6.5.10-8 | The IE NR-DL-TDOA-RequestLocationInformation reserves a BIT STRING Size 1..8 for the requested RSRP measurement. However, a single bit would be sufficient. |
| 17 | Sec. 5.5.1 in [1] | 6.5.10-10 | The capability for periodic reporting cannot be indicated separately for the positioning mode. |
| 18 | Sec. 5.5.2 in [1] | 6.5.10-11 | A BIT STRING Size 1..8 is used for indicating support for DL-PRS RSRP measurements for DL-TDOA positioning.  (related to Issue 6.5.10-8) |
| 19 | Sec. 6.1 in [1] | 6.5.11-1 | Same as 6.5.10-1, but for DL-AoD |
| 20 | Sec. 6.4.1 in [1] | 6.5.11-6 | Same as 6.5.10-10, but for DL-AoD |
| 21 | Sec. 6.6 in [1] | 6.5.11-8 | nr-DL-PRS-RxBeamIndex-r16: a single bit of information, viz. Boolean may be enough. May be no need to report the ID of the RX beam used. |
| 22 | Sec. 7.1 in [1] | 6.5.12-1 | Same as 6.5.10-1, but for Multi-RTT |
| 23 | Sec. 7.3.1 in [1] | 6.5.12-4 | Same as 6.5.10-8, but for Multi-RTT |
| 24 | Sec. 7.4.1 in [1] | 6.5.12-6 | Same as 6.5.10-11, but for Multi-RTT |

# 3. Discussion

**The NOTE’s in this section are Rapporteur’s comments/understanding/questions.**

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|  | Reference | Issue # | Brief Description / Headline |
| 1 | Sec. 2.2 in [1] | 6.4.1-2 | The definition of NR-PhysCellId-r16 may fit better in the new collapsed 6.4.3  The new IE RelativeLocation-r16 may fit better in the common section 6.4.1 |

Description:

(a) The IE *NR-PhysCellId* is currently defined in section 6.4.1 (Common Lower-Level IEs), but it is currently used for NR Positioning only. It was proposed to move this IE to section 6.4.3 (Common NR Positioning Information Elements).

NOTE 1: A NR Physical Cell ID is already used in Rel-15 (e.g., for GNSS Fine Time Assistance), but not defined as a separate IE. Note also, that section 6.4.1 already defines *ARFCN-ValueNR* and *NCGI* (Common Lower-Level IEs).

(b) The IE *RelativeLocation* is currently defined in section 6.4.3 (Common NR Positioning Information Elements), since only used for NR Positioning. It was proposed to move this IE to section 6.4.1 (Common Lower-Level IEs).

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| Company | Comments |
| Huawei, HiSilicon | The proposed chagne is fine with us. |
| vivo | *NR-PhysCellId* should be put under 6.4.1. NR PCI, ARFCN and CGI should be put in the same place since so far NRARFCN and NRCGI are put under 6.4.1.  *RelativeLocation* is fine keep in 6.4.3. |
| CATT | There is no need to move the two IEs, because:   * No need to move *NR-PhysCellId* from 6.4.1 (Common Lower-Level IEs) to section 6.4.3 because the IE is not only used in NR positioning. * No need to move *RelativeLocation* from section 6.4.3 to section 6.4.1 because the IE *RelativeLocation-r16* is used in NR positioning for TRP so far. |
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|  | Reference | Issue # | Brief Description / Headline |
| 2 | Sec. 3.1 in [1] | 6.4.3-1 | Consider renaming the IE NR-TimingMeasQuality. |

Description:

The IE *NR-TimingMeasQuality* is currently used in

- *NR-AdditionalPathList*

- *NR-RTD-Info*

- *NR-DL-TDOA-SignalMeasurementInformation*

- *NR-Multi-RTT-SignalMeasurementInformation*

Given that not all usages may be considered as "measurements", it was proposed to consider changing the name of the IE; for example, *NR-TimingQuality.*

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| Company | Comments |
| Huawei, HiSIlicon | Agree with the agrument above. |
| vivo | We think the parameter is defined by RAN1 for meaurement. We don’t think the reused in other place is accurately (such as in *NR-RTD-Info*).if not appropriate, we shouldn’t reuse it other than change the name. |
| CATT | Ok. |
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|  | Reference | Issue # | Brief Description / Headline |
| 3 | Sec. 3.2.1 in [1] | 6.4.3-2 | Reference TRP Information. The current LPP is unclear about the definition/signalling of "assistance data reference TRP" and "RSTD reference TRP".  Includes also potential issues on nr-DL-PRS-ReferenceInfo and nr-DL-PRS-SFN0-Offset fields, as described. |

Description:

(a) Reference TRP Information

Currently, the "Reference Info" is provided by *DL-PRS-IdInfo* in IE *NR-DL-PRS-AssistanceData:*

NR-DL-PRS-AssistanceData-r16 ::= SEQUENCE {

nr-DL-PRS-ReferenceInfo-r16 DL-PRS-IdInfo-r16 OPTIONAL, -- Need ON

nr-DL-PRS-AssistanceDataList-r16 SEQUENCE (SIZE (1..nrMaxFreqLayers-r16)) OF

NR-DL-PRS-AssistanceDataPerFreq-r16,

nr-SSB-Config-r16 SEQUENCE (SIZE (0..255)) OF NR-SSB-Config-r16,

...

}

The field description for *nr-DL-PRS-ReferenceInfo* defines: "This field indicates the IDs of the reference TRP.". I.e., the field provides the IDs (i.e., plural) which is needed for the "RSTD Reference" candidates. However, for the "Assistance Data Reference", the DL-PRS ID should be sufficient, since (a) expected RSTD is defined for a pair of TRPs, and (b) RTDs can be provided only on DL-PRS ID level (not on Resource Set ID and Resource ID level).

From the discussion/comments in section 3.2 in [1], there appears to be the following options:

Option 1: Distinguish between "assistance data reference TRP" and "RSTD reference TRP". The currently used *DL-PRS-IdInfo* in IE *NR-DL-PRS-AssistanceData* is the (requested/recommended) "RSTD reference TRP" (and can be moved to *NR-DL-TDOA-RequestLocationInformation*), and the "assistance data reference TRP" is indicated separately using a DL-PRS-ID/TRP-ID only (i.e., no Resource Set ID, Resource ID).

Option 2: The assistance data (e.g., *nr-DL-PRS-AssistanceDataList, NR-PositionCalculationAssistance*) are provided as a list of TRPs (as currently defined) and the first entry of the list defines the (assistance data) Reference TRP.

Option 3: "Assistance Data Reference TRP" is the same as "RSTD reference TRP" (i.e., *DL-PRS-IdInfo*), and no change to the specification is needed.

NOTE 3a: An "Assistance Data Reference TRP" seems always needed (to indicate SFN-offset and expected RSTD), whereas a "RSTD reference TRP" would only be needed for UE-assisted DL-TDOA.

NOTE 3b: If Option 3 is desired, it seems the *DL-PRS-IdInfo-r16* should be mandatory present (given NOTE 3a).

NOTE 3c: The "assistance data reference TRP" should be a TRP/cell from which the UE can obtain the SFN. In case of broadcast assistance data, this cell/TRP is the cell from which the UE obtains the posSIB (i.e., each cell would broadcast a different order of the list with Option 2).

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| Company | Comments |
| Huawei, HiSIlicon | We prefer option3.  WE think there is no need to define two references, i.e., RSTD reference and assisntance data reference.  A clarification on the reference like Option3 is enough, which has the least RAN1 spec impact. |
| vivo | Option 3:  In TS 38.214, there are some related descriptions such as  “The UE may be indicated by the network that a DL PRS resources can be used as the reference for the DL RSTD, DL PRS-RSRP, and UE Rx-Tx time difference measurements in a higher layer parameter *DL-PRS-RstdReferenceInfo*. ”  “For the DL RSTD, DL PRS-RSRP, and UE Rx-Tx time difference measurements the UE can report an associated higher layer parameter *Timestamp*. The *Timestamp* can include the SFN and the slot number for a subcarrier spacing. These values correspond to the reference which is provided by *DL-PRS-RSTDReferenceInfo*.”  Therefor,in our view，the IE “nr-DL-PRS-ReferenceInfo-r16” is same with the IE “DL-PRS-RSTDReferenceInfo”as a common IE in TS38.214. So, we didn’t need change it. |
| CATT | Support Option2.  There is no broadcast issue with Option2 becaue only assistance data of DL-TDOA is broadcast. Neither assistance data of DL-AOD nor Multi-RTT will be broadcast in NR.  The modification of option 2 is less and follows the legency concept in LPP. |
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(b) *nr-DL-PRS-SFN0-Offset*

The definition of the SFN0-offset (*nr-DL-PRS-SFN0-Offset-r16*) also requires definition of a "assistance data reference TRP". The field is currently misplaced in IE *NR-DL-PRS-Config-r16* (which has no notion of a "assistance data reference TRP" whatsoever). It should appear at the same level as the expected RSTD:

-- ASN1START

NR-DL-PRS-Config-r16 ::= SEQUENCE {

nr-DL-PRS-ResourceSetList-r16 SEQUENCE (SIZE (1..nrMaxSetsPerTrp-r16)) OF

NR-DL-PRS-ResourceSet-r16,

...

}

NR-DL-PRS-ResourceSet-r16 ::= SEQUENCE {

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

dl-PRS-Periodicity-and-ResourceSetSlotOffset-r16

NR-DL-PRS-Periodicity-and-ResourceSetSlotOffset-r16,

dl-PRS-ResourceRepetitionFactor-r16 ENUMERATED {n1, n2, n4, n6, n8, n16, n32, ...},

dl-PRS-ResourceTimeGap-r16 ENUMERATED {s1, s2, s4, s8, s16, s32, ...},

dl-PRS-NumSymbols-r16 ENUMERATED {n2, n4, n6, n12, ...},

dl-PRS-MutingOption1-r16 DL-PRS-MutingOption1-r16 OPTIONAL, -- Need OP

dl-PRS-MutingOption2-r16 DL-PRS-MutingOption2-r16 OPTIONAL, -- Need OP

dl-PRS-ResourcePower-r16 INTEGER (-60..50),

dl-PRS-ResourceList-r16 SEQUENCE (SIZE (1..nrMaxResourcesPerSet-r16)) OF

NR-DL-PRS-Resource-r16,

...

}

-- ASN1START

NR-DL-PRS-AssistanceData-r16 ::= SEQUENCE {

nr-DL-PRS-ReferenceInfo-r16 DL-PRS-IdInfo-r16 OPTIONAL, -- Need ON

nr-DL-PRS-AssistanceDataList-r16 SEQUENCE (SIZE (1..nrMaxFreqLayers-r16)) OF

NR-DL-PRS-AssistanceDataPerFreq-r16,

nr-SSB-Config-r16 SEQUENCE (SIZE (0..255)) OF NR-SSB-Config-r16,

...

}

NR-DL-PRS-AssistanceDataPerFreq-r16 ::= SEQUENCE {

nr-DL-PRS-PositioningFrequencyLayer-r16

NR-DL-PRS-PositioningFrequencyLayer-r16,

nr-DL-PRS-AssistanceDataPerFreq-r16 SEQUENCE (SIZE (1..nrMaxTRPsPerFreq-r16)) OF

NR-DL-PRS-AssistanceDataPerTRP-r16,

...

}

NR-DL-PRS-AssistanceDataPerTRP-r16 ::= SEQUENCE {

trp-ID-r16 TRP-ID-r16,

nr-DL-PRS-SFN0-Offset-r16 NR-DL-PRS-SFN0-Offset-r16,

nr-DL-PRS-expectedRSTD-r16 INTEGER (-3841..3841),

nr-DL-PRS-expectedRSTD-uncerainty-r16 INTEGER (-246..246),

nr-DL-PRS-Config-r16 NR-DL-PRS-Config-r16,

...

}

NR-DL-PRS-SFN0-Offset-r16 ::= SEQUENCE {

sfn-Offset-r16 INTEGER (0..1023),

integerSubframeOffset-r16 INTEGER (0..9) OPTIONAL, -- Need OP

...

}

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| Company | Comments |
| Huawei, HiSilicon | We als think that the nr-DL-PRS-SFN0-Offset should be moved under NR-DL-PRS-AssistanceDataPerTRP. But, in this case, there is only one field within the IE NR-DL-PRS-Config. Maybe there is no need to define the IE NR-DL-PRS-Config, but use the field nr-DL-PRS-ResourceSetList directly. |
| vivo | Agree with this change. |
| CATT | Support to move TRP level, according to the RAN1 LS:  “Defines time offset of the SFN0 slot 0 for given TRP with respect to SFN0 slot 0” |
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|  | Reference | Issue # | Brief Description / Headline |
| 4 | Sec. 3.2.2a in [1] | 6.4.3-4 | Currently, the field *dl-PRS-ResourceRepetitionFactor* is mandatory within *DL-PRS-ResourceSet*. While should be possible that the field is not configured and there is no repetition. The same rationale also goes for *dl-PRS-ResourceTimeGap.*  Also, check if nr-DL-PRS-expectedRSTD-r16 and nr-DL-PRS-expectedRSTD-uncerainty-r16 need to be mandatory. |

Description:

*dl-PRS-ResourceRepetitionFactor* and *dl-PRS-ResourceTimeGap* are mandatory present. If there is typically no repetition, the fields could be optional present (with default interpretation when absent):

NR-DL-PRS-ResourceSet-r16 ::= SEQUENCE {

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

dl-PRS-Periodicity-and-ResourceSetSlotOffset-r16

NR-DL-PRS-Periodicity-and-ResourceSetSlotOffset-r16,

dl-PRS-ResourceRepetitionFactor-r16 ENUMERATED {n1, n2, n4, n6, n8, n16, n32, ...}

OPTIONAL, -- Need OP

dl-PRS-ResourceTimeGap-r16 ENUMERATED {s1, s2, s4, s8, s16, s32, ...}

OPTIONAL, -- Need OP

dl-PRS-NumSymbols-r16 ENUMERATED {n2, n4, n6, n12, ...},

dl-PRS-MutingOption1-r16 DL-PRS-MutingOption1-r16 OPTIONAL, -- Need OP

dl-PRS-MutingOption2-r16 DL-PRS-MutingOption2-r16 OPTIONAL, -- Need OP

dl-PRS-ResourcePower-r16 INTEGER (-60..50),

dl-PRS-ResourceList-r16 SEQUENCE (SIZE (1..nrMaxResourcesPerSet-r16)) OF

NR-DL-PRS-Resource-r16,

...

}

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| Company | Comments |
| Huawei, HiSilicon | Support  But also, if this is optional, the field value n1 and s1 are not necessary and can thus be removed. |
| vivo | We’re OK with need OP. |
| CATT | dl-PRS-ResourceRepetitionFactor-r16 = 1 means no resource repetition.  n1 can be removed if dl-PRS-ResourceRepetitionFactor-r16 is OP.  If the IE is not included, it means dl-PRS-ResourceRepetitionFactor-r16 =n1;  s1 also can be removed as well if dl-PRS-ResourceTimeGap-r16 is OP. |
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|  | Reference | Issue # | Brief Description / Headline |
| 5 | Sec. 3.2.2b in [1] | 6.4.3-5 | For the indication of SSB as PRS QCL, currently the field PCI is mandatory, however, it is unnecessary when the SSB and PRS locate on the same frequency layer. |

Description:

*pci* should be OPTIONAL in IE *DL-PRS-QCL-Info*, with conditional present tag that if the SSB is on the same frequency layer as the PRS, the field is absent.

DL-PRS-QCL-Info-r16 ::= CHOICE {

ssb-r16 SEQUENCE {

nr-ARFCNRSource-r16 ARFCN-ValueNR-r15

OPTIONAL, -- Cond NotSameAsPRS-FreqLayer

pci-r16 NR-PhysCellId-r16

OPTIONAL, -- Cond NotSameAsPRS-FreqLayer

ssb-Index-r16 INTEGER (0..63),

rs-Type-r16 ENUMERATED {typeC, typeD, typeC-plus-typeD}

},

dl-PRS-r16 SEQUENCE {

qcl-dl-PRS-ResourceId-r16 NR-DL-PRS-ResourceId-r16,

qcl-dl-PRS-ResourceSetId-r16 NR-DL-PRS-ResourceSetId-r16

}

}

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| Company | Comments |
| Huawei, HiSilicon | TRP id already incldues pci, thus it can be optional and use the PCI for the PRS.  While for ARFCN, it is already provided under NR-SSB-CONfig. With PCI, the UE can get the configured ARFCN for the SSB. Hence, there may not be need for addition of nr-ARFCNSource.  We wonder is there really the case that two SSB have the same PCI while different ARFCN? |
| vivo | 1. Frequency layer does not mean same PCI.And the UE doesn’t know the PCI to which the PRS belongs. So it is mandatory. 2. The SSB configuration information includes the ARFCN, we don’t think it needs to be reconfigured. |
| CATT | OK.  The scenario that SSBs are transmitted from a TRP in multiple carriers, and UE needs to know the SSB is associated to which one, would require ARFCN. |
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|  | Reference | Issue # | Brief Description / Headline |
| 6 | Sec. 3.2.5 in [1] | 6.4.3-8 | Need codes are currently missing in IE TRP-ID and the existing condition is confusing/wrong.  Issue depends on the conclusion related to TRP-ID. |

Issue depends on the conclusion related to TRP-ID. See "[Post109bis-e][947][POS] TRP-ID structure (Ericsson)".

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|  | Reference | Issue # | Brief Description / Headline |
| 7 | Sec. 3.2.6 in [1] | 6.4.3-9 | Conditional presence of trp-id field in IE NR-TimeStamp is confusing/wrong. |

Description:

Conditional presence of *trp-id* field in IE *NR-TimeStamp* is confusing/wrong.

NR-TimeStamp-r16 ::= SEQUENCE {

trp-ID-r16 TRP-ID-r16 OPTIONAL, -- Cond NotSameAsRefServ0

nr-SFN-r16 INTEGER (0..1023),

nr-Slot-r16 CHOICE {

scs15-r16 INTEGER (0..9),

scs30-r16 INTEGER (0..19),

scs60-r16 INTEGER (0..39),

scs120-r16 INTEGER (0..79)

},

...

}

From the discussion/comments in section 3.2.6 in [1], there appears to be the following options:

Option 1: Remove the conditional presence of *trp-ID* in IE *NR-TimeStamp*.

Option 2: Remove the *trp-ID* in IE *NR-TimeStamp*.

NOTE 7a: TRP-ID here means some ID of the TRP for which the SFN is valid (i.e., final name depends on solution of TRP issue)

NOTE 7b: Option 2 assumes the *trp-ID* is the same as the (assistance data) reference TRP, and therefore, it is not needed.

NOTE 7c: If Option 2 is desired, what should happen if the UE can not obtain the SFN from the (assistance data) reference TRP? E.g., reference TRP is not the same as serving cell anymore (e.g., after cell change)? Not report any measurements, or not report any time stamp for the measurements (which may effectively be the same)?

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| Company | Comments |
| Huawei, HiSilicon | Option2. There is no need for the field in the NR-TimeStamp based on the above discussion on assistance data reference TRP. |
| vivo | Option2.We think the IE NR-TimeStamp is defined for a timing stamp which shouldn’t include the TRP information. We should indicate the reference TRP that NR-TimeStamp corrsponds to on the outside of the IE. |
| CATT | Option1.  *NR-TimeStamp* provide the time stamp for the location estimate (UE-based) in NR-DL-TDOA-LocationInformation-r16/ NR-DL-AoD-LocationInformation-r16(UE-based report). |
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|  | Reference | Issue # | Brief Description / Headline |
| 8 | Sec. 3.3 in [1]  Sec. 2.4 in [2] | 6.4.3-10 | The IE NR-PositionCalculationAssistance may not be needed. It may be better moved to the IE definitions of NR-UEB-TRP-LocationData and NR-UEB-TRP-RTD-Info from 7.4.2 to 6.4.3. |

Description:

Currently, all IEs needed for UE-based only are collected in a single IE:

-- ASN1START

NR-PositionCalculationAssistance-r16 ::= SEQUENCE {

nr-trp-LocationInfo-r16 NR-TRP-LocationInfo-r16 OPTIONAL, -- Need ON

nr-dl-prs-BeamInfo-r16 NR-DL-PRS-BeamInfo-r16 OPTIONAL, -- Need ON

nr-rtd-Info-r16 NR-RTD-Info-r16 OPTIONAL, -- Need ON

...

}

-- ASN1STOP

This IE is then included in the *XXX-ProvideAssistanceData* messages; e.g.:

-- ASN1START

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

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

nr-SelectedDL-PRS-IndexList-r16 NR-SelectedDL-PRS-IndexList-r16 OPTIONAL, -- Need ON

nr-PositionCalculationAssistance-r16

NR-PositionCalculationAssistance-r16

OPTIONAL, -- Cond UEB

nr-DL-TDOA-Error-r16 NR-DL-TDOA-Error-r16 OPTIONAL, -- Need ON

...

}

-- ASN1STOP

It was proposed to split the *NR-PositionCalculationAssistance* into two IEs (analogous to posSIBs):

-- ASN1START

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

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

nr-SelectedDL-PRS-IndexList-r16 NR-SelectedDL-PRS-IndexList-r16 OPTIONAL, -- Need ON

nr-UEB-TRP-LocationData-r16 NR-UEB-TRP-LocationData-r16 OPTIONAL, -- Cond UEB

nr-UEB-TRP-RTD-Info-r16 NR-UEB-TRP-RTD-Info-r16 OPTIONAL, -- Cond UEB

nr-DL-TDOA-Error-r16 NR-DL-TDOA-Error-r16 OPTIONAL, -- Need ON

...

}

-- ASN1STOP

The *NR-UEB-TRP-LocationData* and *NR-UEB-TRP-RTD-Info* are currently defined outside the *LPP-PDU-Definitions* (as basic production for posSIBs) and would have to be moved to section 6.4.3 (Common NR Positioning Information Elements).

NOTE 8: If the above split is desired, should the same apply to both, DL-TDOA and DL-AoD? I.e., should the *NR-UEB-TRP-RTD-Info* also be present for DL-AoD? With the current structure, the option exists at least.

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| --- | --- |
| Company | Comments |
| Huawei, HiSilicon | We cannot see a clear motivation for this while for posSIB, there is a clear motivation. |
| vivo | It should be same for DL-TDOA and DL-AoD because posSibType6 is both for DL-TDOA and DL-AoD. |
| CATT | Share the same view as Huawei. Need a motivation to triger it. |
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|  | Reference | Issue # | Brief Description / Headline |
| 9 | Sec. 3.3 in [1] | 6.4.3-11 | The description of ‘nr-DL-PRS-SFN0-Offset’ should be modified for UE-assisted positioning. |

Description:

The description of *nr-DL-PRS-SFN0-Offset* should be modified for UE-assisted positioning. This parameter is used for the UE to obtain the timing of TRPs. If the UE doesn’t known the timing of reference TRP, this parameter makes no sense.

Option 1: Change "reference TRP" to "serving cell".

Option 2: Add a description like "The location server should include at least one TRP for which the SFN can be obtained by the target device, e.g. a TRP from the serving cell", so that the UE may also obtain the timing of each TRP.

Option 3: Providing absolute SFN0 timing of reference TRP for the UE.

NOTE 9a: There may not always be a "serving cell" (e.g., broadcast), and a serving cell may change during a positioning session.

NOTE 9b: The *nr-DL-PRS-SFN0-Offset* is always needed for PRS processing (i.e., not only for UE-assisted mode).

NOTE 9c: Option 2 was sufficient for LTE, but is it also sufficient for NR? I.e., in LTE, there is no SFN offset.

NOTE 9d: The issue seems related to 3 (#6.4.3-2; Reference TRP Information) and 7 (#6.4.3-9; trp-id field in IE NR-TimeStamp).

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| Company | Comments |
| Huawei, HiSilicon | We agree with the rapporteur that the issue is related to the definition of assistance data reference trp and RSTD reference TRP. We think these two references can be the same while the description in option2 added tha thte offset is with respect to the reference TRP. |
| vivo | Option1 or Option2 are prefered.  agreement in RAN1#98bis.   |  | | --- | | Agreement:   * A higher layer parameter, DL-PRS-SFN0-Offset, is configured   + Defines time offset of the SFN0 slot 0 for given TRP with respect to SFN0 slot 0 of FFS for RAN2 WG 1) serving TRP or 2) serving cell 3) etc.   + FFS values | |
| CATT | The issue can be discussed in #6.4.3-2; Reference TRP Information. The *nr-DL-PRS-SFN0-Offset* should always be required in PRS processing. |
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|  | Reference | Issue # | Brief Description / Headline |
| 10 | Sec. 2.2 in [2] | 6.4.3-12 | Representation of beam directions: (a) 0.1 degrees resolution (current spec.) (b) 1 degree resolution with an optional refinement to 0.1 degrees. |

Description:

Direction/angle information is currently provided as a single field with 0.1 degrees resolution:

DL-PRS-BeamInfoElement-r16 ::= SEQUENCE {

dl-PRS-Azimuth-r16 INTEGER (0..3599),

dl-PRS-Elevation-r16 INTEGER (0..1800) OPTIONAL, -- Need ON

...

}

LCS-GCS-Translation-Parameter-r16 ::= SEQUENCE {

alpha-r16 INTEGER (0..3599),

beta-r16 INTEGER (0..3599),

gamma-r16 INTEGER (0..3599),

...

}

It was proposed to use 1-degree resolution together with a 0.1-degree delta-field:

DL-PRS-BeamInfoElement-r16 ::= SEQUENCE {

dl-PRS-Azimuth-r16 INTEGER (0..359),

dl-PRS-Azimuth-fine-r16 INTEGER (0..9) OPTIONAL, -- Need OP

dl-PRS-Elevation-r16 INTEGER (0..180) OPTIONAL, -- Need ON

dl-PRS-Elevation-fine-r16 INTEGER (0..9) OPTIONAL, -- Need OP

...

}

LCS-GCS-Translation-Parameter-r16 ::= SEQUENCE {

alpha-r16 INTEGER (0..359),

alpha-fine-r16 INTEGER (0..9) OPTIONAL, -- Cond AzElFine

beta-r16 INTEGER (0..359),

beta-fine-r16 INTEGER (0..9) OPTIONAL, -- Cond AzElFine

gamma-r16 INTEGER (0..359),

gamma-fine-r16 INTEGER (0..9) OPTIONAL, -- Cond AzElFine

...

}

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| --- | --- |
| Company | Comments |
| Huawei, HiSilicon | we also think 0.1 degree resolution is desirable. |
| vivo | If 1 degree is a normal case, then we are OK with this change. |
| CATT | We are OK to use 1-degree resolution together with a 0.1-degree delta-field. |
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|  | Reference | Issue # | Brief Description / Headline |
| 11 | Sec. 4.1.2 in [1] | 6.5.9-2 | The TRP-ID in the IE NR-ECID-SignalMeasurementInformation is currently optional present. However, an identifier of the TRP/cell for which the measurements are applicable is always needed.  The systemFrameNumber can usually only be included if the NR-MeasuredResultsElement is provided for a serving cell. |

Description:

The system frame number in IE *NR-ECID-SignalMeasurementInformation* is currently mandatory present. However, since the measurement element is used for all measured cells/TRPs (i.e., also for neighbour TRPs), a SFN of the measured cell may not always be available at the target device (as also clarified by the field description):

NR-ECID-SignalMeasurementInformation-r16 ::= SEQUENCE {

nr-PrimaryCellMeasuredResults-r16 NR-MeasuredResultsElement-r16,

nr-MeasuredResultsList-r16 NR-MeasuredResultsList-r16 OPTIONAL,

...

}

NR-MeasuredResultsList-r16 ::= SEQUENCE (SIZE(1..32)) OF NR-MeasuredResultsElement-r16

NR-MeasuredResultsElement-r16 ::= SEQUENCE {

systemFrameNumber-r16 BIT STRING (SIZE (10)),

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

resultsSSB-Cell-r16 MeasQuantityResults-r16 OPTIONAL,

resultsCSI-RS-Cell-r16 MeasQuantityResults-r16 OPTIONAL,

resultsSSB-Indexes-r16 ResultsPerSSB-IndexList-r16 OPTIONAL,

resultsCSI-RS-Indexes-r16 ResultsPerCSI-RS-IndexList-r16 OPTIONAL,

...

}

| *NR-ECID-SignalMeasurementInformation* field descriptions |
| --- |
| ***systemFrameNumber***  This field specifies the system frame number of the measured cell during which the measurements have been performed. The target device shall include this field if it was able to determine the SFN of the cell at the time of measurement. |

The above ASN.1 looks like a typo and should be:

NR-ECID-SignalMeasurementInformation-r16 ::= SEQUENCE {

nr-PrimaryCellMeasuredResults-r16 NR-MeasuredResultsElement-r16,

nr-MeasuredResultsList-r16 NR-MeasuredResultsList-r16 OPTIONAL,

...

}

NR-MeasuredResultsList-r16 ::= SEQUENCE (SIZE(1..32)) OF NR-MeasuredResultsElement-r16

NR-MeasuredResultsElement-r16 ::= SEQUENCE {

systemFrameNumber-r16 BIT STRING (SIZE (10)) OPTIONAL,

trp-ID-r16 TRP-ID-r16,

resultsSSB-Cell-r16 MeasQuantityResults-r16 OPTIONAL,

resultsCSI-RS-Cell-r16 MeasQuantityResults-r16 OPTIONAL,

resultsSSB-Indexes-r16 ResultsPerSSB-IndexList-r16 OPTIONAL,

resultsCSI-RS-Indexes-r16 ResultsPerCSI-RS-IndexList-r16 OPTIONAL,

...

}

NOTE 11: TRP-ID here means some ID of the TRP for which the measurements are provided (i.e., final name depends on solution of TRP issue).

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| Company | Comments |
| Huawei, HiSilicon | Support in general.  For the trp-ID, since E-CID does not measure PRS, there is no need and no way to report PRS-ID for E-CID.  For SFN, as the rapporteur has observed, the field should not be mandatory and should only be present when the UE can obtain the SFN for the corresponding measure element |
| vivo | Agree with this change. |
| CATT | Support. The SFN is not mandatory. |
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|  | Reference | Issue # | Brief Description / Headline |
| 12 | Sec. 5.1 in [1]  Sec. 2.5 in [2] | 6.5.10-1 | There is currently no complete description/explanation for the sharing of the assistance data provided in IE NR DL PRS AssistanceData and NR-SelectedDL-PRS-IndexList.  DL-PRS AssistanceData placement in the LPP message structure. |

Description:

In case of multiple Provide Assistance Data IEs for multiple NR positioning methods, the IE *NR-DL-PRS-AssistanceData* for the TRPs would need to be provided only once. There were essentially two remaining options identified in [1],[2]:

Option 1: Keep the current LPP structure and add proper field description.

Option 2: Move the *NR-DL-PRS-AssistanceData* to the Message Body IEs.

Option 1: (DL-TDOA as example; the same applies to DL-AoD and Multi-RTT)

-- ASN1START

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

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

nr-SelectedDL-PRS-IndexList-r16 NR-SelectedDL-PRS-IndexList-r16 OPTIONAL, -- Cond Shared

nr-PositionCalculationAssistance-r16

NR-PositionCalculationAssistance-r16

OPTIONAL, -- Cond UEB

nr-DL-TDOA-Error-r16 NR-DL-TDOA-Error-r16 OPTIONAL, -- Need ON

...

}

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *UEB* | The field is optionally present for UE based NR DL-TDOA; otherwise it is not present. |
| *Shared* | The field is optionally present if not all DL-PRS Resources provided in *nr‑DL‑PRS‑AssistanceData* are applicable for this *NR-DL-TDOA-ProvideAssistanceData* message, or if the IE *NR-DL-PRS-AssistanceData* is provided in IE *NR‑Multi‑RTT‑ProvideAssistanceData* or *NR-DL-AoD-ProvideAssistanceData*. |

| *NR-DL-TDOA-ProvideAssistanceData* field descriptions |
| --- |
| ***nr-DL-PRS-AssistanceData***  This field specifies the assistance data reference and neighbour TRPs and provides the DL-PRS configuration for the TRPs. If this field is absent but the *nr-SelectedDL-PRS-IndexList* field is present, the *nr-DL-PRS-AssistanceData* is provided in IE *NR-Multi-RTT-ProvideAssistanceData* or *NR-DL-AoD-ProvideAssistanceData*. |
| ***nr-SelectedDL-PRS-IndexList***  This field specifies the DL-PRS Resources which are applicable for this *NR-DL-TDOA-ProvideAssistanceData* message. |
| ***nr-PositionCalculationAssistanceData***  This field provides TRP location and timing information for the TRPs provided in *nr-DL-PRS-AssistanceData* or *nr‑SelectedDL-PRS-IndexList* to enable UE-based DL-TDOA. |
| ***nr-DL-TDOA-Error***  This field provides DL-TDOA error reasons. |

Option 2: (DL-TDOA as example; the same applies to DL-AoD and Multi-RTT)

-- ASN1START

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

nr-SelectedDL-PRS-IndexList-r16 NR-SelectedDL-PRS-IndexList-r16 OPTIONAL, -- Need ON

nr-PositionCalculationAssistance-r16

NR-PositionCalculationAssistance-r16

OPTIONAL, -- Cond UEB

nr-DL-TDOA-Error-r16 NR-DL-TDOA-Error-r16 OPTIONAL, -- Need ON

...

}

-- ASN1STOP

ProvideAssistanceData ::= SEQUENCE {

criticalExtensions CHOICE {

c1 CHOICE {

provideAssistanceData-r9 ProvideAssistanceData-r9-IEs,

spare3 NULL, spare2 NULL, spare1 NULL

},

criticalExtensionsFuture SEQUENCE {}

}

}

ProvideAssistanceData-r9-IEs ::= SEQUENCE {

commonIEsProvideAssistanceData CommonIEsProvideAssistanceData OPTIONAL, -- Need ON

a-gnss-ProvideAssistanceData A-GNSS-ProvideAssistanceData OPTIONAL, -- Need ON

otdoa-ProvideAssistanceData OTDOA-ProvideAssistanceData OPTIONAL, -- Need ON

epdu-Provide-Assistance-Data EPDU-Sequence OPTIONAL, -- Need ON

...,

[[

sensor-ProvideAssistanceData-r14 Sensor-ProvideAssistanceData-r14 OPTIONAL, -- Need ON

tbs-ProvideAssistanceData-r14 TBS-ProvideAssistanceData-r14 OPTIONAL, -- Need ON

wlan-ProvideAssistanceData-r14 WLAN-ProvideAssistanceData-r14 OPTIONAL -- Need ON

]],

[[

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

nr-Multi-RTT-ProvideAssistanceData-r16

NR-Multi-RTT-ProvideAssistanceData-r16

OPTIONAL, -- Need ON

nr-DL-AoD-ProvideAssistanceData-r16

NR-DL-AoD-ProvideAssistanceData-r16 OPTIONAL, -- Need ON

nr-DL-TDOA-ProvideAssistanceData-r16

NR-DL-TDOA-ProvideAssistanceData-r16

OPTIONAL -- Need ON

]]

}

|  |  |
| --- | --- |
| Company | Comments |
| Huawei, HiSilicon | We suggest to have a common PRS configuration in *NR-DL-PRS-AssistanceData* promoted outside positioning methods and in parellel to *NR-DL-TDOA-ProvideAssistanceData-r16*, *NR-DL-AoD-ProvideAssistanceData-r16*, and *NR-Multi-RTT-ProvideAssistanceData-r16*, as it is likely we are going to have common PRS processing capabilities.  The field *nr-SelectedDL-PRS-IndexList* can still be conditional present, if not all DL-PRS Resources provided in *nr-DL-PRS-AssistanceData* are applicable for this *NR-DL-TDOA-ProvideAssistanceData* message, and there is no need to say shared assistance data.  For *nr-SelectedDL-PRS-IndexList*, we do not think it needs to have 2-stage perFreq + TRP indication, and the field *nr-SelectedDL-PRS-FrequencyLayerIndex-r16* and the field *nr-SelectedTRP-Index-r16* are useless. For the selection of TRP/DL PRS resource set/DL PRS resources, we simply needs to provide the TRP-ID, selected resource set IDs, and selected resource IDs.  For example (changes are based on R2-2003350):  NR-SelectedDL-PRS-IndexList-r16 ::= SEQUENCE (SIZE (1..256)) OF  NR-SelectedTRP-r16  NR-SelectedTRP-r16 ::= SEQUENCE {  trp-ID-r16 TRP-ID-r16,  dl-SelectedPRS-ResourceSetIndexList-r16 SEQUENCE (SIZE (1..nrMaxSetsPerTrp-r16)) OF  DL-SelectedPRS-ResourceSetIndex-r16  OPTIONAL, --Need ON  ...  }  DL-SelectedPRS-ResourceSetIndex-r16 ::= SEQUENCE {  nr-DL-SelectedPRS-ResourceSetIndex-r16 INTEGER (0..nrMaxSetsPerTrp-r16-1),  dl-SelectedPRS-ResourceIndexList-r16 SEQUENCE (SIZE (1..nrMaxResourcesPerSet-r16)) OF  DL-SelectedPRS-ResourceIndex-r16  OPTIONAL --Need ON  }  DL-SelectedPRS-ResourceIndex-r16 ::= SEQUENCE {  nr-DL-SelectedPRS-ResourceIdIndex-r16 INTEGER (0..nrMaxNumDL-PRS-ResourcesPerSet-1-r16),  ...  } |
| vivo | Option1  In addition, according to the above description:  ‘The field nr-SelectedDL-PRS-IndexList is conditional present, if not all DL-PRS Resources provided in nr-DL-PRS-AssistanceData are applicable for this NR-DL-TDOA-ProvideAssistanceData message, or if the IE NR-DL-PRS-AssistanceData is provided in IE NR Multi RTT ProvideAssistanceData or NR-DL-AoD-ProvideAssistanceData’,  We can find that as long as one of above conditions is met, the field nr-SelectedDL-PRS-IndexList will be present. But as our understanding, if only the second condition is satisfied, the field nr-SelectedDL-PRS-IndexList may not be present when all DL-PRS Resources provided in nr-DL-PRS-AssistanceData are applicable. So we suggest to change the description as  ’The field nr-SelectedDL-PRS-IndexList is conditional present, if not all DL-PRS Resources provided in nr-DL-PRS-AssistanceData are applicable for this NR-DL-TDOA-ProvideAssistanceData message and the IE nr-DL-PRS-AssistanceData is also provided in IE NR Multi RTT ProvideAssistanceData or NR-DL-AoD-ProvideAssistanceData. |
| CATT | Support Option1. The description clarifies where the shared DL-PRS-AssistanceData is when multi positioning methods.  Please note, *NR-DL-TDOA-ProvideAssistanceData* field descriptions should apply to DL-AoD and Multi-RTT.  Option2 is not effiecient when there is single positioning method which happens sometimes.  *NR-DL-PRS-AssistanceData-r16* is more efficient than *nr-SelectedDL-PRS-IndexList-r16* when in single positioning method. |
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|  | Reference | Issue # | Brief Description / Headline |
| 13 | Sec. 5.3.1 in [1] | 6.5.10-3 | DL-PRS RSRP measurements can optionally be provided for DL-TDOA positioning. However, there is currently confusion, since RSTD is a measurement for a pair of TRPs, but the RSRP is a single TRP measurement only. |

Description:

DL-PRS RSRP can provide an auxiliary measurement for DL-TDOA, e.g., to indicate an additional quality for the DL‑PRS measurement, etc.. However, with the current measurement results structure for DL-TDOA, the RSRP for the reference TRP cannot be provided.

It was proposed adding the RSRP measurements for the RSTD Reference TRP to the IE *NR-DL-TDOA-SignalMeasurementInformation*:

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

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

nr-PRS-RSRP-ResultRef-r16 INTEGER (FFS) OPTIONAL,

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

...

}

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

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

trp-ID-r16 TRP-ID-r16,

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-AdditionalPathList-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-AdditionalMeasurements-r16

NR-DL-TDOA-AdditionalMeasurements-r16 OPTIONAL,

...

}

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| Company | Comments |
| Huawei, HiSilicon | It is our understanding that the measurement results for the reference TRP is also included one *NR-DL-TDOA-MeasElement-r16* provided by the list *nr-DL-TDOA-MeasList-r16*. Therefore, we consider the change not needed. The only change that requires discussion is handle of nr-RSTD-r16 for the reference TRP. |
| vivo | We are fine with this change. In addition, for the measurement and report of a reference TRP, other measurements such as additional path and AdditionalMeasurement (e.g. additional measurements from resources different from the reference resource) should also be included. |
| CATT | Support. The RSRP for the reference TRP can help LMF make the decision. |
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|  | Reference | Issue # | Brief Description / Headline |
| 14 | Sec. 5.3.2 in [1] | 6.5.10-4 | The IE NR-TimingMeasQuality is used to provide the quality of the RSTD measurement. However, the quality of the reference TRP TOA used for RSTD cannot be provided. Further, the quality of the additional RSTD measurements per TRP pair (up to 3) can also not be provided. |

Description:

The RSTD measurement is a TDOA measurement, and the quality of the RSTD can be indicated by the IE *NR‑TimingMeasQuality.* The RSTD quality would only be the main diagonal element of a weighting matrix for TDOA; the off-diagonal elements of the weighting matrix are determined by the quality of the reference TRP TOA measurement used for the TDOA (see also LTE OTDOA in LPP). E.g., the selection of the RSTD reference TRP affects all the RSTD (TDOA) measurements.

The issue was also discussed at RAN1#100bis-e, with the following conclusion [5]:

Conclusion:

* It is RAN1 understanding that the NR-TimingMeasQuality is the quality for time of arrival measurements
* NR-TimingMeasQuality is left up to UE implementation
* Notes:
  + No RAN1 specification changes are required.
  + NR-TimingMeasQuality measurement is also applicable for the reference timing used in RSTD measurements

Therefore, the *NR‑TimingMeasQuality* is not the quality of the RSTD, but the quality of the TOA which is used to calculate the RSTD. I.e., there are two qualities needed for a single RSTD measurement (reference quality and neighbour quality):

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

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

nr-TOA-Ref-Quality-r16 NR-TimingMeasQuality-r16,

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

...

}

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

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

trp-ID-r16 TRP-ID-r16,

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-AdditionalPathList-r16 NR-AdditionalPathList-r16 OPTIONAL,

nr-TOA-Quality-r16 NR-TimingMeasQuality-r16,

nr-PRS-RSRP-Result-r16 INTEGER (FFS) OPTIONAL,

-- FFS, value range to be decided in RAN4.

nr-DL-TDOA-AdditionalMeasurements-r16

NR-DL-TDOA-AdditionalMeasurements-r16 OPTIONAL,

...

}

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 to be decided in RAN4

nr-TOA-Quality-r16 NR-TimingMeasQuality-r16,

dl-PRS-RSRP-ResultDiff-r16 INTEGER (FFS) OPTIONAL,

-- FFS on the value range to be decided in RAN4

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

...

}

|  |  |
| --- | --- |
| Company | Comments |
| Huawei/HiSilicon | It is our understanding that the measurement results for the reference TRP is also included one *NR-DL-TDOA-MeasElement-r16* provided by the list *nr-DL-TDOA-MeasList-r16*. Therefore, we consider the change not needed. |
| vivo | In general we agree with the intention, but we worry the naming of nr-TOA-Quality makes the confusion about RSTD and TOA.We prefer put the IE NR-TimingMeasQuality-r16 under NR-DL-TDOA-SignalMeasurementInformation-r16。 |
| CATT | Support. |
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|  | Reference | Issue # | Brief Description / Headline |
| 15 | Sec. 5.3.5 in [1] | 6.5.10-7 | The IE NR-DL-TDOA-MeasElement provides the RSTD measurements for up to 256 TRPs. However, since the RSTD measurement is between a pair of TRPs, only up to 255 report elements for IE NR-DL-TDOA-MeasElement are possible. |

Description:

The IE *NR-DL-TDOA-MeasElement* provides the DL-TDOA measurements for one TRP. Assistance data can be provided for up to 256 TRPs. This implies that there can be up to 255 TRPs for RSTD measurements.

NOTE 15: Note, in [1] some companies think the measurements for the RSTD reference TRP are included in one *NR-DL-TDOA-MeasElement*. However, it is unclear what an RSTD (TDOA) of a single (reference) TRP is.

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-1-r16)) OF NR-DL-TDOA-MeasElement-r16

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

trp-ID-r16 TRP-ID-r16,

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-AdditionalPathList-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-AdditionalMeasurements-r16

NR-DL-TDOA-AdditionalMeasurements-r16 OPTIONAL,

...

}

nrMaxTRPs-1-r16 INTEGER ::= 255

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| Company | Comments |
| Huawei/HiSilicon | It is our understanding that the measurement results for the reference TRP is also included as one *NR-DL-TDOA-MeasElement-r16* provided by the list *nr-DL-TDOA-MeasList-r16*. Therefore, we consider the change may not be needed. |
| vivo | We are fine with this change. |
| CATT | Support. Prefer to report measurement of reference and neighbor TRP separately. |
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|  | Reference | Issue # | Brief Description / Headline |
| 16 | Sec. 5.4.1 in [1] | 6.5.10-8 | The IE NR-DL-TDOA-RequestLocationInformation reserves a BIT STRING Size 1..8 for the requested RSRP measurement. However, a single bit would be sufficient. |

Description:

The IE *NR-DL-TDOA-RequestLocationInformation* reserves a BIT STRING Size 1..8 for the requested RSRP measurement. However, a single bit would be sufficient.

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

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

nr-DL-PRS-RSRP-Requested ENUMERATED { requested } OPTIONAL, -- Need ON

nr-AssistanceAvailability-r16 BOOLEAN,

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

additionalPaths-r16 ENUMERATED { requested } OPTIONAL, -- Need ON

...

}

NOTE16a: In [1], some companies think that reserving 8-bits is more future proof. However, how likely is it that 7 additional DL-TDOA measurements will be defined? And even if so, they can be added in the same way as a single bit.

NOTE 16b: This item seems also contingent on RAN1 capabilities discussions. If the capability for the DL-PRS RSRP measurement will be removed, the *nr-RequestedMeasurements* or *nr-DL-PRS-RSRP-Requested* will not be needed.

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| Company | Comments |
| Huawei/HiSilicon | It is our understanding it is intentionaly reserved by the rapporteur for future extension. |
| vivo | Not needed, maybe more RS will be introduced in the further release. |
| CATT | No strong view. |
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|  | Reference | Issue # | Brief Description / Headline |
| 17 | Sec. 5.5.1 in [1] | 6.5.10-10 | The capability for periodic reporting cannot be indicated separately for the positioning mode. |

Description:

The capability for periodic reporting can be different for UE-based and UE-assisted mode; e.g., may be supported by a UE for UE-based but not for UE-assisted or vice versa. Currently, there is no differentiation in the DL-TDOA capabilities:

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)),

additionalPathsReport-r16 ENUMERATED { supported } OPTIONAL,

periodicalReporting-r16 ENUMERATED { supported } OPTIONAL,

...

}

It was proposed replacing the "ENUMERATED { supported }" for the field *periodicalReporting* in IE *NR-DL-TDOA-ProvideCapabilities* with field "*PositioningModes*".

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)),

additionalPathsReport-r16 ENUMERATED { supported } OPTIONAL,

periodicalReporting-r16 PositioningModes OPTIONAL,

...

}

NOTE 17: This is the same as for all other LPP methods which support multiple positioning modes.

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| Company | Comments |
| Huawei/HiSilicon | It seems by change to *PositioningModes*, the periodic reporting capability is separate for UE-based and UE-assisted, but we are not clear why they need differentiation. |
| vivo | We’re fine with the change. |
| CATT | Ok. |
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|  | Reference | Issue # | Brief Description / Headline |
| 18 | Sec. 5.5.2 in [1] | 6.5.10-11 | A BIT STRING Size 1..8 is used for indicating support for DL-PRS RSRP measurements for DL-TDOA positioning.  (related to Issue 6.5.10-8) |

Description:

For the indication of DL-PRS RSRP support, a single-bit ENUMERATED { supported } would be sufficient.

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-PRS-RSRP-MeasSupported-r16 ENUMERATED { supported } OPTIONAL,

additionalPathsReport-r16 ENUMERATED { supported } OPTIONAL,

periodicalReporting-r16 ENUMERATED { supported } OPTIONAL,

...

}

NOTE 18: NOTEs 16a/b apply here as well

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| Company | Comments |
| Huawei/HiSilicon | It is our understanding it is intentionaly reserved by the rapporteur for future extension. |
| vivo | Not needed, maybe more RS will be introduced in the further release. |
| CATT | No strong view. |
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|  | Reference | Issue # | Brief Description / Headline |
| 19 | Sec. 6.1 in [1] | 6.5.11-1 | Same as 6.5.10-1, but for DL-AoD |

It is assumed the same solution for 12 (#6.5.10-1) will apply for DL-AoD as well.

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|  | Reference | Issue # | Brief Description / Headline |
| 20 | Sec. 6.4.1 in [1] | 6.5.11-6 | Same as 6.5.10-10, but for DL-AoD |

It is assumed the same solution for 17 (#6.5.10-10) will apply for DL-AoD as well.

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|  | Reference | Issue # | Brief Description / Headline |
| 21 | Sec. 6.6 in [1] | 6.5.11-8 | nr-DL-PRS-RxBeamIndex-r16: a single bit of information, viz. Boolean may be enough. May be no need to report the ID of the RX beam used. |

Description:

The field *nr-DL-PRS-RxBeamIndex* in *NR-DL-AoD-MeasElement* is currently used to indicate which (of the up to 8) DL-PRS RSRP measurements have been made with the same RX beam by the UE. I.e., the RSRP measurements in *NR-DL-AoD-MeasList* which have been made with the same RX beam will get the same value of *nr-DL-PRS-RxBeamIndex*:

-- 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-r16)) OF NR-DL-AoD-MeasElement-r16

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

trp-ID-r16 TRP-ID-r16,

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

nr-DL-Aod-AdditionalMeasurements-r16

NR-DL-AoD-AdditionalMeasurements-r16 OPTIONAL,

...

}

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

NR-DL-AoD-AdditionalMeasurementElement-r16

NR-DL-AoD-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-PRS-RSRP-ResultDiff-r16 INTEGER (FFS) OPTIONAL,

-- Need RAN4 inputs on value range

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

...

}

-- ASN1STOP

Some other understanding of the RAN1 agreement is just to indicate whether the same RX beam has been used for all measurements for AoD or not. So, a single bit of information, viz. Boolean is enough. No need to report the ID of the RX beam used. [1]

RAN 1 Agreement:

* When the UE reports DL-PRS RSRP measurements on DL-PRS resources from one DL-PRS Resource Set, the UE may indicate in the measurement report for each TRP which DL-PRS RSRP measurements, if any, have been measured using the same Rx beam.

NOTE 21: For the Rapporteur, it is unclear how the measurement report should be structured with a single-bit indicator for one resource set, so an ASN.1 example would be needed. It seems the *NR-DL-PRS-ResourceSetId* in *NR-DL-AoD-AdditionalMeasurementElement* is not needed, and another SEQUENCE for 1:2 *NR-DL-PRS-ResourceSetId*’s may be required.

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| Company | Comments |
| Huawei, HiSilicon | We agree that this is needed based on the agreement from RAN1. But the indiation does not necessarily need to be a per-beam index indication. We think that an indication with boolean value would be sufficent: for measElement with ture, they belong to the same reception beam, while for those with fales, they belong to the remaining set of beams. |
| vivo | Not needed. |
| CATT | Support a single bit of information.  Boolean parameter cannot indicate two or more RSRP measurement groups with different Rx beam in the 8 RSRP measurements for DL-AoD.  For example, if RSRP measurement 1~4 were measured using Rx beam 1 and RSRP measurement 5~8 using Rx beam 2. If we use Boolean parameter, which is a binary reporting field, it will be FALSE if it is sent per PRS resource set. And even it is sent per PRS resource, it can only indicate RSRP measurement 1~4 were measured using the same Rx beam, but it cannot indicate RSRP measurement 5~8 also using the same Rx beam.  On the contrary, the single bit of information can indicate up to 8 RSRP measurement groups with different Rx beam. |
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|  | Reference | Issue # | Brief Description / Headline |
| 22 | Sec. 7.1 in [1] | 6.5.12-1 | Same as 6.5.10-1, but for Multi-RTT |

It is assumed the same solution for 12 (#6.5.10-1) will apply for Multi-RTT as well.

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|  | Reference | Issue # | Brief Description / Headline |
| 23 | Sec. 7.3.1 in [1] | 6.5.12-4 | Same as 6.5.10-8, but for Multi-RTT |

It is assumed the same solution for 16 (#6.5.10-8) will apply for Multi-RTT as well.

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|  | Reference | Issue # | Brief Description / Headline |
| 24 | Sec. 7.4.1 in [1] | 6.5.12-6 | Same as 6.5.10-11, but for Multi-RTT |

It is assumed the same solution for 18 (#6.5.10-11) will apply for Multi-RTT as well.

# 4. Additional Issues

Any additional ASN.1 issues please (not new features).

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| Company | Description/Problem | Proposed Solution |
| Ericsson | We can include the posSIB that UE requires in the LPP request assistance data message. If NW is already broadcasting, posSIBType6-1 and posSIBType6-2; UE may only request posSIBType6-3 from the NW. The request assistance data can be aligned to reflect the posSIB categorizations.   |  |  |  | | --- | --- | --- | | NR DL-TDOA/DL-AoD Assistance Data (clause 7.4.2) | *posSibType6-1* | *NR-DL-Measurement-AD* | | *posSibType6-2* | *NR-UEB-TRP-LocationData* | | *posSibType6-3* | *NR-UEB-TRP-RTD-Info* | | *NR-DL-TDOA-RequestAssistanceData* The IE *NR-DL-TDOA-RequestAssistanceData* is used by the target device to request assistance data from a location server.  -- ASN1START  NR-DL-TDOA-RequestAssistanceData-r16 ::= SEQUENCE {  nr-PhysCellId-r16 NR-PhysCellId-r16 OPTIONAL,  nr-AdType-r16 BIT STRING { dl-prs (0),  posCalc (1),  posSibType6-1 (2),  posSibType6-2 (3),  posSibType6-3 (4) } (SIZE (1..8)),  ...  }  -- ASN1STOP   | *NR-DL-TDOA-RequestAssistanceData* field descriptions | | --- | | ***nr-PhysCellId***  This field specifies the NR physical cell identity of the current primary cell of the target device. | | ***nr-AdType***  This field indicates the requested assistance data. dl-prs means requested assistance data is *nr-DL-PRS-AssistanceData*, posCalc means requested assistance data is *nr-PositionCalculationAssistanceData* for UE based positioning*. posSibType6-1* means requested assistance data *NR-DL-Measurement-AD,* posSibType6-2 means requested assistance data *NR-UEB-TRP-LocationData,* *posSibType6-3* means requested assistance data *NR-UEB-TRP-RTD-Info.* | |
| vivo | dl-PRS-NumSymbols-r16 which is now under IE NR-DL-PRS-ResourceSet-r16. But the description of dl-PRS-NumSymbol indicates “This parameter indicates the number of symbols per DL PRS Resource within a slot”. | So we think dl-PRS-NumSymbols-r16 should be moved under NR-DL-PRS-Resource-r16. |
| vivo | It is noted that the parameter nr-DL-PRS-UE-Rx-Tx-MeasurementInfoRequest is not captured in the latest version of TS 37.355. But the parameter nr-DL-PRS-UE-Rx-Tx-MeasurementInfoRequest was already in the parameter list [R1-1913674], similar to nr-DL-PRS-RstdMeasurementInfoRequest. So, we think that is an oversight of RAN2.  In 38.214:  “The UE can be configured in higher layer parameter *UE Rx-Tx Time-MeasRequestInfo* to report multiple UE Rx-Tx time difference measurements corresponding to a single configured SRS resource or resource set for positioning. Each measurement corresponds to a single received DL PRS resource or resource set which can be in difference positioning frequency layers.” | Add nr-DL-PRS-UE-Rx-Tx-MeasurementInfoRequest in 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-DL-PRS-UE-Rx-Tx-MeasurementInfoRequest-r16 ENUMERATED { true } OPTIONAL, -- Need ON  nr-RequestedMeasurements-r16 BIT STRING { prsrsrpReq (0)} (SIZE(1..8)),  nr-AssistanceAvailability-r16 BOOLEAN,  nr-Multi-RTT-ReportConfig-r16 NR-Multi-RTT-ReportConfig-r16,  additionalPaths-r16 ENUMERATED { requested } OPTIONAL, -- Need ON  ...  }  NR-Multi-RTT-ReportConfig-r16 ::= SEQUENCE {  maxDL-PRS-RxTxTimeDiffMeasPerTRP-r16 INTEGER (1..4) OPTIONAL,  timingReportingGranularityFactor-r16 INTEGER (FFS) OPTIONAL,  -- FFS in RAN4  ...  }  -- ASN1STOP   | *NR-Multi-RTT-RequestLocationInformation* field descriptions | | --- | | *nr-AssistanceAvailability*  This field indicates whether the target device may request additional PRS assistance data from the server. TRUE means allowed and FALSE means not allowed. | | *maxDL-PRS-RxTxTimeDiffMeasPerTRP*  This field specifies the maximum number of UE-Rx-Tx time difference measurements for different DL PRS resources or DL PRS resource sets per TRP. | | *timingReportingGranularityFactor*  This field specifies the reporting granularity for the UE timing measurements (DL RSTD, the UE Rx-Tx time difference). | | nr-DL-PRS-UE-Rx-Tx-MeasurementInfoRequest  This field indicates whether the target device is requested to report DL PRS Resource ID(s) or DL PRS Resource Set ID(s) used for determining the timing of each TRP in the UE Rx-Tx time difference measurements. | |
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