3GPP TSG-RAN WG2 Meeting #109-e***R2-20xxxxx***

Online, February 24 – March 06, 2020

**Agenda item:** 6.8.2.5

**Source:** Qualcomm Incorporated

**Title:** Summary of [AT109e][624][POS] Open issues on UE-based downlink positioning assistance data

**Document for:**  Discussion and Decision

# 1. Introduction

This document summarizes the following email discussion:

* [AT109e][624][POS] Open issues on UE-based downlink positioning assistance data (Qualcomm)

 Intended outcome: Updated TP reflecting agreement where possible on the open issues:

 (a) whether beamwidth information can be provided in the assistance data in Rel-16 or should be deferred to e.g. Rel-17;

 (b) whether to support LCS-to-GCS translation parameter for the spatial direction information;

 (c) whether to include RTD drift rate in the assistance data;

 (d) whether to include RTD per DL-PRS Resource.

 Updated TP in R2-2001949.

 Deadline: Wednesday 2020-03-04 1300 CET

The summary of "[108#89][NR/Pos] UE-based downlink positioning assistance data" email discussion held between RAN2#108 and RAN2#109-e can be found in [R2-2001234](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_109_e/Docs/R2-2001234.zip).

# 2. Discussion

## 2.1 Beamwidth information for DL-PRS resources

The inclusion of beamwidth information for DL-PRS resources was proposed by Qualcomm in [R2-2001244](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_109_e/Docs/R2-2001244.zip) ("Remaining details for UE-based downlink positioning assistance data").

The motivation can be briefly summarized as follows:

For DL-AoD positioning, the UE may make DL-PRS RSRP measurements of DL-PRS resources from the same TRP. The TRPs may transmit beamformed DL-PRS in a beam sweeping manner that may be measured by the UE. The UE may identify the beam with the e.g. strongest RSRP and use the corresponding direction (azimuth, elevation) as AoD estimate. However, each beam has a certain width which essentially determines the AoD uncertainty. A simple first order approximation of the beamshape could be provided using the DL-PRS beamwidth. If the UE measures two adjacent beams, the beamwidth information can be used to determine a better fit of the AoD between the two PRS beams.

More advanced techniques may make use of more accurate parametrized beamshape information. For DL-AoD positioning, the gNB beam pattern needs to be known in advance, as also described in [R2-2000969](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_109_e/Docs/R2-2000969.zip) ("Discussion on DL-AoD positioning procedure", Huawei, HiSilicon). The beamwidth would allow a simple 1st–order approximation of the beam pattern.

**Question 1:** Do companies agree that beamwidth information can optionally be provided in the assistance data as part of the spatial direction information of the DL-PRS Resources (IE *NR-DL-PRS-BeamInfo*)? Please provide also a brief justification for your answer.

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Ericsson | No for Rel. 16 | The more detailed antenna beam information needs input and evaluations from RAN1 before representations can be discussed in RAN2. Therefore, this seems to be a suitable topic for discussion and evaluation in Rel. 17. |
| OPPO | No | Agree with Ericsson. Since this is highly dependent on ran1, which however did not touched upon this issue yet. considering now is the very late stage of r16, we do not think this is a critial issue thus should not be pursued at ran2. |
| Huawei | Yes (conditional) | We suggest anything available at LMF for the purpose of angle calculation can be provided by the UE, as optional fields.For beamwidth, note that the 3dB bandwidth may not be symmetric about the main peak. |
| CATT | No for Rel-16 | It should be discussed and decided by RAN1. Although it may be useful to improve the positioning accuracy, we can consider it in Rel-17. |
| Apple | Yes | The beamwidth information could help UE to understand the error margins of angle estimation |
| Nokia | No | If this beamwidth parameter is not in the list of L1 parameters from RAN1 then we should not add it at this time. We can consider it in the next release with inputs from RAN1 after their evaluation of the proposal. |
| Intel | Yes | It could be useful for UE based positioning. |

## 2.2. LCS-to-GCS translation parameter for the spatial direction information

The inclusion of LCS-to-GCS translation parameter was originally proposed by Huawei/HiSilicon during the email discussion [108#89][NR/Pos] mentioned in section 1 above.

It was also supported by Qualcomm in [R2-2001244](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_109_e/Docs/R2-2001244.zip) ("Remaining details for UE-based downlink positioning assistance data").

The motivation can be briefly summarized as follows:

As agreed by RAN1, the DL-PRS boresight direction can be provided in either a Global Coordinate System (GCS) or Local Coordinate System (LCS). Therefore, if the DL-PRS Resource AoD is provided in LCS, the conversion parameter need to be provided as well (α (bearing angle), β (downtilt angle), γ (slant angle)).

**Question 2:** Do companies agree that LCS-to-GCS translation parameter can be provided in the assistance data as part of the spatial direction information of the DL-PRS Resources (IE *NR-DL-PRS-BeamInfo*)? Please provide also a brief justification for your answer.

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Ericsson | Yes | The combination LCS plus translation information to GCS is viable. However, we are also fine with GCS only. |
| OPPO | Yes | Since the localization result should be defined in the GCS, if the beam direction is provided in LCS, then it needs to be converted to be in GCS. |
| Huawei | Yes | RAN1 has made the following agreement during previous meetings:Agreement:* A DL PRS resource can be associated with one or more of the following in either GCS or LCS
	+ azimuth angle
	+ elevation angle
* The reporting granularity for the set of angles $α$ (bearing angle), $β$ (downtilt angle) and $γ $ (slant angle) for the translation of the GCS to LCS is defined as 0.1 degree.

If the lcs-To-GCS-Translation is provide, dl-PRS-Azimuth-r16 and dl-PRS-Elevation are defined in LCS; otherwise, dl-PRS-Azimuth-r16 and dl-PRS-Elevation are defined in GCS.It is hard to describe the beam information in GCS for the purpose DL-AoD if e.g. the antenna is celling mounted. |
| CATT | Yes | As it is agreed in RAN1, we should introduce these parameters. |
| Apple | Yes |  |
| Nokia | Yes | Since RAN1 had already agreed this, we are fine to consider this assistance data. |
| Intel | Yes | It has been agreed in RAN1.  |

## 2.3 RTD drift rate

The inclusion of RTD drift rate as part of the RTD information was proposed by Qualcomm in [R2-2001244](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_109_e/Docs/R2-2001244.zip) ("Remaining details for UE-based downlink positioning assistance data").

The motivation can be briefly summarized as follows:

Existing UE-based TDOA related specifications support a RTD drift rate (e.g., 3GPP TS 25.331, OMA LPPe).

One of the reasons is the base station frequency accuracy requirements, which for NR are specified in TS 38.104 (these requirements are the same as for LTE or UMTS).

3GPP specifications require frequency stability of 0.05-0.1 ppm on the air interface. 0.1 ppm equals 100 ns drift after 1 second, which corresponds to about 30 m/s drift rate (which is the value range supported in UMTS and LPPe specifications for the RTD drift rate). The DL-PRS periodicity can be up to 10.24 seconds, and therefore, RTD drift can have a significant adverse impact to positioning accuracy.

An RTD drift rate if available can prolong the validity time of the RTD. The RTD value is essentially one "snapshot" of the RTD, valid at the reference time. If the RTD drift rate is available, the UE can take this into account when extrapolating the RTD at a delta-time from the RTD reference time.

**Question 3:** Do companies agree that RTD Drift Rate can be provided in the assistance data as part of the RTD information (IE *NR-RTD-Info*)? Please provide also a brief justification for your answer.

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Ericsson | No for Rel. 16 | The more detailed RTD information needs input and evaluations from RAN1 before representations can be discussed in RAN2. Therefore, this seems to be a suitable topic for discussion and evaluation in Rel. 17, especially given the generic integrity ambitions of the SID. |
| OPPO | No | Agree with Ericsson. Partially agree with Qualcomm’s intention but the details of usage of this information should be discussed in RAN1 firstly. |
| Huawei | Yes |  |
| CATT | No for Rel-16 | If it is not so urgent, we can consider it in Rel-17. Else, we can define the optional IE in the NR-RTD-Info. We also think it is better to discuss it in RAN1 first. |
| Apple | Yes | Agree with Qualcomm’s intention |
| Nokia | No | Agree that this needs to be evaluated in RAN1 first and can be considered in a future release. |
| Intel | No | Agree this should be evaluated in RAN1 and could be discussed in Rel-17. |

## 2.4 RTD information per DL-PRS Resource

The inclusion of RTD information per DL-PRS Resource as part of the RTD information was proposed by Qualcomm in [R2-2001244](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_109_e/Docs/R2-2001244.zip) ("Remaining details for UE-based downlink positioning assistance data").

The motivation can be briefly summarized as follows:

The DL-PRS RSTD measurements in NR are made per DL-PRS Resource. The UE can report the PRS resource ID(s) or PRS resource set ID(s) used for determining the timing of each TRP in the RSTD measurements. This information may be used by an LMF to e.g., determine the correct transmission reference point and timing required for position calculation.

Thus, it is reasonable for the RTD information to also be indicated per DL-PRS Resource for UE-based. If beams for different PRS resources are formed using different sets of antenna elements, possibly from different sets of panels that are driven by different clocks or have other internal HW delay variations, such information would allow determining the RTD more precisely.

**Question 4:** Do companies agree that RTD can optionally be provided per DL-PRS Resource in the assistance data (IE *NR-RTD-Info*)? Please provide also a brief justification for your answer.

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Ericsson | No for Rel. 16 | The panel to panel time differences can be discussed in Rel. 17 for both UEs and network elements. It has not been discussed in RAN1 in Rel.16.  |
| OPPO | No | Agree with Ericsson |
| Huawei | Yes | On the per DL-PRS resource ganularity, we think it is reasonable since the granularity of definition for reference point is also on the level of DL-PRS resource. |
| CATT | No for Rel-16 | If it is not so urgent, we can consider it in Rel-17. Else, we can define the optional IE in the NR-RTD-Info. We also think it is better to discuss it in RAN1 first. |
| Apple | Yes | Agree with Huawei |
| Nokia | No | Agree with others. This can be considered in a future release. |
| Intel | No | Tend to agree with Ericsson. |

## 2.5 Resolution of Angular Parameter

It was commented during email discussion [108#89][NR/Pos] mentioned in section 1 above, that angular information should be provided in two steps: (a) 1-degree resolution, and (b) optionally 0.1-degree delta resolution (Ericsson).

A corresponding TP could be as follows:

-- ASN1START

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

 dl-PRS-Azimuth-r16 INTEGER (0..359~~9~~),

 dl-PRS-Azimuth-Delta-r16 INTEGER (0..9) OPTIONAL, -- Need ON

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

 dl-PRS-Elevation-Delta-r16 INTEGER (0..9) OPTIONAL, -- Need ON

-- FFS for HPBW

-- dl-PRS-HPBW-Az-r16 INTEGER (0..1200) OPTIONAL, -- Need ON

-- dl-PRS-HPBW-El-r16 INTEGER (0..1200) OPTIONAL, -- Need ON

 ...

}

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

 alpha-r16 INTEGER (0..359~~9~~),

 alpha-delta-r16 INTEGER (0..9) OPTIONAL, -- Need ON

 beta-r16 INTEGER (0..359~~9~~),

 beta-delta-r16 INTEGER (0..9) OPTIONAL, -- Need ON

 gamma-r16 INTEGER (0..359~~9~~),

 gamma-delta-r16 INTEGER (0..9) OPTIONAL, -- Need ON

 ...

}

-- ASN1STOP

**Question 5:** Which option should be used for providing the angular information?

 Option 1: Single field with 0.1-degrees resolution.

Option 2: Two fields: One field with 1-degrees resolution, and a second field with 0.1 delta-resolution. Please provide also a brief justification for your answer.

|  |  |  |
| --- | --- | --- |
| Company | Option 1 or Option2  | Comments |
| Ericsson | Option 2 | It is not realistic to assume that beam angles are available at a 0.1 resolution in many realistic cases. As we wrote in the email discusson, 0.1 beam angle resolution is a bit like the electronic home thermometers with a 0.1 degree resolution but with a 2-3 integer degress uncertainty stated on the back of the device.Since beam information could be broadcasted of shared with a large number of UEs, it is relevant to ensure an efficient representation. Therefore, it seems to be relevant with an additional field with an optionality bit to allow an efficient representation of the typical case of integer antenna beam directions. |
| OPPO | No strong opinion |  |
| Huawei | Option 2 | Option 2 can optimize the overhead. |
| CATT | Option 1 | Option 1 is simple and straight forward. Option 2 only could save few bits in some cases (note for some cases, it would even increase the total bits). But if all other companies would like to use option 2, it is acceptable for us also. |
| Apple | Option 1 | No strong view. Slightly prefer Option 1 |
| Nokia | Neither | We prefer that these granularity recommendations come from RAN1/RAN4 and provided as recommended parameters from RAN1. |
| Intel | No strong opinion | If my understanding is correct, the main motivation of option 2 is, it may not be possible to provide 0.1 degree resolution. Then I tend to agree with Nokia, it should come from RAN4.  |

# 3. Summary

# Annex: Text Proposal

## LPP Assistance Data Transfer

#### *– NR-PositionCalculationAssistance*

The IE *NR-PositionCalculationAssistance* is used by the location server to provide assistance data to enable UE‑based downlink positioning.

-- ASN1START

NR-PositionCalculationAssistance-r16 ::= SEQUENCE {

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

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

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

 ...

}

-- ASN1STOP

| *NR-PositionCalculationAssistance* field descriptions |
| --- |
| ***nr-trp-LocationInfo***This field provides the location coordinates of the antenna reference points of the TRPs. |
| ***nr-dl-prs-BeamInfo***This field provides the spatial directions of DL-PRS Resources for TRPs. |
| ***nr-rtd-Info***This field provides the time synchronization information between the reference TRP and neighbour TRPs.  |

#### – *NR-TRP-LocationInfo*

The IE *NR-TRP-LocationInfo* is used by the location server to provide the coordinates of the antenna reference points for a set of TRPs. For each TRP, the ARP location can be provided for each associated PRS Resource ID per PRS Resource Set.

-- ASN1START

NR-TRP-LocationInfo-r16 ::= SEQUENCE (SIZE (1..4)) OF NR-TRP-LocationInfoPerFreqLayer-r16

NR-TRP-LocationInfoPerFreqLayer-r16 ::= SEQUENCE {

 referencePoint-r16 ReferencePoint-r16 OPTIONAL, -- Cond NotSameAsPrev

 trp-LocationInfoList-r16 SEQUENCE (SIZE (1..64)) OF TRP-LocationInfoElement-r16,

 ...

}

TRP-LocationInfoElement-r16 ::= SEQUENCE {

 trp-id-r16 TRP-ID-r16,

 trp-Location-r16 RelativeLocation-r16 OPTIONAL, -- Need OP

 trp-DL-PRS-ResourceSets-r16 SEQUENCE (SIZE(1..2)) OF

 DL-PRS-ResourceSets-TRP-Element-r16 OPTIONAL, -- Need OP

 ...

}

DL-PRS-ResourceSets-TRP-Element-r16 ::= SEQUENCE {

 dl-PRS-ResourceSetARP-r16 RelativeLocation-r16 OPTIONAL, -- Need OP

 dl-PRS-Resource-ARP-List-r16 SEQUENCE (SIZE(1..64)) OF

 DL-PRS-Resource-ARP-Element-r16 OPTIONAL, -- Need OP

 ...

}

DL-PRS-Resource-ARP-Element-r16 ::= SEQUENCE {

 dl-PRS-Resource-ARP-location-r16 RelativeLocation-r16 OPTIONAL, -- Need OP

 ...

}

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *NotSameAsPrev* | The field is mandatory present in the first entry of the *NR-TRP-LocationInfoPerFreqLayer* list; otherwise it is optionally present, need OP. |

| *NR-TRP-LocationInfo* field descriptions |
| --- |
| ***referencePoint***This field specifies the reference point used to define the TRP location in the *trp-LocationInfoList*. If this field is absent, the reference point is the same as in the previous entry of the *NR-TRP-LocationInfoPerFreqLayer* list. |
| ***trp-LocationInfoList***This field provides the antenna reference point locations of the DL-PRS Resources for the TRPs and comprises the following sub-fields:- ***trp-id***: This field provides an identity of the TRP.- ***trp-Location***: This field provides the location of the TRP relative to the *referencePoint* location. If this field is absent the TRP location coincides with the *referencePoint* location. - ***trp-DL-PRS-ResourceSets***: This field provides the antenna reference point location(s) of the DL-PRS Resource Set(s) associated with this TRP. If this field is absent, the antenna reference point location(s) of the DL-PRS Resource Set(s) coincides with the *trp-Location* location. This field comprises the following sub-fields:- ***dl-PRS-ResourceSetARP***: This field provides the antenna reference point location of the DL-PRS Resource Set relative to the *trp-Location* location. If this field is absent, the antenna reference point location of this DL-PRS Resource Set coincides with the *trp-Location* location.- ***dl-PRS-Resource-ARP-List***: This field provides the antenna reference point location(s) of the DL-PRS Resource(s) associated with this resource set of the TRP. If this field is absent, the antenna reference point location(s) of the DL-PRS Resources coincides with the *dl-PRS-ResourceSetARP* location. This field comprises the following sub-fields: - ***dl-PRS-Resource-ARP-location***: This field provides the antenna reference point location of the DL-PRS Resource associated with the DL-PRS Resource Set of the TRP relative to the *dl-PRS-ResourceSetARP* location. If this field is absent, the antenna reference point location of this DL-PRS Resource coincides with the *dl-PRS-ResourceSetARP* location. |

#### – *ReferencePoint*

The IE *ReferencePoint* provides a well defined location relative to which other locations may be defined.

-- ASN1START

ReferencePoint-r16 ::= SEQUENCE {

 referencePointGeographicLocation-r16 CHOICE {

 location3D-r16 EllipsoidPointWithAltitudeAndUncertaintyEllipsoid,

 ha-location3D-r16 HighAccuracyEllipsoidPointWithAltitudeAndUncertaintyEllipsoid-r15,

 ...

 },

 ...

}

-- ASN1STOP

| *ReferencePoint* field descriptions |
| --- |
| ***referencePointGeographicLocation***This field provides the geodetic location of the reference point. |

#### – *RelativeLocation*

The IE *RelativeLocation* provides a location relative to some known reference location.

-- ASN1START

RelativeLocation-r16 ::= SEQUENCE {

 milli-arc-second-units-r16 ENUMERATED { mas0-03, mas0-3, mas3, mas30, ...},

 height-units-r16 ENUMERATED {mm, cm, m, ...},

 delta-latitude-r16 Delta-Latitude-r16,

 delta-longitude-r16 Delta-Longitude-r16,

 delta-height-r16 Delta-Height-r16,

 locationUNC-r16 LocationUncertainty-r16 OPTIONAL, -- Need OP

 ...

}

Delta-Latitude-r16 ::= SEQUENCE {

 delta-Latitude-r16 INTEGER (-1024..1023),

 coarse-delta-Latitude-r16 INTEGER (0..4095) OPTIONAL, -- Need OP

 ...

}

Delta-Longitude-r16 ::= SEQUENCE {

 delta-Longitude-r16 INTEGER (-1024..1023),

 coarse-delta-Longitude-r16 INTEGER (0..4095) OPTIONAL, -- Need OP

 ...

}

Delta-Height-r16 ::= SEQUENCE {

 delta-Height-r16 INTEGER (-1024..1023),

 coarse-delta-Height-r16 INTEGER (0..4095) OPTIONAL, -- Need OP

 ...

}

LocationUncertainty-r16 ::= SEQUENCE {

 horizontalUncertainty-r15 INTEGER (0..255),

 horizontalConfidence-r15 INTEGER (0..100),

 verticalUncertainty-r15 INTEGER (0..255),

 verticalConfidence-r15 INTEGER (0..100)

}

-- ASN1STOP

| *RelativeLocation* field descriptions |
| --- |
| ***milli-arc-second-units***This field provides the units and scale factor for the *delta-latitude* and *delta-longitude* fields. Enumerated values *mas0-03*, *mas0-3*, *mas3*, and *mas30*, correspond to 0.03, 0.3, 3, and 30 milliarcseconds, respectively.  |
| ***height-units***This field provides the units and scale factor for the *delta-height* field. Enumerated values *mm*, *cm*, and *m* correspond to 10-3 metre, 10-2 metre, and 1 metre, respectively. |
| ***delta-latitude***This field specifies the delta value in latitude of the desired location, defined as "desired location" minus "reference point location" and comprises the following sub-fields: - ***delta-Latitude*** specifies the delta value in latitude in the unit provided in *milli-arc-second-units* field.- ***coarse-delta-Latitude*** specifies the delta value in latitude in 1024 times the size of the unit provided in *milli-arc‑second‑units* field and with the same sign as in the *delta-Latitude* field. If this field is absent, the value for *coarse-delta-Latitude*is zero.I.e., the full *delta-latitude* is given by:(*delta-Latitude* × *milli-arc-second-units*)±(*coarse-delta-Latitude* × 1024 × *milli-arc-second-units*) [milli-arc-seconds] |
| ***delta-longitude***This field specifies the delta value in longitude of the desired location, defined as "desired location" minus "reference point location" and comprises the following sub-fields: - ***delta-Longitude*** specifies the delta value in longitude in the unit provided in *milli-arc-second-units* field.- ***coarse-delta-Longitude*** specifies the delta value in longitude in 1024 times the size of the unit provided in *milli-arc‑second‑units* field and with the same sign as in the *delta-Longitude* field. If this field is absent, the value for *coarse-delta-Longitude*is zero.I.e., the full *delta-longitude* is given by:(*delta-Longitude* × *milli-arc-second-units*)±(*coarse-delta-Latitude* × 1024 × *milli-arc-second-units*) [milli-arc-seconds]  |
| ***delta-height***This field specifies the delta value in ellipsoidal height of the desired location, defined as "desired location" minus "reference point location" and comprises the following sub-fields: - ***delta-Height*** specifies the delta value in ellipsoidal height in the unit provided in *height-units* field.- ***coarse-delta-Height*** specifies the delta value in ellipsoidal height in 1024 times the size of the unit provided in *height-units* field and with the same sign as in the *delta-Height* field. If this field is absent, the value for *coarse-delta-Height*is zero.I.e., the full *delta-height* is given by:(*delta-Height* × *height-units*) *±* (*coarse-delta-Height* × 1024 × *height-units*) [metres]  |
| ***locationUNC***This field specifies the uncertainty of the location coordinates and comprises the following sub-fields:- ***horizontalUncertainty*** indicates the horizontal uncertainty of the ARP latitude/longitude. The ′*horizontalUncertainty*′ corresponds to the encoded high accuracy uncertainty as defined in TS 23.032 [15] and ′*horizontalConfidence*′ corresponds to confidence as defined in TS 23.032 [15].- ***verticalUncertainty*** indicates the vertical uncertainty of the ARP altitude. The '*verticalUncertainty*' corresponds to the encoded high accuracy uncertainty as defined in TS 23.032 [15] and '*verticalConfidence*' corresponds to confidence as defined in TS 23.032 [15].If this field is absent, the uncertainty is the same as for the associated reference point location. |

Editor’s NOTE: Inclusion of HPBW parameter in *DL-PRS-Beam-Info* is FFS.

#### – *NR-DL-PRS-BeamInfo*

The IE *NR-DL-PRS-BeamInfo* is used by the location server to provide spatial direction information of the DL-PRS Resources.

-- ASN1START

NR-DL-PRS-BeamInfo-r16 ::= SEQUENCE (SIZE (1..4)) OF NR-DL-PRS-BeamInfoPerFreqLayer-r16

NR-DL-PRS-BeamInfoPerFreqLayer-r16 ::= SEQUENCE (SIZE (1..64)) OF NR-DL-PRS-BeamInfo-r16

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

 trp-id-r16 TRP-ID-r16,

 lcs-gcs-translation-parameter-r16 LCS-GCS-Translation-Parameter-r16 OPTIONAL, -- Need OP

 dl-prs-BeamInfoSet-r16 DL-PRS-BeamInfoSet-r16,

 ...

}

DL-PRS-BeamInfoSet-r16 ::= SEQUENCE (SIZE(1..2)) OF DL-PRS-BeamInfoResourceSet-r16

DL-PRS-BeamInfoResourceSet-r16 ::= SEQUENCE (SIZE(1..64)) OF DL-PRS-BeamInfoElement-r16

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

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

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

-- FFS for HPBW

-- dl-PRS-HPBW-Az-r16 INTEGER (0..1200) OPTIONAL, -- Need ON

-- dl-PRS-HPBW-El-r16 INTEGER (0..1200) OPTIONAL, -- Need ON

 ...

}

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

 alpha-r16 INTEGER (0..3599),

 beta-r16 INTEGER (0..3599),

 gamma-r16 INTEGER (0..3599),

 ...

}

-- ASN1STOP

| *NR-DL-PRS-Beam-Info* field descriptions |
| --- |
| ***trp-id***This field provides an identity of the TRP. |
| ***lcs-gcs-translation-parameter***This field provides the angles α (bearing angle), β (downtilt angle) and γ (slant angle) for the translation of a Local Coordinate System (LCS) to a Global Coordinate System (GCS) as defined in TR 38.901 [x]. If this field is absent, the *dl-PRS-Azimuth* and *dl-PRS-Elevation* are provided in a GCS. |
| ***dl-prs-BeamInfoSet***This field provides the DL-PRS beam information for each DL-PRS Resource of the DL-PRS Resource Set associated with this TRP. |
| ***dl-PRS-Azimuth***This field specifies the azimuth angle of the boresight direction in which the DL-PRS Resources associated with this DL-PRS Resource ID in the DL-PRS Resource Set are transmitted. For a Global Coordinate System (GCS), the azimuth angle is measured counter-clockwise from geographical North.For a Local Coordinate System (LCS), the azimuth angle is measured measured counter-clockwise from the x-axis of the LCS.Scale factor 0.1 degrees; range 0 to 359.9 degrees. |
| ***dl-PRS-Elevation***This field specifies the elevation angle of the boresight direction in which the DL-PRS Resources associated with this DL-PRS Resource ID in the DL-PRS Resource Set are transmitted. For a Global Coordinate System (GCS), the elevation angle is measured relative to zenith and positive to the horizontal direction (elevation 0 deg. points to zenith, 90 deg to the horizon).For a Local Coordinate System (LCS), the elevation angle is measured relative to the z-axis of the LCS (elevation 0 deg. points to the z-axis, 90 deg to the x-y plane).Scale factor 0.1 degrees; range 0 to 180 degrees. |
| ***dl-PRS-HPBW-Az***This field specifies the half-power beamwidth (HPBW) in the horizontal plane of the beam in which the DL-PRS Resources associated with this DL-PRS Resource IDin the DL-PRS Resource Set are transmitted. HPBW is the angle subtended by the half-power points of the mainlobe in the horizontal plane. Scale factor 0.1 degrees; range 0 to 120 degrees. |
| ***dl-PRS-HPBW-El***This field specifies the half-power beamwidth (HPBW) in the vertical plane of the beam in which the DL-PRS Resources associated with this DL-PRS Resource ID in the DL-PRS Resource Set are transmitted. HPBW is the angle subtended by the half-power points of the mainlobe in the vertical plane. Scale factor 0.1 degrees; range 0 to 120 degrees. |
| ***alpha***This field specifies the bearing angle α for the translation of the LCS to a GCS as defined in TR 38.901 [x].Scale factor 0.1 degrees; range 0 to 359.9 degrees. |
| ***beta***This field specifies the downtilts angle β for the translation of the LCS to a GCS as defined in TR 38.901 [x].Scale factor 0.1 degrees; range 0 to 359.9 degrees. |
| ***gamma***This field specifies the slant angle γ for the translation of the LCS to a GCS as defined in TR 38.901 [x].Scale factor 0.1 degrees; range 0 to 359.9 degrees. |

Editor’s NOTE: Inclusion of *rtd-DriftRate* and *delta-rtd-set* parameter in *RTD-Info* is FFS.

#### – *NR-RTD-Info*

The IE *NR-RTD-Info* is used by the location server to provide time synchronization information between a reference TRP and a list of neighbour TRPs.

-- ASN1START

NR-RTD-Info-r16 ::= SEQUENCE {

 referenceTRP-RTD-Info-r16 ReferenceTRP-RTD-Info-r16,

 rtd-InfoList-r16 RTD-InfoList-r16,

 ...

}

ReferenceTRP-RTD-Info-r16 ::= SEQUENCE {

 ref-trp-id-r16 TRP-ID-r16,

 refTime-r16 CHOICE {

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

 utc-r16 UTCTime,

 ...

 },

 rtd-RefQuality-r16 NR-MeasQuality-r16 OPTIONAL, -- Need ON

 ...

}

RTD-InfoList-r16 ::= SEQUENCE (SIZE (1..4)) OF RTD-InfoListPerFreqLayer-r16

RTD-InfoListPerFreqLayer-r16 ::= SEQUENCE (SIZE(1..63)) OF RTD-InfoElement-r16

RTD-InfoElement-r16 ::= SEQUENCE {

 trp-id-r16 TRP-ID-r16,

 subframeOffset-r16 INTEGER (0..1966079),

 rtd-Quality-r16 NR-MeasQuality-r16,

-- FFS on drift rate

-- rtd-DriftRate-r16 INTEGER (-256..255) OPTIONAL, -- Need ON

-- FFS on delta-rtd-set

-- delta-rtd-set-r16 SEQUENCE (SIZE (1..2)) OF

-- Delta-RTD-ResourceSet-r16 OPTIONAL, -- Need ON

 ...

}

Delta-RTD-ResourceSet-r16 ::= SEQUENCE {

 delta-rtd-r16 INTEGER (-64..63) OPTIONAL, -- Need ON

 delta-rtd-ResourceList-r16 SEQUENCE (SIZE (1..64)) OF

 Delta-RTD-ResourceElement-r16 OPTIONAL, -- Need ON

 ...

}

Delta-RTD-ResourceElement-r16 ::= SEQUENCE {

 delta-rtd-r16 INTEGER (-64..63) OPTIONAL, -- Need ON

 ...

}

-- ASN1STOP

| *NR-RTD-Info* field descriptions |
| --- |
| ***referenceTRP-RTD-Info***This field defines the reference TRP for the RTD and comprises the following sub-fields:- ***ref-trp-id***: This field specifies the identity of the reference TRP.- ***refTime***: This field specifies the reference time at which the *rtd-InfoList* is valid. The *systemFrameNumber* choice refers to the SFN of the reference TRP. - ***rtd-RefQuality***: This field specifies the quality of the timing of reference TRP, used to determine the RTD values provided in *rtd-InfoList*. |
| ***trp-id-r16***This fields provides the identity of the TRP for which the *RTD-InfoElement* is applicable. |
| ***subframeOffset***This field specifies the subframe boundary offset at the TRP antenna location between the reference TRP and this neighbour TRP in time units  where $Δf\_{max}=480∙10^{3}$ Hz and  (TS 38.211 [x]). The offset is counted from the beginning of a subframe #0 of the reference TRP to the beginning of the closest subsequent subframe of this neighbour TRP.Scale factor 1 Tc. |
| ***rtd-Quality***This field specifies the quality of the RTD. |
| ***rtd-DriftRate***This field specifies the drift rate of the RTD between the reference TRP and this neighbour TRP in units of 0.5 Tc per second. A positive value indicates that the reference TRP clock is running at a greater frequency than the neighbour TRP clock.Scale factor 0.5 Tc/sec. |
| ***delta-rtd***This field provides a delta RTD value to be added to the RTD of the TRP for the corresponding DL-PRS Resource in the Resource Set. Scale factor 0.5 Tc |

## posSIB Types Element Definitions

#### – *NR-UEB-TRP-LocationData*

The IE *NR-UEB-TRP-LocationData* is used in the *assistanceDataElement* if the *posSibType* in IE *PosSIB-Type* defined in TS 38.331 [x] indicates '*posSibTypeX-y*'.

-- ASN1START

NR-UEB-TRP-LocationData-r16 ::= SEQUENCE {

 nr-trp-LocationInfo-r16 NR-TRP-LocationInfo-r16,

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

 ...

}

-- ASN1STOP

| *NR-UEB-TRP-LocationData* field descriptions |
| --- |
| ***nr-trp-LocationInfo*** LPP IE *NR-TRP-LocationInfo* as defined in sub-clause x.y.z.b. |
| ***nr-dl-prs-BeamInfo***LPP IE *NR-DL-PRS-Beam-Info* as defined in sub-clause x.y.z.c. |

#### – *NR-UEB-TRP-RTD-Info*

The IE *NR-UEB-TRP-RTD-Info* is used in the *assistanceDataElement* if the *posSibType* in IE *PosSIB-Type* defined in TS 38.331 [x] indicates '*posSibTypeX-z*'.

-- ASN1START

NR-UEB-TRP-RTD-Info-r16 ::= SEQUENCE {

 nr-rtd-Info-r16 NR-RTD-Info-r16,

 ...

}

-- ASN1STOP

| *NR-UEB-TRP-RTD-Info* field descriptions |
| --- |
| ***nr-rtd-Info*** LPP IE *NR-RTD-Info* as defined in sub-clause x.y.z.c. |