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

Online, June 01 – 12, 2020

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

**Source:** Ericsson

**Title:** Email discussion report: [Post109bis-e][949][POS] Structure of UE-based assistance data (Ericsson)

**Document for:**  Discussion and Decision

# 1. Introduction

This document summarizes the following email discussion:

* [Post109bis-e][949][POS] Structure of UE-based assistance data (Ericsson)

      Scope: Discuss the structure of UE-based assistance data and determine if changes are needed to minimise repetition of information.

      Intended outcome: Report to next meeting

      Deadline:  Long

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

From [1], [2] and [3], it was clear that the baseline representation of TRP location, beam info and possibly also RTD is not efficient in all cases. [1] analysed the PER-encoded number of bytes for two example scenarions, considering a *matching hierarchy* representation (baseline) and a *liear list structure* respresentation, where the letter was seen as much more efficient. During the email discussion [3], Qualcomm suggested a change to the baseline representation to make the representation more flexible, and in particular better at avoiding repeating UEB AD information that is the same. This one is referred to as a a *matching structure with reference option* representation.

In this email discussion, we will discuss these different representations to agree on an efficient structure for UEB AD.

# 2. References

[1] R2-2003144, “Important LPP structural aspects”, Ericsson

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

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

# 3. Discussion

In order to analyze PER-encoded ASN.1 examples, we consider the two examples in [1] based on 3GPP IOO:

1. IOO, FR1, 1 frequency layer, 12 TRPs, 1 Resource Set of 1 DL-PRS resource per TRP (minimalistic setup)
2. IOO, FR2, 2 frequency layers, 12 3-sector nodes (36 TRPs), 1 resource set of 8 DL-PRS resources per TRP

For these two, we encode the NR-DL-PRS-AssistanceDataList and the UEB NR-TRP-LocationInfoLIst based on the matching hierarchies (baseline), matching hierarchy with a reference option and the flat linear list structure (FS – flat structure) respectively. The PER-encoded ASN.1 in bytes becomes:

Table . PER-encoded ASN.1 in bytes of the combination of two IEs for two key scenarios.

|  |  |  |
| --- | --- | --- |
|  | Example 1, IOO FR1 | Example 2, IOO FR2 |
|  | Matching hierarchies (baseline) | Matching hierarchies with reference option | Linear list structure | Matching hierarchies with reference option | Matching hierarchies (baseline) | Linear list structure |
| NR-DL-PRS-AssistanceDataList | 290 | 290 | 314 | 5205 | 5205 | 5350 |
| NR-TRP-LocationInfoLIst | 211 | 212 | 187 | 1189 | 393 | 187 |
| In total | 501 | 502 | 501 | 6394 | 5598 | 5537 |

In the email discussion [2], companies indicated a preference for a matching structure, but there were concerns raised about the overhead in some scenarios. With the matching structure with a reference option, most of the reduction in message size can be achieved, as seen from the table.

If also the beam information is the same for two TRPs at the same location but at different frequency layers, there can be additional savings in size due to the the beam information, as illustrated in [1].

In the following subsections, companies are asked to provide comments to the preferred representation for location, beam and RTD information. Furthermore, a text proposal adopting the proposal by Qualcomm to make the matching structure representation more efficient, can be found in the Annex.

## 3.1 Location information representation

As seen in Table 1, the matching structure with the TRP reference option is almost as efficient as the linear list. Given that companies indicated a preference for a matching structure in the email discussion, the addition of a TRP reference seem to be reasonable compromise. Essentially, it means that the location information of a TRP is either provided with details, or as a reference to another TRP with the same location information.

Companies are asked to provide comments to the suggested addition of a TRP reference to avoid duplication of location information when several TRPs are co-located, typically the case with more than one frequency layer.

|  |
| --- |
| Table 3.1 Optional TRP reference in TRP location information IE to avoid data duplication |
| Company | Comments |
|  |  |
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## 3.2 Beam information representation

As seen in [1], beam information can combine into a considerable amount of assistance data. If TRPs have the same beam configuration, for example two TRPs at the same location but at different frequency layers, then it is much more efficient to use a reference to the other TRP instead of repeating the beam information.

Companies are asked to provide comments to the suggested addition of a TRP reference to avoid duplication of beam information when several TRPs are co-located, typically the case with more than one frequency layer.

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| --- |
| Table 3.2 Optional TRP reference in TRP beam information IE to avoid data duplication |
| Company | Comments |
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## 3.3 RTD information representation

Depending on how TRPs are designed and deployed, it is possible that two TRPs have the same RTD configuration, for example two TRPs at the same location but operating at different frequency layers. In such cases, it is much more efficient to use a reference to the other TRP instead of repeating the RTD information.

Companies are asked to provide comments to the suggested addition of a TRP reference to avoid duplication of RTD information when several TRPs are co-located, typically the case with more than one frequency layer.

|  |
| --- |
| Table 3.2 Optional TRP reference in TRP RTD information IE to avoid data duplication |
| Company | Comments |
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## 3.4 Text Proposal

The optional TRP reference has been introduced in a text proposal in the Annex.

Companies are asked to provide comments to the text proposal with the suggested addition of a TRP reference to avoid duplication of assistance data when several TRPs are co-located, typically the case with more than one frequency layer.

|  |
| --- |
| Table 3.4 Text proposal with an optional TRP reference in the Annex |
| Company | Comments |
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# 4. Conclusion

# Annex 1, Text proposal to 3GPP TS 37.355 for efficient representation of UEB AD

*[…]*

### 6.4.3 Common NR Positioning Information Elements

#### 6.4.3.1 Common NR assistance data Information Elements

 *[…]*

*–* *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,

 associatedTRP-ID-r16 TRP-ID-r16 OPTIONAL,

 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.- ***associatedTRP-ID***: This field provides a reference to another TRP with the same location information. - ***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 meter, and 1 meters, 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*) [meters]  |
| ***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. |

– *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,

 associatedTRP-ID-r16 TRP-ID-r16 OPTIONAL,

 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

 ...

}

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. |
| ***associatedTRP-ID***This field provides a reference to another TRP with the same beam information. |
| ***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 [44]. 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. |
| ***alpha***This field specifies the bearing angle α for the translation of the LCS to a GCS as defined in TR 38.901 [44].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 [44].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 [44].Scale factor 0.1 degrees; range 0 to 359.9 degrees. |

 – *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,

 associatedRefTRP-ID-r16 TRP-ID-r16 OPTIONAL,

 refTime-r16 CHOICE {

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

 utc-r16 UTCTime,

 ...

 },

 rtd-RefQuality-r16 NR-TimingMeasQuality-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,

 associatedTRP-ID-r16 TRP-ID-r16 OPTIONAL,

 subframeOffset-r16 INTEGER (0..1966079),

 rtd-Quality-r16 NR-TimingMeasQuality-r16,

 ...

}

-- 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.- ***associatedRefTRP-ID***: This field provides a reference to another TRP with the same reference RTD information. - ***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. |
| ***associatedTRP-ID***This field provides a reference to another TRP with the same RTD information. |
| ***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 [41]).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. |