3GPP TSG-RAN WG2 Meeting #119-e ***R2-22xxxxx***

Electronic Meeting, August 17 – 29, 2022

**Agenda item:** 5.3.3

**Source:** Qualcomm Incorporated

**Title:** Summary of [AT119-e][407][POS] Rel-15/16 LPP (Qualcomm)

**Document for:**  Discussion

# 1. Introduction

This document summarizes the following email discussion:

* [AT119-e][407][POS] Rel-15/16 LPP (Qualcomm)

      Scope: Evaluate the CRs in R2-2207103/R2-2207104/R2-2207870/R2-2207871/R2-2207872/R2-2208069/R2-2208070/R2-2208071/R2-2208121/R2-2208123 and check for agreeability (discussion document in R2-2208119 can be taken into account).

      Intended outcome: Agreed CRs

      Deadline: Tuesday 2022-08-23 1200 UTC

##### References:

[1] R2-2207103, "Minor corrections on TS 37.355", CATT.

[2] R2-2207104, "Minor corrections on TS 37.355", CATT.

[3] R2-2207870, "Correction to need code in posSIB\_R17", Huawei, HiSilicon.

[4] R2-2207871, "Correction to need code in posSIB\_R16", Huawei, HiSilicon.

[5] R2-2207872, "Correction to need code in posSIB\_R15", Huawei, HiSilicon.

[6] R2-2208069, "Correction of TRP beam information field descriptions for UEB DL-AoD", Ericsson.

[7] R2-2208070, "Clarification on NR-DL-PRS-ResourcesCapability", Ericsson.

[8] R2-2208071, "Clarification on NR-DL-PRS-ResourcesCapability", Ericsson.

[9] R2-2208119, "Issues with DL-PRS Search Window Definitions", Qualcomm Incorporated. discussion

[10] R2-2208121, "Correction to DL-PRS Search Window calculation", Qualcomm Incorporated.

[11] R2-2208123, "Correction to DL-PRS Search Window calculation", Qualcomm Incorporated.

# 2. Phase-1 Discussion

## 2.1 Common Positioning

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| [**R2-2207103**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_119-e/Docs/R2-2207103.zip) | Minor corrections on TS 37.355 | CATT |
| [**R2-2207104**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_119-e/Docs/R2-2207104.zip) | Minor corrections on TS 37.355 | CATT |

Contributions [1],[2] propose the following corrections:

**Reason for change:**

1. The IE environment in *CommonIEsRequestLocationInformation* which provides the target device with information about expected multipath and non line of sight (NLOS) in the current area is for A-GNSS, not for RAT-Dependent positioning methods.

2. Editorial corrections: UL-PRS should be UL SRS for positioning.

**Summary of change:**

1. Clarify the IE environment in *CommonIEsRequestLocationInformation* is for A-GNSS.

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| --- |
| ***environment***  This field provides the target device with information about expected multipath and non line of sight (NLOS) for A-GNSS in the current area. The following values are defined:  - badArea: possibly heavy multipath and NLOS conditions (e.g. bad urban or urban).  - notBadArea: no or light multipath and usually LOS conditions (e.g. suburban or rural).  - mixedArea: environment that is mixed or not defined.  If this field is absent, a default value of 'mixedArea' applies. |

2. Editional corrections: UL-PRS should be UL SRS for positioning.

**Consequences if not approved:**

The target and LMF will take different understanding on the environment in *CommonIEsRequestLocationInformation* when several types of environments involved, e.g. the hybrid positioning methods including A-GNSS and RAT-Dependent positioning.

**Moderator's Comments:**

- On change (1), it is not clear why the Rel-16 [1] and Rel-17 [2] proposed changes are different.

- On change (1), the *environment* field is not for A-GNSS only. This field was copied from RRLP 44.031 (which was used as guideline for LPP Rel-9), originally intended for E-OTD but added to common positioning in LPP. This change, if agreed, may create backwards compatibility issues.

- Change (2) looks "editorial".

**Question 1:** Do you agree that the proposed changes in R2-2207103 [1] and R2-2207104 [2] are essential corrections? If yes, do you have any comments on the CRs provided in [1] and [2]?

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| --- | --- | --- |
| Company | Essential Correction Yes/No | Comments |
| Intel | No | Agree Moderator’s comments. No essential as there is no interoperability issues. The environment was introduced from Rel-9. Do not see why we should correct it for now? UL-PRS, do not see the serious problem. If anything is needed, LPP Rapporteur can capture it in Rapporteur CR. |
| Qualcomm | No | The CR seems not correct.  The editorial correction (change 2) can be merged into another Rel-16 LPP CR (if there is any). |
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## 2.2 Need Codes for posSIB

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| [**R2-2207870**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_119-e/Docs/R2-2207870.zip) | Correction to need code in posSIB\_R17 | Huawei, HiSilicon |
| [**R2-2207871**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_119-e/Docs/R2-2207871.zip) | Correction to need code in posSIB\_R16 | Huawei, HiSilicon |
| [**R2-2207872**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_119-e/Docs/R2-2207872.zip) | Correction to need code in posSIB\_R15 | Huawei, HiSilicon |

Contributions [3],[4],[5] propose the following corrections:

**Reason for change:**

It should be clarified in the description that all the fields with need ON should be interpreted as need OR when included in the system information. Otherwise, for example, if the network has system information update and does not want to support a certain feature, the UE will keep it with need ON. This is clearly not the intended UE behaviour.

**Summary of change:**

Clarify that all the fields with need ON should be interpreted as need OR:

For the optional fields defined in posSIBs, the UE should consider the need code to be "Need OR" if it is originally specified as "Need ON" within its corresponding *assistanceDataElement*.

**Consequences if not approved:**

It is misleading to adopt need ON for optional fields in posSIB.

**Moderator's Comments:**

- This seems not strictly needed, since 36.331 and 38.331 specify the posSIB handling.

**Question 2:** Do you agree that the proposed changes in R2-2207870 [3], R2-2207871 [4] and R2-2207872 [5] are essential corrections? If yes, do you have any comments on the CRs provided in [3],[4],[5]?

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| --- | --- | --- |
| Company | Essential Correction Yes/No | Comments |
| Intel | No | Agree with Moderator. Do not see the serious problem on this. Should not it be very rare case that the network suddenly do not want to support some positioning methods? And how can the change work for legacy UE?  In addition, the changes cannot cover NR case, scnie Need R is used; |
| Qualcomm | No | We don't really see the problem. |
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## 2.3 *associated-DL-PRS-ID* in IE *NR-DL-PRS-BeamInfo*

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| [**R2-2208069**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_119-e/Docs/R2-2208069.zip) | Correction of TRP beam information field descriptions for UEB DL-AoD | Ericsson |

The contribution [6] discusses some issues with the *associated-DL-PRS-ID* in IE *NR-DL-PRS-BeamInfo.* According to [6], the motivation for the *associated-DL-PRS-ID* in IE *NR-DL-PRS-BeamInfo* was to potentially reduce overhead. Essentially, the beam information (*DL-PRS-BeamInfoSet-r16*) can be defined in a local coordinate system (LCS) and may be the same for several TRPs in the assistance data list. This (common) beam information could then be rotated using the *LCS-GCS-TranslationParameter-r16* to make the beam information applicable to a specific TRP. However, this is not possible with the current specification, since the field description currently defines:

| ***associated-DL-PRS-ID***  This field specifies the *dl-PRS-ID* of the associated TRP from which the beam information and parameters for LCS to GCS translation are adopted. If the field is omitted, the beam information is provided via the *dl-prs-BeamInfoSet* field and the LCS to GCS translation parameter is provided via the *lcs-GCS-TranslationParameter*. If the field is present, the fields *lcs-GCS-TranslationParameter* and *dl-PRS-BeamInfoSet* shall be absent. |
| --- |
| ***lcs-GCS-TranslationParameter***  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 and the field associated-DL-PRS-ID are 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. |

Therefore, if an *associated DL-PRS ID* is present (essentially, the "reference TRP" from which the beam information is being used), both, the actual beam information (*dl-PRS-BeamInfoSet*) and LCS-GCS parameter (*lcs-GCS-TranslationParameter*) are absent.

Contribution [6] then notes that for the Rel-17 IE *NR-TRP-BeamAntennaInfo,* it is possible to provide the *lcs-GCS-TranslationParameter* when an associated DL-PRS ID is provided:

| ***associated-DL-PRS-ID***  This field specifies the *dl-PRS-ID* of the associated TRP from which the beam antenna information is obtained. See the field descriptions for *nr-TRP-BeamAntennaAngles* and *lcs-GCS-TranslationParameter*. |
| --- |
| ***lcs-GCS-TranslationParameter***  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 and the *associated-DL-PRS-ID* field are both absent, the *azimuth* and *elevation* are provided in a GCS. If this field is absent and the *associated-DL-PRS-ID* field is present, then the *lcs-GCS-TranslationParameter* for this TRP is obtained from the *lcs-GCS-TranslationParameter* of the associated TRP. |
| ***nr-TRP-BeamAntennaAngles***  This field provides the relative power between DL-PRS Resources per angle per TRP. If this field is absent and the field *associated-DL-PRS-ID* is present, the *nr-TRP-BeamAntennaAngles* for this TRP are obtained from the *nr-TRP-BeamAntennaAngles* of the associated TRP. |

Contribution [6] then makes the following (main) proposal:

Proposal 1 [6]: Correct the behaviour description of associated-DL-PRS-ID-r16 and lcs-GCS-TranslationParameter-r16 using one of the Options below

• Option 1. Correct the field description without any capability

• Option 2. Correct the field description with a specific new bit enhBeamInfoSup in the field nr-PosCalcAssistanceSupport-r17

• Option 3. Correct the field description with a specific new capability enhBeamInfoSup-r16

**Moderators Comments:**

* It seems the different options propose to make either a (strictly speaking) non-backwards compatible change (Option 1), or a backwards compatible change by adding some UE capabilities (Options 2/3).
* However, for a "strict backwards compatible change" (Option 2/3) the current Rel-16 interpretation/specification needs to be retained, and a UE capability would be needed to allow indication of which version is supported by the UE (the existing Rel-16 interpretation, or the proposed new interpretation). Since for Rel-16 *NR-PositionCalculationAssistance* there is only a single bit for request and no differentiation in the UE capabilities, any additional UE capability must be added to both, DL-AoD and DL-TDOA IEs.
* Adding a UE capability (Option 2/3) seems not enough since the IE *NR-DL-PRS-BeamInfo* may also be provided via broadcast (IE *NR-UEB-TRP-LocationData*). A UE would need to know which version/interpretation the NW is using when broadcasting the *NR-DL-PRS-BeamInfo*.
* Moderator believes there are the following general 3 Alternatives:

**Alternative 1:** No correction is needed.

I.e., there is nothing wrong with the current specification. However, with the current specification it would not be possible to reduce some overhead in some cases (as it seems was the intention with the *associated-DL-PRS-ID*).

**Alternative 2:** Modify the field description as proposed in [6]; i.e., align with the corresponding field description for the IE *NR-TRP-BeamAntennaInfo.*

As discussed in [6], this alternative would be – very strictly speaking – not backwards compatible. It is unclear how existing UEs (if any) would behave if the *associated-DL-PRS-ID* together with the *lcs-GCS-TranslationParameter* is present. A UE may detect a "configuration error" and may e.g., ignore the whole assistance data (since not a valid configuration according to current specification).

**Alternative 3:** Make a strict backwards compatible change.

Moderator believes this requires the introduction of a new IE, e.g., *NR-DL-PRS-BeamInfo-2*, together with new UE capabilities. The new IE *NR-DL-PRS-BeamInfo-2* would be mostly the same as the Rel-16 IE *NR-DL-PRS-BeamInfo,* but with the modified field description (as in Alternative 2).  
The new IE *NR-DL-PRS-BeamInfo-2* could then be included in both, IE *NR-PositionCalculationAssistance* and IE *NR-UEB-TRP-LocationData*. In that way, there would be no confusion on which version(s)/interpretation(s) the UE supports, and which version(s)/interpretation(s) a NW provides (both, via LPP and via posSIB). However, this requires quite some additional ASN.1 and it may end up that both version(s)/interpretation(s) may have to be supported by UEs/NWs in practice.

**Question 3:** Regarding the *associated-DL-PRS-ID* in IE *NR-DL-PRS-BeamInfo*, which of the 3 Alternatives outlined above is preferred?

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| Company | Alt. 1/2/3 /other | Comments |
| Intel | Alt1 | We understand the intention of the change is to reduce the signalling load if the configuration can be common. This is the signalling optimization instead of the correction. Do not think the need to optimize rel-16. |
| Qualcomm | Alt2 | Otherwise, the *associated-DL-PRS-ID* seems useless. |
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## 2.4 Positioning Frequency Layer

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| [**R2-2208070**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_119-e/Docs/R2-2208070.zip) | Clarification on NR-DL-PRS-ResourcesCapability | Ericsson |
| [**R2-2208071**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_119-e/Docs/R2-2208071.zip) | Clarification on NR-DL-PRS-ResourcesCapability | Ericsson |

Contributions [7],[8] propose the following corrections:

**Reason for change:**

From TS 37.355 specification perspective, there is definition of positioning frequency layer. The term frequency layer or positioning layer on its own is not defined. However, in one occurrence of TS 37.355, it mentions frequency layer without positioning and in the other occurrence there is positioning layer which should be positioning frequency layer.

**Summary of change:**

The field descriptions are clarified that it is indeed a positioning frequency layer:

| ***maxNrOfDL-PRS-ResourceSetPerTrpPerFrequencyLayer***  Indicates the maximum number of DL-PRS Resource Sets per TRP per positioning frequency layer supported by UE. |
| --- |
| ***maxNrOfTRP-AcrossFreqs***  Indicates the maximum number of TRPs across all positioning frequency layers. |
| ***maxNrOfPosLayer***  Indicates the maximum number of supported positioning frequency layers. |

**Consequences if not approved:**

Risk of misunderstanding. Incomplete specification.

**Moderator's Comments:**

- Looks "editorial".

**Question 4:** Do you agree that the proposed changes in R2-2208070 [7] and R2-2208071 [8] are essential corrections? If yes, do you have any comments on the CRs provided in [7],[8]?

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| Company | Essential Correction Yes/No | Comments |
| Intel | No | Editorial changes. |
| Qualcomm |  | Can be merged into another Rel-16 LPP CR (if there is any). |
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## 2.5 DL-PRS Search Window

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| [**R2-2208119**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_119-e/Docs/R2-2208119.zip) | Issues with DL-PRS Search Window Definitions | Qualcomm Incorporated |
| [**R2-2208121**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_119-e/Docs/R2-2208121.zip) | Correction to DL-PRS Search Window calculation | Qualcomm Incorporated |
| [**R2-2208123**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_119-e/Docs/R2-2208123.zip) | Correction to DL-PRS Search Window calculation | Qualcomm Incorporated |

Contribution [9] discusses some issues with the DL-PRS assistance data definitions which can lead to wrong DL-PRS search window calculations, and therefore, failure in acquiring the DL-PRS at the target device.

The issue comes from the fact that (a) the timing offsets at the TRP locations (SFN offsets) are defined positively (towards the "next subframe boundary") whereas the timing offset at the UE location ((expected) RSTD) can be positive or negative (towards the "closest subframe boundary"); and (b) the window centre calculations use a mixture of timings at TRP location and UE location.

Essentially, the search window should be offset by (relative to reference TRP timing)

geometric RSTD (propagation delay difference) + transmission offset + DL-PRS offset

which corresponds to

geometric RSTD + residual offset (i.e., fractional part of the subframe offset) + *N.*

The expected RSTD (= geometric RSTD + residual offset) is wrapped to (-0.5,0.5). Therefore, the expected RSTD + *N* is wrong whenever there is a wrap around (e.g., a 0.9 ms residual offset would be wrapped to -0.1 ms expected RSTD).

The LMF would know when this wrap around happens (which depends on both, transmission offset (RTD) and geometric delay difference (a-priori UE location)), and therefore, would know when a 1 ms offset need to be added to *N* to obtain the correct starting subframe of the DL-PRS of a neighbour TRP.

Contributions [10],[11] propose the following corrections:

**Reason for change:**

The DL-PRS search window calculations specified in the field description for *nr-DL-PRS-ExpectedRSTD-Uncertainty* can fail if the geometric time difference (propagation delay difference) is not zero and/or the expected RSTD is negative as described in further detail in R2-2208119. A "search window" offset" of 1 ms would be required in certain situations and combinations of transmit time offset and propagation delay differences.

**Summary of change:**

A *searchWindowOffset* parameter is added to the IE *NR-DL-PRS-AssistanceDataPerTRP,* which can take the values 0 or 1, and which should be added to N when calculating the centre location of the DL-PRS search window.

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-AssistanceDataPerFreq-Ext-r16

SEQUENCE (SIZE (1..nrMaxTRPsPerFreq-r16)) OF

NR-DL-PRS-AssistanceDataPerTRP-Ext-r16

]]

}

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

dl-PRS-ID-r16 INTEGER (0..255),

nr-PhysCellID-r16 NR-PhysCellID-r16 OPTIONAL, -- Need ON

nr-CellGlobalID-r16 NCGI-r15 OPTIONAL, -- Need ON

nr-ARFCN-r16 ARFCN-ValueNR-r15 OPTIONAL, -- Need ON

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

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

nr-DL-PRS-ExpectedRSTD-Uncertainty-r16

INTEGER (0..246),

nr-DL-PRS-Info-r16 NR-DL-PRS-Info-r16,

...,

[[

prs-OnlyTP-r16 ENUMERATED { true } OPTIONAL -- Need ON

]]

}

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

searchWindowOffset-r16 ENUMERATED { m0, m1, ... } OPTIONAL -- Need ON

...

}

|  |
| --- |
| ***nr-DL-PRS-ExpectedRSTD-Uncertainty***  This field indicates the uncertainty in *nr-DL-PRS-ExpectedRSTD* value.The uncertainty is related to the location server′s a‑priori estimate of the target device location. The *nr-DL-PRS-ExpectedRSTD* and *nr-DL-PRS-ExpectedRSTD-Uncertainty* togetherdefine the search window for the target device.  The resolution R is  - Ts if all PRS resources are in frequency range 2,  - 4×Ts otherwise,  with Ts=1/(15000\*2048) seconds.  The target device may assume that the beginning of the subframe for the PRS of this TRP is received within the search window of size  - [*-nr-*DL*-PRS-ExpectedRSTD-Uncertainty*×R *;* *nr-DL-PRS-ExpectedRSTD-Uncertainty*×R] centred at TREF*+*1 millisecond×(N+M)+*nr-DL-PRS-ExpectedRSTD*×4×Ts,  where TREF is the reception time of the beginning of the subframe for the PRS of the assistance data reference TRP at the target device antenna connector, N can be calculated based on  - *nr-DL-PRS-SFN0-Offset*  - *dl-PRS-Periodicity-and-ResourceSetSlotOffset*  - *dl-PRS-ResourceSlotOffset*  and M is given by *searchWindowOffset*. |
| ***searchWindowOffset***  This field specifies the excess value to be added to *N* when computing the centre location of the search window as described in *nr-DL-PRS-ExpectedRSTD-Uncertainty* field description. Enumerated value '*m0'* indicates M=0, '*m1*' indicates M=1. |

**Consequences if not approved:**

The calculation of the DL-PRS search window centre may result in an incorrect starting subframe of the DL-PRS of a neighbour TRP, and therefore, DL-PRS acquisition may fail.

**Moderator's Comments:**

- Since the IE *NR-DL-PRS-AssistanceDataPerTRP* is already extended in Rel-17, the extension needs to be one level higher in the ASN.1 (as proposed in [10],[11]), otherwise the Rel-17 version would require a non-backwards compatible change.

**Question 5:** Do you agree that the proposed changes in R2-2208121 [10] and R2-2208123 [11] are essential corrections? If yes, do you have any comments on the CRs provided in [10],[11]?

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| --- | --- | --- |
| Company | Essential Correction Yes/No | Comments |
| Intel |  | The contribution raised a good point. It is worth to dig into the details. However should not this be discussed in RAN1/4 first? |
| Qualcomm | Yes (proponent) | To Intel:  This was introduced by RAN2 via [R2-2007836](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2007836.zip) at RAN2#111-e. The issue was (partly) already discovered in R2-2007836:  "In this version of specification, only non-negative values shall be signalled."  The above sentence, however, has been deleted in the agreed CR since it covers only part of the problem. The issue has then been "forgotten". I don't think this can be fixed in RAN1/4. |
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# 3. Phase-2 Discussion

TBD