**3GPP TSG-RAN WG2 Meeting #117-eR2-22xxxxx**

**Electronic meeting, Feb 21st – March 4th, 2022**

**Agenda item:** 8.11.2.6

**Source:** CATT

**Title:** Report of [Pre117-e][611][POS] Open issues on positioning accuracy enhancements (CATT)

**Document for:** Discussion and Agreement

# 1 Introduction

This is the report of following offline discussion:

* [Pre117-e][611][POS] Open issues on positioning accuracy enhancements (CATT)

The expected output of this offline discussion will include:

* TPs for running CR (LPP and RRC)
* Proposals for running CR
* Open issue list, including been resolved, still left, and new identified.

Note: No company tdocs are expected on the open issues which are discussed in section 3, as guided by Chair: [Pre117-e] discussions for Company inputs without tdoc.

Deadline for comments (from companies): Monday 2022-02-14 1800 UTC;

Proposals for review (from companies): Thursday 2022-02-17 1200 UTC.

# 2 Contact Information

Respondents to the email discussion are kindly asked to fill in the following table.

|  |  |
| --- | --- |
| Company | Contact: Name (E-mail) |
| Qualcomm | sfischer@qti.qualcomm.com |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

# 3 Discussion

The open issues which are captured in the Report of email discussion [Post116bis-e][634][POS] Positioning open issues list (Intel) [3] and Summary of [Post116bis-e][628][POS] 37.355 running CR (Qualcomm) [4] will be further discussed here one by one.

## 3.1 Mitigation of UE/TRP Rx/Tx timing delays

**Background of Mitigating UE/TRP Rx/Tx timing errors:**

For DL-TDOA, RSTD measurements are impacted by UE Rx/TRP Tx timing errors;

For UL-TDOA, RTOA measurements are impacted by UE Tx/TRP Rx timing errors;

For Multi-RTT, UE/gNB Rx-Tx time difference measurements are impacted by UE/TRP Tx/Rx timing errors;

A UE may have multiple Tx/Rx RF chains (e.g., multiple Tx/Rx antenna panels):

* Different UE Tx/Rx RF chains may have different Tx/Rx timing errors
* Differentiation of the timing measurements from different Tx/Rx RF chains does not eliminate the impact of Tx/Rx timing errors

For example, when a RSTD measurement is obtained from the same UE Rx RF chain, the RSTD is not impacted by UE Rx timing errors. However, if a RSTD is obtained from two TOAs measured from two different UE Rx RF chains, the RSTD measurement is impacted by the difference of the Rx timing errors of the two UE Rx RF chains.



### 3.1.1 UE Tx TEG association for Multi-RTT via LPP

The inclusion of report UE Tx TEG association for Multi-RTT via LPP was proposed by CATT in R2-2200300, and Qualcomm in R2-2200959. For multi-RTT case, UE Rx-Tx measurement is related to UE Rx TEG and UE Tx TEG, or UE RxTxTEG. Only if UE reports Tx TEG IDs, the LMF needs to know the UE Tx TEG association of the reported Tx TEG IDs. The LMF does not need to know the UE Tx TEG association of un-reported Tx TEG IDs.

|  |
| --- |
| Agreement:*Confirm and modify the working assumption with the following modifications:** *For mitigating UE Tx timing errors for Multi-RTT, subject to UE’s capability, support the LMF to request a UE to provide the association information of UL SRS resources for positioning with Tx TEGs directly to the LMF if the UE supports multiple Tx TEGs for Multi-RTT.*
	+ *~~FFS: whether to support the LMF to forward the association information to the serving and neighboring gNBs~~*
	+ *UE should report its capability of supporting multiple UE Tx TEGs for Multi-RTT directly to the LMF.*
* *Note: For mitigating UE Tx timing errors when both UL-TDOA and Multi-RTT, or UL-TDOA and DL-TDOA are used, the UE should provide the association information of UL SRS resources for positioning with Tx TEGs, subject to UE capability (in the bullets above):*
	+ *to the serving gNB if a request to provide the association information is received from the gNB*
	+ *to the LMF if a request to provide the association information is received from the LMF.*
* *~~FFS: Mitigation of UE Tx timing errors when Multi-RTT, UL-TDOA and/or DL-TDOA are used.~~*
 |

The UE Tx TEG association request and report for Multi-RTT which was required by RAN1 can be briefly summarized as follows according to RAN1 LS[1]:

1. There is no configurable periodicities and change of TxTEG request for Multi-RTT from RAN1.
2. How to indicate the association information of UL SRS resources for Multi-RTT with Tx TEGs?

For multi-RTT case, periodic reporting was also discussed, but not agreed in RAN1. Since the UE can report the Tx TEG directly to the LMF when the UE reports the UE Rx-Tx, some companies in RAN1 think there is no need to specifically configure periodic reporting. So there is no periodic reporting request from RAN1.

**Question 1: Do companies agree that no configurable periodicities and no change of TxTEG request for Multi-RTT from RAN1? Please provide also a brief justification for your answer.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | No | 1. I can not see why a TxTEG depends on the positioning method (i.e., should be independent on e.g., UL-TDOA or Multi-RTT since it only provides the SRS/TEG association.). 2. It is unclear what "configurable periodicities" mean. For any LPP positioning method, dependent on UE capabilities, periodic reporting can be supported. 3. A TxTEG change within a measurement report (i.e., within Response Time) can be indicated with a time stamp (see Question 2). |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

How to indicate the association information of UL SRS resources for Multi-RTT with Tx TEGs?

For multi-RTT case, UE Rx-Tx measurement is related to UE Rx TEG and UE Tx TEG, or UE RxTxTEG. If UE reports RxTx TEG ID, but not UE Tx TEG ID, then UE does not need to report the UE Tx TEG association. Only if UE reports Tx TEG IDs, the LMF needs to know the UE Tx TEG association of the reported Tx TEG IDs. The LMF does not need to know the UE Tx TEG association of un-reported Tx TEG IDs.

There are two options to indicate the association of UL SRS resources for Multi-RTT from two companies [7][5]:

* **Option a):** report the association of UL SRS resources directly in NR-Multi-RTT-SignalMeasurementInformation [7].

-- ASN1START

NR-Multi-RTT-SignalMeasurementInformation-r16 ::= SEQUENCE {

 nr-Multi-RTT-MeasList-r16 NR-Multi-RTT-MeasList-r16,

 nr-NTA-Offset-r16 ENUMERATED { nTA1, nTA2, nTA3, nTA4, ... } OPTIONAL,

 ...,

 [[

 ueTxTEGList-r17 SEQUENCE (SIZE(1..maxNumOfUE-TxTEG-1-r17)) OF UETxTEG-r17-IEs OPTIONAL

 ]]

}

UETxTEG-r17-IEs ::= SEQUENCE {

 ueTxTEG-ID-r17 INTEGER (0..maxNumOfUE-TxTEG-1-r17),

 srs-PosResourceAssociationBitmap-r17 BIT STRING (SIZE (64)) OPTIONAL,

 ...

}

maxNumOfUE-TxTEG-1-r17 INTEGER ::= 7 FFS

The bitmap can show the association for the SRS resources within 64bit which is the maximum of resourceid. ‘1’ indicates that this resoureceid is associated with the TxTEG-ID, ‘0’ indicate none.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| resourceid | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | … | 60 | 61 | 62 | 63 |
| association  | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |  … | 1 | 0 | 0 | 0 |

* **Option b):** report the association of UL SRS resources together with UE TxTEG ID in NR-Multi-RTT-MeasList-r16 [5].

NR-Multi-RTT-MeasList-r16 ::= SEQUENCE (SIZE(1..nrMaxTRPs-r16)) OF NR-Multi-RTT-MeasElement-r16

NR-Multi-RTT-MeasElement-r16 ::= SEQUENCE {

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

 nr-PhysCellID-r16 NR-PhysCellID-r16 OPTIONAL,

 nr-CellGlobalID-r16 NCGI-r15 OPTIONAL,

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

 nr-DL-PRS-ResourceID-r16 NR-DL-PRS-ResourceID-r16 OPTIONAL,

 nr-DL-PRS-ResourceSetID-r16 NR-DL-PRS-ResourceSetID-r16 OPTIONAL,

 nr-UE-RxTxTimeDiff-r16 CHOICE {

 k0-r16 INTEGER (0..1970049),

 k1-r16 INTEGER (0..985025),

 k2-r16 INTEGER (0..492513),

 k3-r16 INTEGER (0..246257),

 k4-r16 INTEGER (0..123129),

 k5-r16 INTEGER (0..61565),

 ...

 },

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

 nr-TimeStamp-r16 NR-TimeStamp-r16,

 nr-TimingQuality-r16 NR-TimingQuality-r16,

 nr-DL-PRS-RSRP-Result-r16 INTEGER (0..126) OPTIONAL,

 nr-Multi-RTT-AdditionalMeasurements-r16

 NR-Multi-RTT-AdditionalMeasurements-r16 OPTIONAL,

 ...,

 [[

 nr-UE-RxTx-TEG-Info-r17 NR-UE-RxTx-TEG-Info-r17 OPTIONAL,

NR-UE-RxTx-TEG-Info-r17 ::= SEQUENCE {

 srs-PosResourceSetId-r17 INTEGER (0..15) OPTIONAL,

 srs-PosResourceId-r17 SEQUENCE (SIZE (1..maxNumOfPosSRSResourcesPerTxTEG-r17)) OF

 INTEGER (0..63) OPTIONAL,

Both Option a and Option b is workable.

Option a reports the association of all the related UE TxTEG IDs in *nr-UE-RxTx-TEG-Info* out of the measurement report list.

Option b reports the association of UL SRS resources together with UE TxTEG ID in NR-Multi-RTT-MeasList-r16.

But Option a can save more on air resources compared with option b. Since UE TxTEG association is irrelevant with TRP (receiving channels in UE), UE TxTEG association can be moved out of the *NR-Multi-RTT-MeasList-r16*.

There is no requirement on the change of TxTEG in Multi-RTT according to the LS [1], hence there is no need to report the timestamp to indicate the TxTEG change.

**Option a) Report the association of UL SRS resources directly in NR-Multi-RTT-SignalMeasurementInformation.**

**Option b) Report the association of UL SRS resources together with UE TxTEG ID in NR-Multi-RTT-MeasList-r16.**

**Question 2: Which option do you prefer on report of association of UL SRS resources with UE TxTEG for Multi-RTT? Please provide your preference for details for your favourable option in the comments column.**

|  |  |  |
| --- | --- | --- |
| Company | Option  | Comments |
| Qualcomm | Modified (a) | Huawei suggested a similar solution to (a) in R2-2201722 (Summary of [Post116bis-e][628][POS] 37.355 running CR (Qualcomm)), row 8 of the Excel sheet, which does not need a 64-bit bitmap (which would be inefficient if there is only a small number of resources per TEG), and which can be extended to include a time stamp in the case the SRS/TEG association changes during the measurement report (Response Time):NR-Multi-RTT-SignalMeasurementInformation-r16 ::= SEQUENCE { nr-Multi-RTT-MeasList-r16 NR-Multi-RTT-MeasList-r16, nr-NTA-Offset-r16 ENUMERATED { nTA1, nTA2, nTA3, nTA4, ... } OPTIONAL, ..., [[ nr-SRS-TxTEG-Set-r17 SEQUENCE (SIZE(1..maxTxTEG-Sets-r17)) OF  NR-SRS-TxTEG-Element-r17 OPTIONAL ]]}NR-SRS-TxTEG-Element-r17 ::= SEQUENCE { nr-TimeStamp-r17 NR-TimeStamp-r16 OPTIONAL, -- Need OP nr-UE-Tx-TEG-ID-r17 INTEGER (0..maxNumOfTxTEGs-1-r17), srs-PosResourceSetId-r17 INTEGER (0..15) OPTIONAL, srs-PosResourceId-r17 SEQUENCE (SIZE (1..maxNumOfPosSRSResourcesPerTxTEG-r17)) OF INTEGER (0..63), ...} |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

### UE Tx TEG association for UL-TDOA via RRC

The serving gNB request a UE to provide the association information of UL SRS resources for positioning with Tx TEGs to the serving gNB if the UE supports multiple UE Tx TEGs. The Tx TEG association information reporting can be two modes according to the LS [1]:

1. single request/response mode
2. based on a configured periodicity(The values of the configurable periodicities are up to RAN2)
	* It is up to RAN2 to decide how to indicate the change of the Tx TEG association during the configured period (e.g., using the timestamps).
	* It is up to RAN4 to decide when the Tx TEG association is changed

|  |
| --- |
| **Agreement*** *For UL-TDOA, supporting the following for the serving gNB to request a UE to report the Tx TEG association information between UE Tx TEG IDs and SRS resources for positioning, subject to UE capability of supporting UE Tx TEG:*
	+ *Based on a configured periodicity, a UE may report the UE Tx TEG association for the SRS resources for positioning that have already been transmitted during the configured period*
		- *It is up to RAN2 to decide how to indicate the change of the Tx TEG association during the configured period (e.g., using the timestamps)*
		- *It is up to RAN4 to decide when the Tx TEG association is changed*
	+ *The values of the configurable periodicities are up to RAN2*
	+ *Note: Tx TEG association information reporting by single request/response mode is assumed already supported with the previous agreement.*
* *Send an LS to RAN2/RAN4 (cc: RAN3)*
	+ *to RAN2, including the following RAN1’s agreement related to the reporting of the UE Tx TEG, for RAN2 to work on the signaling*
	+ *to RAN4 for checking the agreement and work on how to decide when the Tx TEG association is changed*
 |

Meanwhile RAN2 reached the agreement on the association for UL-TDOA as below:

For UL-TDOA, RRC signalling is used to convey the information about signalling for association of UL SRS resources with UE Tx TEGs ID to the gNB. For multi-RTT, LPP is used. FFS which RRC message(s) are used.

The UE Tx TEG association request and report for UL-TDOA based on the previous discussion can be briefly summarized as follows:

1. Which RRC message for single request/response mode?
2. Which RRC message for configured periodicity report?
3. What are the values of the configurable periodicities?
4. How to config the request of association information of UL SRS resources?
5. How to indicate the association information of UL SRS resources for positioning with Tx TEGs?

1). Which RRC message for single request/response mode?

There are options of single request / report according to the contributions and discussion at 116bis-e meeting:

**Option a) UE TxTEG Report Config in SRS-Config IE to configure reporting (request)**

**Option b) RRC UEAssistanceInformation (reponse)**

**Option c) New RRC message (response)**

**Option d) RRCReconfigurationComplete (reponse)**

**Question 3: Which signaling option you prefer for single request/response mode on report of association of UL SRS resources with UE TxTEG via RRC? Please provide your preference for signalling details for your favourable option in the comments column.**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comments |
| Qualcomm | c | Since this is a (very) specific positioning feature, which should not be mixed with other (essential) RRC functions.Another option could be to use the *LocationMeasurementIndication* message. The UE could push a *LocationMeasurementIndication* when the TxTEG changes.A Reqest could be included in the SRS-Config. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

2). Which RRC message for configured periodicity report?

There are options of configured periodicity report according to the contributions and discussion at 116bis-e meeting:

**Option a) UE TxTEG Report Config in SRS-Config IE to configure reporting (request)**

**Option b) RRC UEAssistanceInformation (response)**

**Option c) New RRC message (response)**

**Option d) RRCReconfigurationComplete (response)**

**Question 4: Which signaling option you prefer for configured periodicity report of association of UL SRS resources with UE TxTEG via RRC? Please provide your preference for signalling details for your favourable option in the comments column.**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comments |
| Qualcomm | c | I don't think a periodic report is needed, since this information may not change often. A report when the TxTEG changes should be sufficient.  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

3). What are the values of the configurable periodicities?

It was discussed by both CATT in R2-2200300 and Ericsson in R2-2201069. The values of configurable periodicities are both proposed to config in *SRS-Config* IE as the below values:

UE-TxTEG-ReportConfig ::= SEQUENCE {

 reportAmount-r17 ENUMERATED {r1, r2, r4, r8, r16, r32, r64, infinity},

 reportingInterval-r17 ENUMERATED {noPeriodicalReporting, ms120, ms240, ms480, ms640, ms1024, ms2048, ms5120, ms10240, ms20480, NULL1, NULL2, NULL3, NULL4},

 ...

----------Editor Notes: reportingInterval-r17 should be discussed by RAN2.

}

 txTEG-PeriodicalReporting ENUMERATED {ms120, ms240, ms480, ms640, ms1024, ms2048, ms5120, ms10240} OPTIONAL -- Need R

**Option a): noPeriodicalReporting, ms120, ms240, ms480, ms640, ms1024, ms2048, ms5120, ms10240, ms20480**

**Option b): ms120, ms240, ms480, ms640, ms1024, ms2048, ms5120, ms10240**

**Question 5: Which option do you prefer for of the configurable periodicities on report of association of UL SRS resources with UE TxTEG via RRC? Please provide your preference for details for your favourable option in the comments column.**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comments |
| Qualcomm | other | If periodic reporting is required, the reporting interval should be aligned with the SRS periodicity. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

4). How to config the request of association information of UL SRS resources?

the ***UE-TxTEG-ReportConfig***  IE indicates that both single response and periodic reporting is requested and comprises the following subfields:

- ***reportingAmount*** indicates the number of periodic location information reports requested. Enumerated values correspond to 1, 2, 4, 8, 16, 32, 64, or infinite/indefinite number of reports. If the *reportingAmount* is '*infinite/indefinite'*, the target device shou-ld continue periodic reporting until the SRS is released. The value 'r1' indicates the single request/response.

- ***reportingInterval*** indicates the interval between the second RRC message which reports UE TxTEG association and the first report UE TxTEG association. The value '*noPeriodicalReporting*' indicates the single request/response.

UE-TxTEG-ReportConfig ::= SEQUENCE {

 reportingAmount-r17 ENUMERATED {r1, r2, r4, r8, r16, r32, r64, infinity, NULL1, NULL2, NULL3, NULL4},

 reportingInterval-r17 ENUMERATED {noPeriodicalReporting, ms120, ms240, ms480, ms640, ms1024, ms2048, ms5120, ms10240, ms20480, NULL1, NULL2, NULL3, NULL4},

 ...

}

**Question 6: Do you agree the reportingAmount and reportingInterval to config the UE TxTEG for both single request / report and configured periodicity report? Please provide your preference for details for your favourable option in the comments column.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | No | *reportingAmount* cannot be predicted. The TEGs are needed for the duration of the positioning session/SRS transmission. See also our response to Questions 4 and 5. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

5). How to indicate the association information of UL SRS resources for positioning with Tx TEGs?

It is up to RAN2 to decide how to indicate the change of the Tx TEG association during the configured period (e.g., using the timestamps) [1].

The change is explained by vivo in R2-2200330 [8]: The following Figure 2 shows a simple example. It is observed that in SRS instance 1, 2 SRS resources associated with the same Tx TEG, namely, {SRS resource 0→Tx TEG0; SRS resource 1→Tx TEG0}; however, in SRS instance 2, due to the UE flips, the Tx TEG association information is changed, namely, {SRS resource 0→Tx TEG0; SRS resource 1→Tx TEG1}. After that, the Tx TEG association does not change till SRS instance 5.



**Figure 2 UE Tx TEG(s) change associated with SRS resource(s)**

Assuming the UE reports the Tx TEG association information between UE Tx TEG IDs and SRS resources periodically as Figure 3.



**Figure 3 periodical Tx TEG change report**

That’s the reason why RAN1 recommend the timestamp to *indicate the change of the Tx TEG association during the configured period.*

There are two options on how to indicate the the change of the Tx TEG association from two companies [8] [7]:

**Option a: Indication of associationInformationChange is introduced [8]**

|  |
| --- |
| TxTEGAssociationInformation ::= SEQUENCE { srs-ResourceId SRS-ResourceId, initialTEG INTEGER (1.. maxNrofTEG), OPTIONAL, associationInformationChange CHOICE { noChange ENUMERATED { true } OPTIONAL, tegChangeList SEQUENCE (SIZE (1..maxNrofChange)) OF TEGChange OPTIONAL, }TEGChange ::= SEQUENCE { changedTEG INTEGER (1.. maxNrofTEG), timeStamp INTEGER (0..maxPeriod),} |

**Option b: Each of association information of UL SRS resources with timestamp [7]**

UE-TxTEG-Report-v17xy-IEs ::= SEQUENCE {

 ue-TxTEG-UL-TDOA-r17 UE-TxTEG-UL-TDOA-r17 OPTIONAL,

 nonCriticalExtension SEQUENCE {} OPTIONAL

}

UE-TxTEG-UL-TDOA ::= SEQUENCE {

 ue-TxTEG-List-r17 SEQUENCE (SIZE(1.. maxueTxTEGReport-r17)) OF UE-TxTEG-r17-IEs

}

----------Editor Notes: maxueTxTEGReport-r17 depend on the configurable period and should be discussed by RAN2.

UE-TxTEG-r17-IEs ::= SEQUENCE {

 nr-TimeStamp-r17 NR-TimeStamp-r17 OPTIONAL,

 ueTxTEG-ID-r17 INTEGER (0.. maxNumOfUE-TxTEG-1-r17),

 srs-PosResourceAssociationBitmap-r17 BIT STRING (SIZE (64)) OPTIONAL,

 ...

}

maxueTxTEGReport-r17 ::= INTEGER FFS

NR-TimeStamp-r17 ::= SEQUENCE {

 nr-SFN-r17 INTEGER (0..1023),

 nr-Slot-r17 CHOICE {

 scs15-r17 INTEGER (0..9),

 scs30-r17 INTEGER (0..19),

 scs60-r17 INTEGER (0..39),

 scs120-r17 INTEGER (0..79)

 },

 ...

}

maxNumOfUE-TxTEG-1-r17 INTEGER ::= 7

Option b seems more straightforward to report the association of UE TxTEG and complete the whole ASN.1 design. Since each change with timestamp during the report period can be recorded in *ue-TxTEG-List-r17*, it seems no need to indicate the change additionally.

**Option a): Indication of associationInformationChange is introduced**

**Option b): Each of association information of UL SRS resources with timestamp**

***Question* 7: Which option do you prefer for the change of the Tx TEG association report during the configured period? Please provide your preference for details for your favourable option in the comments column.**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comments |
| Qualcomm | b | A simple timestamp should be sufficient, and probaly needed anyhow since RAN1 agreement says: "UE may report the UE Tx TEG association for the SRS resources for positioning **that have already been transmitted** during the configured period". I.e., the timestamps are about something that happened in the past, and there is "no commitment" about the future (which is impossible anyhow; see also our response to Question 6).  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

### Broadcast of TRP Tx TEG info

The agreement has been reached after the online discussion at 116bis-e meeting as below:

Agreements:

Proposal 2.1-3: to include the association information of DL PRS resources with TRP Tx TEG ID in posSIB.

This open issue is recored in Report of email discussion [Post116bis-e][634][POS] Positioning open issues list (Intel) [3]:

|  |  |
| --- | --- |
| Support of broadcast signalling;FFS whether existing posSIB or new posSIB should be used | **Status**: Discussion see R2-2201768. check the status of LPP email discussion 116bis-628, check the status of RRC email discussion 116bis-631 |

The existing posSIB can be found as below. The existing posSIB for UE-Based is *NR-UEB-TRP-LocationData* and *NR-UEB-TRP-RTD-Info.*

|  |  |  |
| --- | --- | --- |
| NR DL-TDOA/DL-AoD Assistance Data (clauses 6.4.3, 7.4.2) | *posSibType6-1* | *NR-DL-PRS-AssistanceData* |
| *posSibType6-2* | *NR-UEB-TRP-LocationData* |
| *posSibType6-3* | *NR-UEB-TRP-RTD-Info* |

LPP CR rapporteur proposed that new posSIB:

|  |  |  |
| --- | --- | --- |
| NR DL-TDOA/DL-AoD Assistance Data (clauses 6.4.3, 7.4.2) | *posSibType6-5* | *NR-DL-PRS-TRP-TEG-Info*  |
|  |  |

**Option a): existing posSIB *NR-UEB-TRP-LocationData* or *NR-UEB-TRP-RTD-Info* for the TRP Tx TEG info.**

**Option b): new *posSibType6-5* *NR-DL-PRS-TRP-TEG-Info* for the TRP Tx TEG info.**

**Question 8: Which option do you prefer for** **TRP Tx TEG for broadcast? Please provide your preference for details for your favourable option in the comments column.**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comments |
| Qualcomm | See comment | If *NR-DL-PRS-TRP-TEG-Info* is kept separate: Option (b)If *NR-DL-PRS-TRP-TEG-Info* is moved to *NR-UEB-TRP-RTD-Info*: Option (a) (obviously)In general, different info should be in different posSIBs. Different posSIBs can be mapped to the same posSI message. The UE would know from the scheduling info what is provided in a posSI before reading the posSI. If the TRP Tx TEG-Info is incldued in *NR-UEB-TRP-LocationData*, a UE would only know whether the *NR-DL-PRS-TRP-TEG-Info* is provided or not after the UE had obtained and decoded the whole posSI.  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

The definition of *NR-DL-PRS-TRP-TEG-Info* can be found as below according to the running CR [5]:

*– NR-DL-PRS-TRP-TEG-Info*

The IE *NR-DL-PRS-TRP-TEG-Info* is used by the location server to provide the association information of DL-PRS Resources with TRP Tx TEGs.

– *NR-DL-PRS-TRP-TEG-Info*

The IE *NR-DL-PRS-TRP-TEG-Info* is used by the location server to provide the association information of DL-PRS Resources with TRP Tx TEGs.

-- ASN1START

NR-DL-PRS-TRP-TEG-Info-r17 ::= SEQUENCE (SIZE (1..nrMaxFreqLayers-r16)) OF

 NR-DL-PRS-TRP-TEG-InfoPerFreqLayer-r17

NR-DL-PRS-TRP-TEG-InfoPerFreqLayer-r17 ::= SEQUENCE (SIZE (1..nrMaxTRPsPerFreq-r16)) OF

 NR-DL-PRS-TRP-TEG-InfoPerTRP-r17

NR-DL-PRS-TRP-TEG-InfoPerTRP-r17 ::= 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

 dl-PRS-TEG-InfoSet-r17 SEQUENCE (SIZE(1..nrMaxSetsPerTrpPerFreqLayer-r16)) OF

 DL-PRS-TEG-InfoPerResource-r17,

 ...

}

DL-PRS-TEG-InfoPerResource-r17 ::= SEQUENCE (SIZE(1..nrMaxResourcesPerSet-r16)) OF

 DL-PRS-TEG-InfoElement-r17

DL-PRS-TEG-InfoElement-r17 ::= SEQUENCE {

 dl-prs-trp-Tx-TEG-ID-r17 INTEGER (0..maxNumOfgNB-TxTEGs-1-r17),

 ...

}

-- ASN1STOP

|  |
| --- |
| *NR-DL-PRS-TRP-TEG-Info* field descriptions |
| ***dl-PRS-ID***This field specifies the DL-PRS ID of the TRP for which the TRP Tx TEG information is provided. |
| ***nr-PhysCellID***This field specifies the physical Cell-ID of the TRP for which the TRP Tx TEG information is provided, as defined in TS 38.331 [35]. |
| ***nr-CellGlobalID***This field specifies the NCGI, the globally unique identity of a cell in NR, of the TRP for which the TRP Tx TEG information is provided, as defined in TS 38.331 [35]. |
| ***nr-ARFCN***This field specifies the NR-ARFCN of the TRP's CD-SSB (as defined in TS 38.300 [47]) corresponding to *nr-PhysCellID*. |
| ***dl-PRS-TEG-InfoSet***This field specifies the TRP Tx TEG ID associated with the transmissions of each DL-PRS Resource of the TRP. It follows the resource association of this DL-PRS Resource of the TRP. |

One comment was captured in R2-2201722 Summary of [Post116bis-e][628][POS] 37.355 running CR (Qualcomm) [4]: Association between DL-PRS assistance data and NR-DL-PRS-TRP-TEG-Info should be clarified. This may apply to some similar Rel-16 elements as well, since there is no resourceSetID and resourceID in nr-PositionCalculationAssistance-r16. So nr-PositionCalculationAssistance-r16 follows the association (resourceSetID and resourceID) info in nr-DL-PRS-Info-r16.

**Question 9: Do companies agree the definition and description of NR-DL-PRS-TRP-TEG-Info for broadcast? Please provide your preference for details for your favourable option in the comments column.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | See comment | This is independent on broadcast and should be added as a NOTE on top of all similar IEs. The proposed text would also need clarification/improvement, since it is not clear what "It follows…" mean. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

### Whenther and how to restrict the PRS number in *NR-DL-TDOA-AdditionalMeasurementsExt-r17*

This open issue is recorded by Summary of [Post116bis-e][628][POS] 37.355 running CR (Qualcomm) in R2-2201722 [4].

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| R1-13 | The maximum number of DL PRS resources per target TRP in a measurement report is still limited to 4. | For the NR-DL-TDOA-AdditionalMeasurementsExt-r17, the maximum number of DL PRS resources per target TRP in a measurement report is still limited to 4. How to restrict the PRS number shall be discussed. | NR-DL-TDOA-AdditionalMeasurementsExt-r17 | vivo(132) |

According to the RAN1 agreement, the number of DL PRS resources per target TRP in a measurement report is still limited to 4 as in Rel-16 as below:

**Agreement (RAN1#107-e)**

* The maximum number of reported RSTD measurements obtained from different DL PRS resources per UE Rx TEG per target TRP is 4.
	+ The target TRP can be the same as the RSTD reference TRP or a neighbor TRP
	+ Note: The number of DL PRS resources per target TRP in a measurement report is still limited to 4 as in Rel-16.

The following options can be taken based on the companies’ input.

**Option a): revise the structure of report measurement as a measurement list per PRS resource;**

**Option b): introduce a restriction in the field description.**

**Question 10: Which options do companies agree on restricting the PRS number per target TRP in a measurement report? Please provide also a brief justification for your answer.**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comments |
| Qualcomm | Option (b), if needed | I don't see a strong need for this, since this is the case in Rel-16 and I don't see why Rel-17 implementations should suddenly change.  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

### Support of RSTD measurements from different DL PRS resources per UE Rx TEG

Two companies proposed the samilar design of RSTD measurements from different DL PRS resources per UE Rx TEG[7][5]. Please find design in the running CR in R2-2201723 as below high light with yellow:

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

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

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

 nr-PhysCellID-r16 NR-PhysCellID-r16 OPTIONAL,

 nr-CellGlobalID-r16 NCGI-r15 OPTIONAL,

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

 nr-DL-PRS-ResourceID-r16 NR-DL-PRS-ResourceID-r16 OPTIONAL,

 nr-DL-PRS-ResourceSetID-r16 NR-DL-PRS-ResourceSetID-r16 OPTIONAL,

 nr-TimeStamp-r16 NR-TimeStamp-r16,

 nr-RSTD-r16 CHOICE {

 k0-r16 INTEGER (0..1970049),

 k1-r16 INTEGER (0..985025),

 k2-r16 INTEGER (0..492513),

 k3-r16 INTEGER (0..246257),

 k4-r16 INTEGER (0..123129),

 k5-r16 INTEGER (0..61565),

 ...

 },

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

 nr-TimingQuality-r16 NR-TimingQuality-r16,

 nr-DL-PRS-RSRP-Result-r16 INTEGER (0..126) OPTIONAL,

 nr-DL-TDOA-AdditionalMeasurements-r16

 NR-DL-TDOA-AdditionalMeasurements-r16 OPTIONAL,

 ...,

 [[

 nr-UE-Rx-TEG-ID-r17 INTEGER (0..maxNumOfRxTEGs-1-r17) OPTIONAL,

 nr-DL-PRS-FirstPathRSRP-Result-r17 INTEGER (0..FFS) OPTIONAL,

 nr-los-nlos-Indicator-r17 LOS-NLOS-Indicator-r17 OPTIONAL,

 nr-AdditionalPathListExt-r17 NR-AdditionalPathListExt-r17 OPTIONAL,

 nr-DL-TDOA-AdditionalMeasurementsExt-r17

 NR-DL-TDOA-AdditionalMeasurementsExt-r17 OPTIONAL

 ]]

}

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

 NR-DL-TDOA-AdditionalMeasurementElement-r16

NR-DL-TDOA-AdditionalMeasurementsExt-r17 ::= SEQUENCE (SIZE (1..maxAddMeasTDOA-r17)) 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 CHOICE {

 k0-r16 INTEGER (0..8191),

 k1-r16 INTEGER (0..4095),

 k2-r16 INTEGER (0..2047),

 k3-r16 INTEGER (0..1023),

 k4-r16 INTEGER (0..511),

 k5-r16 INTEGER (0..255),

 ...

 },

 nr-TimingQuality-r16 NR-TimingQuality-r16,

 nr-DL-PRS-RSRP-ResultDiff-r16 INTEGER (0..61) OPTIONAL,

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

 ...,

 [[

 nr-UE-Rx-TEG-ID-r17 INTEGER (0..maxNumOfRxTEGs-1-r17) OPTIONAL,

 nr-DL-PRS-FirstPathRSRP-ResultDiff-r17

 INTEGER (0..FFS) OPTIONAL,

 nr-los-nlos-Indicator-r17 LOS-NLOS-Indicator-r17 OPTIONAL,

 nr-AdditionalPathListExt-r17 NR-AdditionalPathListExt-r17 OPTIONAL

 ]]

}

-- ASN1STOP

The updated description of *nr-UE-Rx-TEG-ID* based on the running CR in R2-2201723 and combine the restriction of maximum number of reported RSTD measurements in R2-2200300:

|  |
| --- |
| ***nr-UE-Rx-TEG-ID***This field provides the ID of the UE Rx TEG associated with the TOA measurement. Note, the TOA measurement refers to the TOA of this neighbour TRP or the reference TRP, as applicable, used to determine the *nr-RSTD* or *nr-RSTD-ResultDiff*. When LMF request to measure the same DL PRS with different UE Rx TEGs for RSTD measurements, the maximum number of reported RSTD measurements obtained from different DL PRS resources per UE Rx TEG per target TRP is 4. |

**Question 11: Do companies agree the above stage-3 design of RSTD measurements from different DL PRS resources per UE Rx TEG? Please also provide a brief comment for your answer.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | Yes | I'm not sure I understand the issue. This seems rather obvious? |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

### Support of UE Rx-Tx time difference measurements obtained from different DL PRS resources per UE Rx TEG/ RxTx TEG

Two companies proposed the samilar design of UE Rx-Tx time difference measurements obtained from different DL PRS resources per UE Rx TEG/ RxTx TEG [7][5]. Please find the updated and combined design based on the running CR in R2-2201723 high light with yellow and R2-2200300:

NR-Multi-RTT-MeasList-r16 ::= SEQUENCE (SIZE(1..nrMaxTRPs-r16)) OF NR-Multi-RTT-MeasElement-r16

NR-Multi-RTT-MeasElement-r16 ::= SEQUENCE {

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

 nr-PhysCellID-r16 NR-PhysCellID-r16 OPTIONAL,

 nr-CellGlobalID-r16 NCGI-r15 OPTIONAL,

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

 nr-DL-PRS-ResourceID-r16 NR-DL-PRS-ResourceID-r16 OPTIONAL,

 nr-DL-PRS-ResourceSetID-r16 NR-DL-PRS-ResourceSetID-r16 OPTIONAL,

 nr-UE-RxTxTimeDiff-r16 CHOICE {

 k0-r16 INTEGER (0..1970049),

 k1-r16 INTEGER (0..985025),

 k2-r16 INTEGER (0..492513),

 k3-r16 INTEGER (0..246257),

 k4-r16 INTEGER (0..123129),

 k5-r16 INTEGER (0..61565),

 ...

 },

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

 nr-TimeStamp-r16 NR-TimeStamp-r16,

 nr-TimingQuality-r16 NR-TimingQuality-r16,

 nr-DL-PRS-RSRP-Result-r16 INTEGER (0..126) OPTIONAL,

 nr-Multi-RTT-AdditionalMeasurements-r16

 NR-Multi-RTT-AdditionalMeasurements-r16 OPTIONAL,

 ...,

 [[

 nr-UE-RxTx-TEG-Info-r17 NR-UE-RxTx-TEG-Info-r17 OPTIONAL,

 nr-DL-PRS-FirstPathRSRP-Result-r17 INTEGER (0..FFS) OPTIONAL,

 nr-los-nlos-Indicator-r17 LOS-NLOS-Indicator-r17 OPTIONAL,

 nr-AdditionalPathListExt-r17 NR-AdditionalPathListExt-r17 OPTIONAL,

 nr-Multi-RTT-AdditionalMeasurementsExt-r17

 NR-Multi-RTT-AdditionalMeasurementsExt-r17 OPTIONAL

 ]]

}

NR-Multi-RTT-AdditionalMeasurements-r16 ::= SEQUENCE (SIZE (1..3)) OF

 NR-Multi-RTT-AdditionalMeasurementElement-r16

NR-Multi-RTT-AdditionalMeasurementsExt-r17 ::= SEQUENCE (SIZE (1..maxAddMeasRTT-r17)) OF

 NR-Multi-RTT-AdditionalMeasurementElement-r16

NR-Multi-RTT-AdditionalMeasurementElement-r16 ::= SEQUENCE {

 nr-DL-PRS-ResourceID-r16 NR-DL-PRS-ResourceID-r16 OPTIONAL,

 nr-DL-PRS-ResourceSetID-r16 NR-DL-PRS-ResourceSetID-r16 OPTIONAL,

 nr-DL-PRS-RSRP-ResultDiff-r16 INTEGER (0..61) OPTIONAL,

 nr-UE-RxTxTimeDiffAdditional-r16 CHOICE {

 k0-r16 INTEGER (0..8191),

 k1-r16 INTEGER (0..4095),

 k2-r16 INTEGER (0..2047),

 k3-r16 INTEGER (0..1023),

 k4-r16 INTEGER (0..511),

 k5-r16 INTEGER (0..255),

 ...

 },

 nr-TimingQuality-r16 NR-TimingQuality-r16,

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

 nr-TimeStamp-r16 NR-TimeStamp-r16,

 ...,

 [[

 nr-UE-RxTx-TEG-Info-r17 NR-UE-RxTx-TEG-Info-r17 OPTIONAL,

 nr-DL-PRS-FirstPathRSRP-ResultDiff-r17

 INTEGER (0..FFS) OPTIONAL,

 nr-los-nlos-Indicator-r17 LOS-NLOS-Indicator-r17 OPTIONAL,

 nr-AdditionalPathListExt-r17 NR-AdditionalPathListExt-r17 OPTIONAL

 ]]

}

NR-UE-RxTx-TEG-Info-r17 ::= SEQUENCE {

 nr-ue-RxTx-TEG-r17 CHOICE {

 case1-r17 SEQUENCE {

 nr-UE-RxTx-TEG-ID-r17 INTEGER (0..maxNumOfRxTxTEGs-1-r17)

 },

 case2-r17 SEQUENCE {

 nr-UE-RxTx-TEG-ID-r17 INTEGER (0..maxNumOfRxTxTEGs-1-r17),

 nr-UE-Tx-TEG-ID-r17 INTEGER (0..maxNumOfTxTEGs-1-r17)

 },

 case3-r17 SEQUENCE {

 nr-UE-Rx-TEG-ID-r17 INTEGER (0..maxNumOfRxTEGs-1-r17),

 nr-UE-Tx-TEG-ID-r17 INTEGER (0..maxNumOfTxTEGs-1-r17)

 },

 case4-r17 SEQUENCE {

 nr-UE-RxTx-TEG-ID-r17 INTEGER (0..maxNumOfRxTxTEGs-1-r17),

 nr-UE-Tx-TEG-ID-r17 INTEGER (0..maxNumOfTxTEGs-1-r17),

 nr-UE-Rx-TEG-ID-r17 INTEGER (0..maxNumOfRxTEGs-1-r17)

 }, FFS

 ...

 },

 ...

}

-- ASN1STOP

The updated description of *nr-UE-RxTx-TEG-Info* based on the running CR in R2-2201723:

|  |
| --- |
| ***nr-UE-RxTx-TEG-Info***This field provides the ID(s) of the UE TEG associated with the *nr-UE-RxTxTimeDiff* or*nr-UE-RxTxTimeDiffAdditional* measurement and comprises the following subfields:- ***srs-PosResourceSetId*** specifies the SRS Resource Set ID as defined in TS 38.331 [35] of the *srs-PosResourceId*'s.- ***srs-PosResourceId*** specifies the SRS Resource IDs as defined in TS 38.331 [35] belonging to the *nr-ue-RxTx-TEG*.- ***nr-ue-RxTx-TEG*** specifies the IDs of the UE TEGs and can include one of the following combinations of TEG IDs:- ***case1*** provides the UE RxTx TEG ID;- ***case2*** provides the UE RxTx TEG ID together with the UE Tx TEG ID;- ***case3*** provides the UE Rx TEG ID together with the UE Tx TEG ID;- ***case4*** provides the UE RxTx TEG ID together with both, the UE Tx TEG ID and UE Rx TEG ID; (FFS)where the Rx TEG is used to receive the DL-PRS, the Tx TEG is used to transmit the UL SRS for Positioning, and the RxTx TEG is associated with a {DL-PRS Resource, UL SRS for Positioning Resource} pair. |

**Question 12: Do companies agree the above stage-3 design of UE Rx-Tx time difference measurements obtained from different DL PRS resources per UE Rx TEG/ RxTx TEG? Please also provide a brief comment for your answer.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | See comment | With our comment on Question 2, this would need to be revised, since the *nr-UE-Tx-TEG-ID-r17* is not needed anymore. However, the 4-cases should be kept simplifying the request and capabilities. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

### Support of RTOA measurements obtained from different UL SRS resources for positioning per TRP Rx TEG

Although this open issue is recorded in Report of email discussion [Post116bis-e][634][POS] Positioning open issues list (Intel), it belongs to RAN3 business and won’t be discussed here.

### Support of gNB Rx-Tx time difference measurements

Although this open issue is recorded in Report of email discussion [Post116bis-e][634][POS] Positioning open issues list (Intel), it belongs to RAN3 business and won’t be discussed here:

* Support of gNB Rx-Tx time difference measurements obtained from different UL SRS resources per TRP Rx TEG
* Support of gNB Rx-Tx time difference measurements obtained from different UL SRS resources per TRP RxTx TEG

## 3.2 DL-AoD enhancement

### 3.2.1 Beam/Antanna information

As for the beam/antenna information interaction between LMF and UE, RAN2 made the following agreements, with details are FFS now.

|  |
| --- |
| * **Proposal 2.1-1: enhance LPP assistance data signalling to allow UE to request and LMF to provide TRP beam/antenna information.**
 |

* ***UE request of the TRP beam/antenna information***

Based on the current running CR of TS37.355, a new IE *PosCalcAssistanceRequest* is introduced for the positioning calculation related assistance information that can be requested by UE for UE-based positioning. However, some companies point out that the new *PosCalcAssistanceRequest* is not needed, since the LMF will provide the assistance data to the UE that supports the beam/antenna info for UE-based positioning, that is the legacy nr-AdType is enough with the value 'posCalc'.

-- ASN1START

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

 nr-PhysCellID-r16 NR-PhysCellID-r16 OPTIONAL,

 nr-AdType-r16 BIT STRING { dl-prs (0),

 posCalc (1) } (SIZE (1..8)),

 ...,

 [[

 nr-PosCalcAssistanceRequest-r17 BIT STRING { trpLoc (0),

 beamInfo (1),

 rtdInfo (2),

 beamAntInfo (3),

 losNlosInfo (4),

 trpTEG-Info (5)

 } (SIZE (1..8)) OPTIONAL,

 nr-on-demand-DL-PRS-Request-r17 NR-On-Demand-DL-PRS-Request-r17 OPTIONAL

 ]]

}

-- ASN1STOP

**Question 13: Do companies agree that the new R17 PosCalcAssistanceRequest for the positioning calculation related assistance information that can be requested by UE for UE-based positioning is needed? Please provide also a brief justification for your answer.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | Yes | Since there are now also more "advanced" assistance data possible, a UE may not need all UE-based assistance data in all situations. A simple differentiation between "UE-assisted" (dl-prs) and "UE-based" (posCalc) would be sub-optimal/inefficient. For example, for "low QoS" a UE may not need the TRP TEGs; or a UE may not need both, bore-sight beam directions and antenna pattern at the same time, etc. Or a UE may have some assistance data already stored from previous session and/or broadcast, etc. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Further, as for the new R17 *PosCalcAssistanceRequest*, the first three bits, i.e., the bit 0 of trpLoc, the bit 1 of beamInfo and the bit 2 of rtdInfo, refer to the positioning assistance information introduced in Rel-16. According to email rapporteur’s view, the R17 positioning calculation assistance information request should include the R16 information.

**Question 14: Do companies agree that the new R17 PosCalcAssistanceRequest should not be used to request the R16 positioning calculation assistance information? Please provide also a brief justification for your answer.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | No | See comment to Question 13. This is already sub-optimal in Rel-16, since for DL-AoD for example, a UE may usually not need the RTD's (but RTD's would be needed for hybrid DL-AoD and DL-TDOA), etc.. Different use cases may require different sets of assistance data.This is in principle not different compared to e.g., A-GNSS assistance data request. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Besides, in the current running CR, a unified *nr-PosCalcAssistanceRequest-r17* and *nr-PosCalcAssistanceSupport-r17* is introduced for both DL-TDOA and DL-AOD. However based on RAN1 agreement, the beam/antenna information request is only supported in UE-based DL-AOD. In this sense, we may need to restrict the UE request of beam/antenna information only for DL-AOD.

|  |
| --- |
| Agreement:Regarding support of angle calculation enhancement for DL-AoD:• Support gNB providing the beam/antenna information to the LMF.o The gNB beam/antenna information can be provided to the UE for UE-based DL-AoD |

Further, the rtdInfo and trpTEG-Info are only applicable to TDOA related positioning method, and not applicable to DL-AOD.

Based on above analysis, it is better to use different bit map/request for DL-TDOA and DL-AoD, and also the bit map/support indication for DL-TDOA and DL-AoD.

**Question 15: Do companies agree that the new R17 bit map/request, and also the bit map/support indication for DL-TDOA and DL-AoD should be different? Please provide also a brief justification for your answer.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | No | It's already the same in Rel-16. Position calculation is often "hybrid". Which assistance data are needed for position calculation depends on UE implementation and use case. See also comemnt to Question 14. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

* ***LMF provision of the TRP beam/antenna information***

As for the provision of beam/antenna information from LMF to UE, the following open issues are addressed based on the following RAN2 agreements and running CR of TS37.355:

1. FFS to extend the R16 NR-DL-PRS-BeamInfo to include the TRP beam/antenna information or a new IE introduced
2. FFS both the azimuth and elevation can be optional
3. FFS the peak power value that is used as the reference for other resource powers on a specific angle is not provided
4. FFS the value ranges relative power of the DL-PRS Resource

a). FFS to extend the R16 NR-DL-PRS-BeamInfo to include the TRP beam/antenna information or a new IE introduced

As for how to provide the beam/antenna information from LMF to UE, either a new IE, e.g., *NR-TRP-BeamAntennaInfo* in running CR of TS37.355, or to extend the R16 NR-DL-PRS-BeamInfo, e.g., reuse the frequency layer and TRP specific information, can work.

**Option a: New IE to carry the TRP beam/antenna information, e.g., *NR-TRP-BeamAntennaInfo* in running CR of TS37.355;**

**Option b: Extend the R16** **NR-DL-PRS-BeamInfo to carry the TRP beam/antenna information, e.g., reuse the frequency layer and TRP specific information (TRP ID, ARFCN etc.).**

**Question 16: Which options do companies agree on supporting LMF to provide the TRP beam/antenna information to UE? Please provide also a brief justification for your answer.**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comments |
| Qualcomm | (a) | (b) seems not feasible and/or complex, since both have a different purpose:The existing *NR-DL-PRS-BeamInfo* provides the bore-sight direction for each resource of a set of a TRP of a PLF.The TRP beam/antenna information provides the relative power of PRS Resources per angle per TRP (across sets).A UE may also not need both assistance data at the same time. In addition, the *NR-DL-PRS-BeamInfo* is also needed for UE-assisted DL-AoD. So separating them would also be cleaner. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

b). FFS both the azimuth and elevation can be optional

One company point out that the both azimuth and elevation can be optional with the understanding that at least one should be provided, with the reason that in Rel-17 linear array was agreed for UL methods, where only elevation angle in the LCS can be useful.

**Question 17: Do companies agree that both the azimuth and elevation within the TRP beam/antenna information from LMF to UE can be optional? Please provide also a brief justification for your answer.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | No | One angle seems always be needed. For a linear array, one would still need one azimuth angle (e.g., 120 degress) and a list of elevation angles (or the other way around).  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

c). FFS the peak power value that is used as the reference for other resource powers on a specific angle is not provided

The following agreements were made by RAN1 on TRP beam/antenna information. According to the agreements as highlightend in yellow, it seems that the peak power per angle which is used as the reference for other resource powers on a specific angle is not provded. But since this is RAN1 leading topic, maybe we need to check with RAN1.

|  |
| --- |
| AgreementFrom the RAN1 perspective, for the TRP beam/antenna information to be optionally provided by the LMF to the UE for UE-based DL-AoD:• The LMF provides the quantized version of the relative Power between PRS resources per angle per TRP.o The relative power is defined with respect to the peak power in each angleo For each angle, at least two PRS resources are reported.o Note: the peak power per angle is not provided• Note: up to RAN3 to decide how the TRP beam information is provided to the LMF for both UE-assisted and UE-based• Send an LS to RAN2/RAN3 to decide on the signaling details |

**Question 18: Do companies agree that the peak power value that is used as the reference for other resource powers on a specific angle is not provided, or further check with RAN1? Please provide also a brief justification for your answer.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No/Ask RAN1 | Comments |
| Qualcomm | Yes | This is clear from RAN1 agreements. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

d). FFS the value ranges relative power of the DL-PRS Resource

The value ranges of the relative power of DL-PRS resource are now FFS. From email rapporteur’s view, this should be decided by RAN1.

**Question 19: Do companies agree that the value ranges of the relative power of DL-PRS resource should be decided by RAN1? Please provide also a brief justification for your answer.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | See comment | No strong view, but this does not look challenging and could also be defined by RAN2. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

### 3.2.2 DL-AoD positioning with RSRPP

Based on the current running CR, it appears that if RSRPP is reported, UE should always report RSRP. However, some companies argue that in R17, the RSRPP and the RSRP can be both optional, i.e., UE only report RSRPP, but without RSRP to LMF. And if it is, a new variant need to be introduced to carry the optional RR17 RSRP and RSRPP.

**Question 20: Do companies agree that both the RSRPP and RSRP can be optional within the measurement results info provided by UE to LMF for DL-AOD in R17? Please provide also a brief justification for your answer.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | No | This would create fragmentation of DL-AoD positioning/UEs. RSRP is the "basic" measurement for DL-AoD and mandatory in Rel-16 for UEs supporting DL-AoD. The RSRPP is an enhancement in Rel-17. If we would do this, we would have two different versions of DL-AoD. I also cannot see a reason why a UE capable of measuring the RSRPP could not also report the RSRP. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Further, the value ranges of the RSRPP are now FFS. From email rapporteur’s view, this should be decided by RAN1.

**Question 21: Do companies agree that the value ranges of the RSRPP should be decided by RAN1? Please provide also a brief justification for your answer.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm |  | I think this will be RAN4, and I assume this will be a similar (or even the same) mapping table as the RSRP. We also need an "absolute" and "relative" version (for the additional measurements). |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

### 3.2.3 Expected angle assistance

As for the expected angle value and uncertainty information interaction between LMF and UE, RAN2 made the following agreements.

|  |
| --- |
| * **Proposal 2.1-6: enhance LPP assistance data signalling to allow UE to request and LMF to provide the expected angle value and uncertainty.**
 |

As for details of the provision of expected angle assistance (expected angel value and uncetainty), the following open issue are addressed.

1. FFS the angle assistance information should be per TRP
2. FFS the angel assistance information should be included in NR-DL-PRS-AssistanceDataPerTRP-r16 (like expected RSTD and expected RSTD uncertainty)
3. FFS the value ranges and may be decided by RAN1

a). FFS the angle assistance information should be per TRP

**Question 22: Do companies agree that the angle assistance information (expected angel value and uncetainty) should be per TRP? Please provide also a brief justification for your answer.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | Yes | This is a mistake in the current draft LPP. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

b). FFS the angel assistance information should be included in NR-DL-PRS-AssistanceDataPerTRP-r16 (like expected RSTD and expected RSTD uncertainty)

Further based on input of Q22, if the angel assistance information shuld be per-TRP, there are two options on providing the expected angel assitstance information to UE:

**Option a: New IE to carry the expected angle assistance information, e.g., *NR-DL-AoD-ExpectedAngleAssistance* in running CR of TS37.355;**

**Option b: Extend the R16 IE NR-DL-PRS-AssistanceDataPerTRP-r16 to carry the expected angle assistance information (like expected RSTD and expected RSTD uncertainty), with restrictions that it is only applied for DL-AOD positioning method.**

**Question 23: Which options do companies agree on supporting LMF to provide the angel assistance information (expected angel value and uncetainty) to UE? Please provide also a brief justification for your answer.**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comments |
| Qualcomm | a | Different assistance data should be kept separate. It will become confusing/complex if we start merging different assistance data types into DL-PRS assistance data. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

c). FFS the value ranges and may be decided by RAN1

The value ranges of the expected angle assistance information are now FFS. From email rapporteur’s view, this should be decided by RAN1.

**Question 24: Do companies agree that the value ranges of the relative power of DL-PRS resource should be decided by RAN1? Please provide also a brief justification for your answer.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | See comment | There seems a typo in this Question. I assume "relative power of DL-PRS resources" should be "expected angle assistance information".No strong view, but this does not look challenging and could also be defined by RAN2. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

### 3.2.4 DL-PRS Resource Priority List

As for the priorization of DL-AOD reporting, RAN2 made the following agreements.

|  |
| --- |
| * **Proposal 2.1-4: include in the LPP assistance data the information about subset of PRS resources for the purpose of prioritization of DL-AOD reporting.**
 |

As for details of the provision of subset of PRS resources for the purpose of prioritization of DL-AOD reporting, the following open issue are addressed.

1. FFS the provision of the R17 DL-PRS resource priority list should be included in NR-DL-PRS-Resource-r16 IE?
2. FFS any further description of UE behaviour needed related to the measurements and/or reporting?
3. FFS generaral encoding of the IE could be improved?

a). FFS the provision of the R17 DL-PRS resource priority list should be included in NR-DL-PRS-Resource-r16 IE

There are two options on providing the R17 DL-PRS resource priority list to UE:

**Option a: New IE to carry the R17 DL-PRS resource priority list information, e.g., *NR-DL-PRS-ResourceSubset* in running CR of TS37.355;**

**Option b: Extend the R16 IE NR-DL-PRS-Resource-r16 to carry the R17 DL-PRS resource priority list information information, with restrictions that it is only applied for DL-AOD positioning method.**

**Question 25: Which options do companies agree on supporting LMF to provide the R17 DL-PRS resource priority list to UE? Please provide also a brief justification for your answer.**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comments |
| Qualcomm | (a) | Same as for Question 23. Different assistance data types should be kept separate. It will become confusing/complex if we start merging different assistance data into DL-PRS assistance data. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

b). FFS any further description of UE behaviour needed related to the measurements and/or reporting?

Based on RAN1 agreements, the following agreements are associated with the prioritization of DL-AOD reporting, as highlightend in yellow.

|  |
| --- |
| Agreement For UE-assisted DL-AOD positioning method, to enhance the signaling to the UE for the purpose of PRS resource(s) reporting, the LMF may indicate in the assistance data (AD), one or both the following: • option 1: subject to UE capability, for each PRS resource, a subset of PRS resources for the purpose of prioritization of DL-AOD reporting:o a UE may include the requested PRS measurement for the subset of the PRS in the DL-AoD additional measurements if the requested PRS measurement of the associated PRS is reported  The requested PRS measurement can be DL PRS RSRP and/or path PRS RSRP. o UE may report PRS measurements only for the subset of PRS resources.o Note: The subset associated with a PRS resource can be in a same or different PRS resource set than the PRS resource • option 2: subject to UE capability, for each PRS resource, the boresight direction information. • Note: Either case does not imply any restriction on UE measurement • FFS: prioritization of the PRS resources and resource subsets to be measured  |

Some companies point out that the above two behaviours are different and which one to perform shall be clarified in the TS, i.e., up to UE implementation or indicated by the LMF in the location information request.

**Question 26: Do companies agree that further description of UE behaviour needed related to the measurements and/or reporting is needed related to the prioritization of DL-AOD reporting? Please provide also a brief justification for your answer.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | See comment | No strong view, but I think this is not needed. The description from the assistance data should be enough, and a UE can only report what it was able to measure anyhow. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

c). FFS generaral encoding of the IE could be improved?

Further, one company point out that the current structure of 'nr-DL-PRS-ResourcePriorityList is quite reduent as not every resource shall be associate wih one subset.

**Question 27: Do companies agree that generaral encoding of the IE could be improved? Please provide also a brief justification for your answer.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm |  | It must fit to the "master" *NR-DL-PRS-AssistanceData* at the end (similar to other assistance data). |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

## 3.3 Multipath/NLOS mitigation

### 3.3.1 LOS/NLOS indicator

On the LOS/NLOS indicators which are reported to the LMF for DL and DL+UL positioning measurements, the issues that whether the LOS/NLOS indicator for the UE measurements have a per resource indicator and a per TRP indicator is addressed based on companies’ input.

**Question 28: Do companies agree that the LOS/NLOS indicator for the UE measurements have a per resource indicator and a per TRP indicator? Please provide also a brief justification for your answer.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | No | The measurement has a LOS/NLOS indicator. What should a per TRP/per Resource mean in the measurement report? I also cannot see this from the RAN1 agreements. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

### 3.3.2 FFS the PRS-RSRPP request for DL-TDOA and Multi-RTT

According to the running CR of TS37.355, the PRS-RSRPP request for DL-TDOA and Multi-RTT only apply to the first path. However, it seems that such request also applis to additional paths, as highlightend in yellow.

|  |
| --- |
| Agreement• Support the LMF to request DL PRS-RSRPP together with timing measurement as part of DL-TDOA and multi-RTT reporting enhancementso Note: This applies to the first path and also to additional paths. |

**Question 29: Do companies agree that the request of DL PRS-RSRPP also applies to the additional paths except the first path? Please provide also a brief justification for your answer.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm |  | Not quite clear what the issue is. The additional path itself is a separate request/capability and the RSRPP request for the additional path is already supported in the draft LPP:additionalPathsDL-PRS-RSRP-Request-r17 ENUMERATED { requested } |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

# Reference to dependency (FFS in RAN1)

This section is for information, i.e. no questions to answer. The references to dependency are summarized here, waiting for further information from RAN1.

## 4.1 Mitigation of UE/TRP Rx/Tx timing delays

1. C1-1: whether srs-PosResourceSetId-r17 is required in UE TxTEG
2. C1-2: ueRxTxTEG-ID-group

FFS: A triplet of UE {RxTx TEG ID, Rx TEG ID, Tx TEG ID}

1. C1-3: Timestamp of a UE measurement instance (R1-A3)

FFS: The measurement instances are within a [configured] measurement time window

FFS: Each UE measurement instance can be configured with N instances of the DL-PRS Resource Set

## 4.2 DL-AoD enhancement

1. C2-1：FFS on the value range of relative power of the DL-PRS Resource (R1-A2)
2. C2-2：FFS on value range of RSRPP (R1-A1)
3. C2-3：FFS on value range of expected angle assistance (expected angel value and uncertainty) (R1-A4)

## 4.3 PRU and others

1. C3-1: all interaction between PRU (work as UE) and LMF depend on RAN1

# Open issue lists

This section is for information, i.e. no questions to answer. All the open issues discussed in section 3 are summarized here, in order to track the open issues.

## 5.1 Mitigation of UE/TRP Rx/Tx timing delays

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Issue** | **Description**  | **Corresponding questions** |  | **Status(resolved/left/new)** |
| A1-1(R1-1) | How to report UE Tx TEG association for Multi-RTT via LPP, including what the maximum numbers of the change of TxTEG to be supported within one reporting. IE: *NR-Multi-RTT-SignalMeasurementInformation-r16 ->NR-UE-RxTx-TEG-Info-r17* | Question 1/2 (section 3.1.1) |  |  |
| A1-2 | How to design UE Tx TEG association request and report for UL-TDOA via RRC, including which RRC message, what the periodicity and intervals are, what the maximum number of ueTxTEGReport in one message.IE: *UE-TxTEG-Report-v17xy-IEs* | Question 3/4/5/6/7 (section 3.1.2) |  |  |
| A1-3(R1-12, R2-A4) | Whether existing posSIB or new posSIB should be used to provide TRP TxTEG. IE: *posSibType6-5 NR-DL-PRS-TRP-TEG-Info* | Question 8/9 (section 3.1.3) |  |  |
| A1-4(R1-13) | The maximum number of DL PRS resources per target TRP in a measurement report is still limited to 4. How to restrict the PRS number shall be discussed. IE: *NR-DL-TDOA-AdditionalMeasurementsExt-r17* | Question 10 (section 3.1.4) |  |  |
| A1-5 | Support of RSTD measurements from different DL PRS resources per UE Rx TEG  | Question 11 (section 3.1.5) |  |  |
| A1-6 | Support of UE Rx-Tx time difference measurements obtained from different DL PRS resources per UE Rx TEG Support of UE Rx-Tx time difference measurements obtained from different DL PRS resources per UE RxTx TEG | Question 12 (section 3.1.6) |  |  |

## 5.2 DL-AoD enhancement

|  |  |  |  |
| --- | --- | --- | --- |
| **Issue** | **Description**  | **Corresponding questions** | **Status(resolved/left/new)** |
| A2-1(R1-2) | Should we have a bit for each assistance data element (incl. the Rel-16 ones)? Should the bit map/request be different for DL-TDOA and DL-AoD? Same for capabilities. | Question 13/14/15 (section 3.2.1) |  |
| A2-2(R1-3) | Should the beam pattern info be included in Rel-16 NR-DL-PRS-BeamInfo? Any changes needed to support linear arrays? (FFS both azimuth and elevation can be optional) | Question 16/17/18 (section 3.2.1) |  |
| C2-1(R1-A2) | FFS on the value range of relative power of the DL-PRS Resource | Question 19 (section 3.2.1) |  |
| A2-3(R1-4) | Do we need a DL-AoD variant which supports the Rel-17 RSRPP measurement only?  | Question 20 (section 3.2.2) |  |
| C2-2(R1-A1) | FFS on value range of RSRPP  | Question 21 (section 3.2.2) |  |
| A2-4( R1-5) | Needs to be per TRP.Should this be included in NR-DL-PRS-AssistanceDataPerTRP-r16 (like expected RSTD and expected RSTD uncertainty)?  | Question 22/23 (section 3.2.3) |  |
| C2-3(R1-A4) | FFS on value range of expected angle assistance (expected angel value and uncertainty)  | Question 24 (section 3.2.3) |  |
| A2-5(R1-6) | Should this be included in NR-DL-PRS-Resource-r16 IE? Any further description of UE behaviour needed?General encoding of the IE could be improved? | Question 25/26/27 (section 3.2.4) |  |

## 5.3 Multipath/NLOS mitigation

|  |  |  |  |
| --- | --- | --- | --- |
| **Issue** | **Description**  | **Corresponding questions** | **status** |
| A3-1(R1-8) | Should the LOS/NLOS indicator for the UE measurements have a per resource indicator and a per TRP indicator?  | Question 28 (section 3.3.1) |  |
| A3-2 | FFS this not only for first path? (From\_R1-2112976\_pos\_parameter\_Summary.xlsx) | Question 29 (section 3.3.2) |  |

# 6 Conclusion

**TBD**

# 7 Reference

1. R2-2200092 LS on the reporting of the Tx TEG association information (R1-2112968; contact: CATT) RAN1 LS in Rel-17 NR\_pos\_enh-Core To:RAN2, RAN4 Cc:RAN3
2. R2-2200095 LS on updated Rel-17 LTE and NR higher-layers parameter list (R1-2112977; contact: Ericsson) RAN1 LS in Rel-17 NR\_pos\_enh, To:RAN2, RAN3 Cc:RAN4
3. R2-2202005 Report of email discussion [Post116bis-e][634][POS] Positioning open issues list (Intel) Intel Corporation
4. R2-2201722 Summary of [Post116bis-e][628][POS] 37.355 running CR (Qualcomm)
5. R2-2201723 Running LPP CR for NR positioning enhancements draftCR Qualcomm Incorporated
6. R2-2201768 Summary of [AT116bis-e][612][POS] Positioning accuracy enhancements (Apple) Apple discussion NR\_pos\_enh-Core
7. R2-2200300 Discussion on LPP and RRC signaling impact of mitigating UE and TRP RxTx timing delays CATT discussion Rel-17 NR\_pos\_enh-Core
8. R2-2200330 Discussion on accuracy enhancements vivo discussion Rel-17 NR\_pos\_enh-Core
9. 3GPP TS38.305 : “Stage 2 functional specification of User Equipment (UE) positioning in NG-RAN” V16.7.0
10. 3GPP TS38.331: “Radio Resource Control (RRC) protocol specification(Release 16)”. V16.7.0
11. 3GPP TS37.355: “LTE Positioning Protocol (LPP)”. V16.7.0

# 8 Annex

TBD