3GPP TSG-RAN WG1 Meeting #108-e R1- 2202605

e-Meeting, February 21st – March 3rd, 2022

Agenda Item: 5.3

Source: Moderator (Ericsson)

Title: FL summary #3 for AI 8.5.3 Accuracy improvements for DL-AoD positioning solutions

Document for: Discussion, Decision

1. Introduction

This FL summary documents the proposals and discussions for agenda item 8.5.3, based on the following chairman decision:

[108-e-R17-ePos-03] Email discussion for maintenance on accuracy improvements for DL-AoD positioning solutions – Florent (Ericsson)

* 1st check point: February 25
* Final check point: March 3

The FL proposals are based on submission to AI 8.5.3 [1-16] and treat the following aspects:

* Aspect #1 reporting of first path RSRP
  + TOA reporting
  + Normalization of the PRS RSRP
* Aspect #2 extension of number of reported RSRP measurements
  + Value for max number of reported measurement
  + RX beam considerations
* Aspect #3 Adjacent beam identification in AD and reporting by the UE
  + LMF Request of a subset of PRS measurement related to a PRS measurement
  + Indication of the subsets
  + Prioritization of measurements
  + Signalling of boresight information
* Aspect #4 Support of additional gnodeB beam information signalling
  + Signalling of the beam information, representation of beam angle and power
* Aspect #5 AoD uncertainty window
* Aspect#6 2-step beam refinement
* Text proposals for corrections to the current specifications.

Additionally, the LS in R1-220905 is treated during this email discussion.

1. Aspects for discussion

## Main discussion topics

### Aspect #1 Clarification for DL-PRS RSRPP (High priority)

#### Summary

#### Proposal 1.1 (definition of DL PRS RSRPP) (closed)

#### Summary of proposals

Regarding the definition of DL PRS-RSRPP, all received contributions In [1][6][7][12][16] agree to confirm the RAN4 assumption based on the LS R4-2202780 regarding the definition of path power. 2 TPs are received, with different rewordings of the definition.

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| --- | --- |
| Source | Proposal |
| [1] | ***Proposal 1: Adopt the following TP for DL PRS-RSRPP.***   |  |  |  |  |  | | --- | --- | --- | --- | --- | | 5.1.35 DL PRS reference signal received path power (DL PRS-RSRPP)   |  |  | | --- | --- | | **Definition** | DL PRS reference signal received path power (DL PRS-RSRPP), is defined as the power (in [W]) of the linear average of the channel response compensated by the i-th path delay on the resource elements that carry the DL PRS signals, where DL PRS-RSRPP for 1st path delay is the power corresponding to the first detected path in time.  For frequency range 1, the reference point for the DL PRS-RSRPP shall be the antenna connector of the UE. For frequency range 2, DL PRS-RSRPP shall be measured based on the combined signal from antenna elements corresponding to a given receiver branch. | | **Applicable for** | RRC\_CONNECTED,  RRC\_INACTIVE | |   ***FL note: this is refered as TP1.1a in the proposal below*** |
| [5] | 5.1.35 DL PRS reference signal received path power (DL PRS-RSRPP)  |  |  | | --- | --- | | **Definition** | DL PRS reference signal received path power (DL PRS-RSRPP), is defined as linear average of the power contributions (in[W]) of the received DL PRS signal of the resrouce elements configured for the measurement at the i-th path delay of the channel response, where DL PRS-RSRPP for 1st path delay is the power contribution corresponding to the first detected path in time.  For frequency range 1, the reference point for the DL PRS-RSRPP shall be the antenna connector of the UE. For frequency range 2, DL PRS-RSRPP shall be measured based on the combined signal from antenna elements corresponding to a given receiver branch. | | **Applicable for** | RRC\_CONNECTED,  RRC\_INACTIVE | |
| [6] | **Proposal 2**: The current PRS RSRPP definition needs modification considering RAN4 input. E.g.,   * DL PRS reference signal received path power (DL PRS-RSRPP), is defined as the linear average over the power contributions of the resource elements that carry ~~of the received~~ DL PRS signal configured for the measurement at the i-th path delay of the channel response within the considered measurement frequency bandwidth, where ~~DL PRS-RSRPP for~~ the 1st path delay is the ~~power corresponding to the~~ first detected path in time.   FL note: this is refered as TP1.1b in the proposal below |
| [7] | Proposal 2   * + **Confirm RAN4 understanding that the DL PRS-RSRPP is defined per path and per RE** |
| [12] | ***Proposal 1: RAN1 confirms that PRS-RSRPP should be defined as the path RSRP per RE.*** |
| [16] | Proposal 1: Confirm RAN4’s understanding in the first bullet of R4-2202780, clarifying that the path RSRP is an average for all REs carrying PRS for a given path. |

#### First round of discussion

Since all proposals agree with RAN4’s LS view on the power definition for PRS RSRPP, it is proposed to discuss capturing the following:

**Proposal 1.1 RAN1 confirms RAN4’s understanding from R4-2202780 regarding the DL-PRS-RSRPP definition. The DL PRS RSRPP is defined per path as a linear average of the path PRS power in REs occupied by the PRS.**

Regarding what TP to endorse, we can first gauge the preference of the group on the proposed TP. For this proposal as well as the proposal discussed as proposal 1.2, a reply LS to RAN4 should be discussed once the proposal have converged:

**Question 1.1: which of TP 1.1a or 1.1b should be endorsed, and with what (in any) modification)**

Companies are encouraged to provide comments in the table below.

**Proposal 1.1**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Nokia/NSB | We are okay with this proposal. |
| CATT | Support the proposal in principle, but the definition of DL-PRS-RSRPP should be polished. |
| OPPO | Support the proposal |
| Huawei, HiSilicon | Support the proposal. |
| vivo | okay |
| ZTE | Okay with this proposal. |
| LGE | Support. |
| Lenovo, Motorola Mobility | Support |
| Lenovo, Motorola Mobility | Also fine with TP1.1b |
| Ericsson | OK |
| Fraunhofer | Support |
| Samsung | Not support.  RAN1 has discussed the definition of RSRPP in the previous meetings. There is no clean way to define the RSRPP in frequency domain like PRS RRSP and that is why RAN1 defined the RSRPP in time domain.  In theory, the path RSRP can be defined as    In particular if n=0, then    Thus, the calculation for RSRPP is not a linear average of the path PRS power in the PRS REs but it should be the **power of linear average of the PRS REs.** |
| InterDigital | Support |
| NTT DOCOMO | Support |
| Xiaomi | Support the proposal |
| FL | To Samsung: in my understanding, any delay in the time domain can be translated to a phase rotation in the frequency domain, so to calculate the power of a path you could:   * + - * in the time domain, read the correlator output for the correlation of the received signal with the PRS at a time offset t where t is the TOA of the path.       * or in the frequency domain, this correspond to the sum for each frequency of the product X(f).Y(f)\*exp(j2\*j\*pi\*f\*t)   it is not clear to me if the equation fo x(n) is for the PRS power, but the case for n=0 is not the general case, for any n the solution should be |

**Question 1.1**

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| --- | --- |
| **Company** | **Comment** |
| Nokia/NSB | TP1.1b. We are open to discuss necessary modification or other options. |
| CATT | We also proposed a TP in [5] for the definition of DL-PRS-RSRPP as follows, and we prefer this version(we also had added the TP in the above summary table in section 2.1.1.2.1): [TP1.1c] 5.1.35 DL PRS reference signal received path power (DL PRS-RSRPP)  |  |  | | --- | --- | | **Definition** | DL PRS reference signal received path power (DL PRS-RSRPP), is defined as linear average of the power contributions (in[W]) of the received DL PRS signal of the resrouce elements configured for the measurement at the i-th path delay of the channel response, where DL PRS-RSRPP for 1st path delay is the power contribution corresponding to the first detected path in time.  For frequency range 1, the reference point for the DL PRS-RSRPP shall be the antenna connector of the UE. For frequency range 2, DL PRS-RSRPP shall be measured based on the combined signal from antenna elements corresponding to a given receiver branch. | | **Applicable for** | RRC\_CONNECTED,  RRC\_INACTIVE | |
| OPPO | Prefer 1.1b |
| Huawei, HiSilicon | From our side, it is not quite clear how “power contributions of the resource elements … at the i-th path delay” is obtained by UE. If we agree with the 1b, maybe we can reply to RAN4 that it is up to RAN4 to further clarify how this can be done. |
| vivo | We have some concerns about the modification of the last sentence of TP 1.1b about removing PRS RSRPP. For us, the definition is for RSRPP, removing it to explain (1st path delay is the first detected path) is vague. |
| Ericsson | We think that TP 1.1b can be used as a start. TP1.1a defines the RSRPP with the power of the linear average over the PRS REs, but the RSRPP is actually the linear average of the power over the PRS Res at the path position (i.e. the other way around).  We propose to remove the “ within the considered measurement frequency bandwidth” a from the definition, since we already capture that the power measurement is on the PRS Res, which themselves define the measurement bandwidth.  Proposed update:   * DL PRS reference signal received path power (DL PRS-RSRPP), is defined as the linear average over the power contributions of the resource elements that carry ~~of~~ the ~~received~~ DL PRS signal configured for the measurement at the i-th path delay of the channel response ~~within the considered measurement frequency bandwidth~~, where ~~DL PRS-RSRPP for~~ the 1st path delay is the ~~power corresponding to the~~ first detected path in time. |
| Fraunhofer | Prefer TP1.1a or the Ericsson proposal, don’t see a reason why this part “… within the considered measurement frequency bandwidth” shall be captured for the definition. |
| Nokia/NSB | We thought the description on ‘‘within the considered measurement frequency bandwidth‘‘ might be necessary since the UE sometimes estimates not all of the transmitted PRS REs (e.g., estimation of PRS only inside of BWP), but we are fine with removing it if there is no ambiguity.  We understand Huawei’s comment as in equation it might be correct to say power of the linear average of PRS REs but we were not sure if it was okay to define RSRP in this way. To complete this issue, we prefer to send an LS to RAN4 to ask for necessary modification whatever option is agreed. |

#### second round of discussion

regarding proposal 1, it is proposed to capture Huawei’s comment on leaving how to realise the measurement (in frequency or time domain) in up to ran4:

**Proposal 1.1-1 RAN1 confirms RAN4’s understanding from R4-2202780 regarding the DL-PRS-RSRPP definition. The DL PRS RSRPP is defined per path as a linear average of the path PRS power in REs occupied by the PRS.** **it is up to RAN4 to further clarify how the measurement is performed by the UE.**

regarding what TP to capture, a majority seemt OK with most of TP 1,1b. therefore we propose to continue refining the wording based on that TP. The starting point is based on the received comments regarding the text on measurement bandwidth and the last sentence changes:

**Proposal 1.1-2:** the following definition for DL PRS RSRPP in 38.215 is endorsed:

* DL PRS reference signal received path power (DL PRS-RSRPP), is defined as the linear average over the power contributions of the resource elements that carry ~~of the received~~ DL PRS signal configured for the measurement at the i-th path delay of the channel response ~~within the considered measurement frequency~~ bandwidth, where DL PRS-RSRPP for the 1st path delay is the power corresponding to the first detected path in time.

Companies are encouraged to provide feedback in the table below:

**Proposal 1.1-1, Proposal 1.1-2**

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| --- | --- |
| **Company** | **Comment** |
| CATT | We are generally fine with the proposal, and we prefer the following updated definition based on Proposal 1.1-2(The revisions are marked with Yellow background):  **Updated Proposal 1.1-2:** the following definition for DL PRS RSRPP in 38.215 is endorsed:   * DL PRS reference signal received path power (DL PRS-RSRPP), is defined as the linear average over the power contributions (in[W]) of the resource elements that carry ~~of the received~~ DL PRS signal configured for the measurement at the i-th path delay of the channel response ~~within the considered measurement frequency~~ ~~bandwidth~~, where DL PRS-RSRPP for the 1st path delay is the power contribution corresponding to the first detected path in time. |
| Qualcomm | OK with CATT’s changes |
| Nokia/NSB | We are fine with the change from CATT |
| OPPO | CATT’s change is better |

#### Conclusion for proposal 1.1-1 and 1.1-2

The discussion is concluded for proposal 1.1-2, with the following online agreement:

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| --- |
| **Agreement**  The following definition for DL PRS RSRPP in 38.215 is endorsed:   * DL PRS reference signal received path power (DL PRS-RSRPP), is defined as the power of the linear average of the channel response at the i-th path delay of the resource elements that carry DL PRS signal configured for the measurement, where DL PRS-RSRPP for the 1st path delay is the power contribution corresponding to the first detected path in time. |

A separate discussion is needed to inform RAN4 of the definition. we can start drafting the LS, but since we have multiple discussion with ran4 impact, we can wait agreeing on the LS until all RAN4 related topics are covered.

#### Proposal 1.2 (normalization of the path RSRP measurement / differential reporting) (closed)

#### Summary of proposals

The proposals discuss the following issues separate issues:

* Reporting of the first path DL PRS RSRPP for the main measurement:
  + The report includes PRS RSRP and a differential DL PRS RSRPP is reported with PRS RSRP as reference [2][3][4][9][10][16]
  + The report includes both PRS RSRP and PRS RSRPP [6] (no use of differential reporting for RSRPP)
  + First path DL PRS RSRPP is reported standalone (without PRS RSRP) and as a absolute measurement (not relative to another measurement[12]).
  + Support both options of differential and non-differential reporting of RSRPP [7]
  + Proposals against: [12] [20]
* Reporting of the path RSRP for additional measurements and additional paths:
  + The report uses relative reporting for additional path or measurements [5][12]
* The report indicates either RSRP or RSRPP is reported [11]
* Reporting range:
  + Encoding and resolutions are discussed in [1][7]

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| --- | --- |
| Source | Proposal |
| [1] | ***Proposal 3: Support the following encoding scheme for DL PRS-RSRPP in DL-AoD.***   * ***The main RSRPP value that serves as the reference for all the remaining RSRPP values is reported with the absolute value using 7 bits according to Table 10.1.24.3.1-1 of TS 38.133, which is the maximum RSRPP for the first path among all the reported DL PRS resources.*** * ***The remaining RSRPP values are reported with the single-sided differential value using 5 bits according to Table 10.1.24.3.2-1 of TS 38.133.***   ***Proposal 6: Support the following encoding scheme for DL PRS-RSRPP in DL-TDOA and Multi-RTT.***   * ***The main RSRPP values that serves as the reference for all the remaining RSRPP values (including the additional resource and additional paths) is reported with the absolute value using 7 bits according to Table 10.1.24.3.1-1 of TS 38.133, which is the RSRPP for the first path for a main DL PRS resource.*** * ***The remaining RSRPP values are reported with the double-sided differential value using 6 bits according to Table 10.1.24.3.2-2 of TS 38.133, including the additional paths for the main DL PRS resource, and the first path and additional paths for the other DL PRS resources.*** |
| [2] | ***Proposal 2***   * ***PRS-RSRP reporting is the prerequisite of the first path of the PRS resource:***   + ***Normalization: differential PRS-RSRPP reporting is reported as the difference in dB with respect to PRS-RSRP.***   + ***Same Rx branches as applied for PRS-RSRP measurement are used for PRS-RSRPP measurement.*** * ***Value {1} should be added to the candidate value of the maximum number of PRS-RSRPP.*** |
| [3] | ***Proposal 1:*** *The path PRS RSRP of a DL PRS resource is reported relative to the corresponding DL PRS-RSRP at least for first detected path.* |
| [4] | Proposal 1: For each PRS RSRPP reporting, the UE reports the differential RSRP with reference to the RSRP of the corresponding PRS resource. |
| [5] | ***Proposal-6: When differential reporting is used, the reference measurement should be the absolute value of PRS-RSRPP of the strongest path.*** |
| [6] | **Proposal 3**: If the UE reports PRS RSRPP for the first path for a PRS resource, it should report it together with PRS-RSRP for the PRS resource. |
| [7] | Proposal 1   * + **For both UE-based and UE-assisted DL-AOD positioning, the UE can be requested subject to UE capability to measure and report (for UE-assisted) the DL PRS-RSRPP of the first path using the following RX diversity options:**     - **Option 1: if the DL PRS-RSRPP of the first path is reported only, then the DL PRS-RSRPP of the first path is reported using the absolute values**     - **Option 2: if both DL PRS-RSRP and DL PRS-RSRPP of the first path are reported, then the DL PRS-RSRP is reported using the absolute values and the DL PRS-RSRPP of the first path is reported using the differential values, where the DL PRS-RSRP is selected as a reference measurement**     - **The absolute values are reported in the range [-156 dBm, -31 dBm] with 1 dB resolution**     - **The differential values are reported in the range [-30 dB, 0 dB] with 1 dB resolution** |
| [9] | **Proposal 1: From RAN1’s perspective, the relative power of DL PRS RSRPP to the DL PRS RSRP from the same DL PRS resource is reported.**   * **Send LS to RAN2 and RAN4 to check in case they have concerns.** |
| [10] | *Proposal 1: Prefer to normalize the PRS-RSRPP with PRS RSRP for signaling overhead reduction.* |
| [11] | ***Proposal 1: An indicator of whether the report for PRS RSRP includes all the paths or the first arrival path only is supported.*** |
| [12] | ***Proposal 2: Support reporting first-path PRS-RSRPP by reusing absolute PRS-RSRP measurement report mapping for the first measurement (similar to PRS-RSRP in NR Rel-16).***  ***Proposal 3: Support reporting first-path PRS-RSRPP for additional measurements by reusing differential PRS-RSRP measurement report mapping with respect to the first-path PRS-RSRPP of the first measurement (similar to the reporting of PRS-RSRP for the additional measurements in NR Rel-16).***  ***Proposal 4: Support reporting additional path PRS-RSPP for a measurement (first or additional) by reusing differential reporting with respect to the PRS-RSRPP of the first-path of the measurement.*** |
| [16] | Proposal 2: Define the path DL PRS RSRP as the absolute power, without normalization.  Proposal 3 In measurement reports,  - The report includes differential path PRS RSRP and optionally DL PRS RSRP  - Differential DL PRS-RSRPP is reported as the difference in dB with respect to the reference measurement DL PRS RSRP  - If DL PRS RSRP is not included in the report, the gNB assumes the latest available DL PRS RSRP for the same PRS resource was used as reference measurement.  Proposal 4 : Include DL PRS-RSRPP of the first path in NR DL-AoD Location Information alongside the existing DL PRS-RSRP measurement. Specifically, add it to the NR-DL-AoD-MeasElement IE and the NR-DL-AoD-AdditionalMeasurementElement IE  Proposal 5 : Send an LS to RAN2 and RAN4 regarding the use of differential DL PRS RSRPP together with DL PRS RSRP |

#### First round of discussion

It is proposed to start the discussion with the way DL-RSRPP should be reported for the first path, and choose between the option of using relative reportive with PRS RSRP as reference, or absolute reporting. The proposal applies not only to DL-AOD, but also to first path measurements used in other methods using PRS RSRPP (DL-TDOA, multi-RTT). Once the discussion progresses for the first path reporting, we can proceed with discussing additional path / additional measurements and parameter range.

Note that for this proposal as well as the proposal discussed as proposal 1.1, a reply LS to RAN4 should be discussed once the proposal have converged.

**Proposal 1.2: for the reporting of first path DL-PRS RSRPP in the main measurement (i.e. not additional measurement) in a measurement report, the report is constructed by (downselect):**

* **Alt1: DL PRS RSRPP is reported by including DL PRS RSRP and differential PRS RSRPP, with PRS RSRP as a reference for the differential PRS RSRPP.** 
  + **FFS: overhead reduction mechanisms, e.g. not always including PRS RSRP in the report.**
* **Alt2: absolute (not relative) DL PRS RSRPP is reported, and DL PRS RSRP can optionally be included in the report**
* **Alt3: either DL PRS RSRP or absolute DL PRS RSRPP is reported, and an indicator signals what is reported.**

Companies are encouraged to provide comments in the table below.

**Proposal 1.2**

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| **Company** | **Comment** |
| Qualcomm | Alt. 1 with modification:   * DL PRS RSRP is mandatory * DL PRS RSRPP is reported optionally for each measurement.   + For the 1st measurement, it is absolute reporting (NO need to be differential with DL PRS RSRP)   + For the additional measurement, it is differential reporting with respect to the RSRPP of the 1st measurement |
| Nokia/NSB | Before discussing the downselect option, we would like to first clarify one thing. If the UE reports first path DL-PRS RSRPP in the main measurement, should the PRS resource for this PRS RSRPP be the same as the PRS RSRP reporting introduced in Rel-16? or, is this feature a new feature, so the PRS resource ID for PRS RSRPP can be different than the PRS resource ID for PRS RSRP? |
| CATT | We prefer Alt.2. |
| OPPO | Alt1  Alt1 can provide more information with less overhead. |
| Huawei, HiSilicon | We prefer Alt.2, but we respect that in Rel-16, the „main“ PRS-RSRP is already mandatory for DL-AoD, and prefer to have the same mandatory „main“ PRS-RSRP for DL-AoD. For additional measurement, given that we already extend this list to 23, we believe in the additional measurement, a new IE variant could be introduced that both RSRP and RSRPP can be optional.  So for the main measurement, RSRP is mandatory, RSRPP is optional, and both RSRP and RSRPP are reported with absolute value.  NR-DL-AoD-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-DL-PRS-RSRP-Result-r16 INTEGER (0..126),  nr-DL-PRS-RxBeamIndex-r16 INTEGER (1..8) OPTIONAL,  nr-DL-AoD-AdditionalMeasurements-r16  NR-DL-AoD-AdditionalMeasurements-r16 OPTIONAL,  …  }  NR-DL-AoD-AdditionalMeasurements-r16 ::= SEQUENCE (SIZE (1..7)) OF  NR-DL-AoD-AdditionalMeasurementElement-r16  NR-DL-AoD-AdditionalMeasurementElement-r16 ::= SEQUENCE {  nr-DL-PRS-ResourceID-r16 NR-DL-PRS-ResourceID-r16 OPTIONAL,  nr-DL-PRS-ResourceSetID-r16 NR-DL-PRS-ResourceSetID-r16 OPTIONAL,  nr-TimeStamp-r16 NR-TimeStamp-r16,  nr-DL-PRS-RSRP-ResultDiff-r16 INTEGER (0..30),  nr-DL-PRS-RxBeamIndex-r16 INTEGER (1..8) OPTIONAL,  …  } |
| vivo | Alt 1  We acknowledge that Alt2 has more flexibility about path RSRP measurement but considering the specification impaction and tight timeline, Alt 1 is preferred.  For the Nokia question, if Alt 2 is chosen, the PRS resource ID for PRS RSRPP may be different than the PRS resource ID for PRS RSRP. But if Alt 1 is chosen, the PRS resource ID for PRS RSRPP is the same as the PRS resource ID for PRS RSRP. And we prefer the resource ID of RSRPP is the same as the resource ID of RSRP since the RSRP in Rel-16 is mandatory |
| Intel | Alt. 1 |
| ZTE | For DL-AOD, the DL PRS RSRP is mandatory to be reported in Rel-16. Therefore, we think Alt.1 is a better choice.  For Nokia’s question, if PRS RSRPP and DL PRS RSRP are both requested by network, the PRS RSRPP and DL PRS RSRP should correspond to the same PRS resource ID. E.g. UE may report multiple triplets: {PRS resource ID1, DL PRS RSRP1, DL PRS RSRPP1 }, {PRS resource ID2, DL PRS RSRP2, DL PRS RSRPP2}... |
| LGE | we prefer Alt.2 and we are supportive of differential reporting for N-additional paths which may be dealt in 8.5.5. |
| Lenovo, Motorola Mobility | Alt.1 also prefer that RSRP be at least a mandatory reporting option as Rel-16. |
| Ericsson | Preference for alt1, but this is really a reporting optimization that ca be left to RAN2 and RAN4. |
| Fraunhofer | Alt. 2 |
| InterDigital | Alt. 1. For clarification, we are also supportive to distinguish mandaory (DL PRS RSRP) and optional measurements in the report. |
| NTT DOCOMO | We prefer Alt.1. DL PRS RSRP should be reported. |
| Xiaomi | Prefer Alt 1 for overhead reduction. |
|  |  |

#### second round of discussion

the support for the alternatives is as follow:

* Alt1: Qualcomm, OPPO, vivo, Intel, Alt1, Lenovo, Motorola Mobility, Ericsson, Interdigital, NTT DOCOMO, Xiaomi
* Alt2: CATT, Huawei, HiSilicon, LGE, Fraunhofer

There is a majority for support of alt1. However, the following was agreed by RAN4:

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| --- |
| **Issue 3-1-2: PRS-RSRPP report mapping**  ***Agreements:***  Re-use the existing absolute and differemtial report mapping tables for PRS-RSRP for PRS-RSRPP   * Note: Other types of PRS-RSRPP report mapping discussed under issues 3-1-3 and 3-1-4.   **Issue 3-1-3: PRS-RSRPP reporting together with PRS-RSRP**  ***Agreements:***  Should PRS-RSRPP be normalized for reporting if it is reported with PRS-RSRP?   * NO   **Issue 3-1-4: PRS-RSRPP reporting without PRS-RSRP report**  ***Agreements:***  Should PRS-RSRPP be normalized for reporting if it is reported without PRS-RSRP?   * NO |

Based on the RAN4 agreement, it is proposed to reconsider whether RAN1 wants to over-ride the RAN4 agreement and support alt 1, or confirm the agreement and support alt2. Thus proposal 1.2 is not changed for now. companies are encouraged to provide feedback in the table below:

**Proposal 1.2**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| CATT | Since RAN4 had made the related agreements on this issue, we prefer to respect them and support Alt.2. |
| Qualcomm | To FL: We dont think that RAN4 agreed to Alt. 2, the way it is being phrased above. Alt. 2 says:   * **Alt2: absolute (not relative) DL PRS RSRPP is reported, and DL PRS RSRP can optionally be included in the report**   It is not clear to us that RAN4 agreed that there is not going to be PRS-RSRP for the 1st measurement. The point of the question is whether it needs to be normalized based on the definition. RAN4 has not decided that PRS-RSRP will not be reported. RAN4 didnt discuss the optionality of RSRP.  In short, we should not override RAN4 agreement, but this doesnt mean that we need to agree on Alt. 2.  We can just say:   * **When PRS RSRPP is reported (for any measurement, or first or additional path), no normalization with the PRS RSRP is needed.** * **FFS: Differential reporting with respect to the PRS RSRPP measurements**   Now to solve the FFS, we can fill in a table.   * We propose the following:  |  |  |  | | --- | --- | --- | | **PRS RSRPP reporting** | **1st path** | **Additional path** | | **1st measurement** | QC: Absolute | QC: Differential with respect to the 1st measurement & 1st path | | **Additional measurement** | Differential with respect to the 1st measurement & 1st path | Differential with respect to the 1st additional measurement & 1st path | |
| Huawei, HiSilicon | Just to clarify that we are talking about DL-AoD or DL-TDOA/Multi-RTT as well.  We agree with the table suggested by Qualcomm with the understanding that this table applies to DL-TDOA/Multi-RTT, while the 1st path column applies to DL-AoD.  We also acknowledge that the optionality of RSRP is a separate discussion according the LS from RAN2.  **For RAN1 agreements “The requested PRS measurement can be DL PRS RSRP and/or path PRS RSRP. ”, is there a need to request and provide only the RSRPP measurements for the additional measurements (without legacy RSRP)?**  From our side, we think that for DL-AoD, only the main RSRP should be reported. Additional measurement of RSRP and RSRPP should be optional. |
| ZTE | We’re fine with the Table suggested by Qualcomm with the understanding that the 1st measurement for DL-PRS RSRP should be mandatory for DL-AoD.  Agree with Huawei that 1st path column in the Table applies to DL-AoD. |
| LGE | To cover all of RAN4’s agreements that not only PRS-RSRPP can not be normalized with PRS-RSRP but also Re-use the existing absolute and differential report mapping tables, we think that there is only one way to achieve the goal and then the way is using both absolute RSRPP for 1st path and differential reporting for additional paths with respect to 1st path. We are supportive of QC’s suggested table. |
| vivo | The proposal includes two issues  One is about whether the DL-RSRP is mandatory, and the issue is related to the RAN2 question ‘ **is there a need to request and provide only the RSRPP measurements for the additional measurements (without legacy RSRP)?** ‘  **Answer**： NO since the RSRP in the first measurement and additional measurement in Rel-16 is mandatory  Another is about the reference to DL PRS-RSRPP, we think there are three options  Option 1：absolute only, no reference  Option 2：relative to DL PRS RSRP  Option 3： relative to first path DL PRS RSRPP of first measurement.  Based on the above agreement listed as FL, it is about “should PRS-RSRPP be normalized ...”, but RAN4 doesn’t send the agreement to us, and up to RAN1/RAN2 to decide what reference is used in RAN4 LS.  So, in our view, if Alt1 is the majority preference, Alt1 can be agreed   |  | | --- | | LS   * mapping tables in TS38.133 clause 10.1.24.3.1 and 10.1.24.3.2 respectively. * When differential reporting is used, PRS-RSRPP is reported as the difference in dB with respect to a reference measurement. RAN4 understands that it is up to RAN1/2 to decide what reference measurement would be for the PRS-RSRPP differential reporting. | |
| Xiaomi | We are fine with Qualcomm’s proposal |
| OPPO | We can be ok with Alt2 since RAN4 has the related agreement and we shall respect the agreement.  Regarding the differential with respect to the first path, there might be a problem since the first path might not have the largest RSRP and then the possible range for differential would be from negative to positive. Given that, the benefit of reporting differential might be gone. |

#### Third round of discussion (GTW)

From the feedback collected in the second round, alt1 still has preference but with some modification with regard to reporting of the main measurement and additional measurement. We also include wording to reply to RAN2 regarding the optionality of RSRP in issue #5 of R1-2202620 / R2-2203597. Based on the collected feedback, the proposal is revised as follow:

**Proposal 1.2b: for the reporting of first path DL-PRS RSRPP in DL AOD,**

* **For the 1st measurement, the report includes DL PRS RSRP and optionally DL PRS RSRPP using absolute reporting**
* **For additional measurement, DL PRS RSRPP can be optionally reported using differential reporting with the first measurement of DL PRS RSRPP**
* **Send the agreement in an LS reply to RAN2 as a reply regarding the question “For RAN1 agreements “The requested PRS measurement can be DL PRS RSRP and/or path PRS RSRP. ”, is there a need to request and provide only the RSRPP measurements for the additional measurements (without legacy RSRP)?”**

Companies are encouraged to provide comments in the table below.

**Proposal 1.2b**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Huawei, HiSilicon | We do not think this proposal addresses RAN2 LS. The key issue from RAN2 should be for DL-AoD, is it possible not to support RSRP if RSRPP is reported.  Our answer is that for the main measurement, RSRP should be mandatory, but for the additional measurement, RSRP can be optional as well as RSRPP.  Note that the existing list NR-DL-AoD-AdditionalMeasurements-r16 would anyway be extended to incorporate more than 8 RSRP/RRSPP measurement, and each element could have a new IE structure.  NR-DL-AoD-AdditionalMeasurements-r16 ::= SEQUENCE (SIZE (1..7)) OF  NR-DL-AoD-AdditionalMeasurementElement-r16 |
| OPPO | If the RAN2 quesiton is to ask if „nr-DL-PRS-RSRP-ResultDiff-r16“ can be optional (which is not optional in rel16), then we should answer it clearly that DL PRS RSRP in additional measurment is optional and RSRPP is optional, but the UE has to report one of them. |
| Nokia/NSB | Sorry for our late comment. In consideration of RAN4 decision captured in the 2nd round and FL’s comment, we prefer to respect RAN4 decision, so we are okay with Alt.2 of the previous rounds. For this proposal, we have the similar view with Huawei. |
| ZTE | We share the same view with Huawei.  In addition, we prefer to to change “ DL PRS RSRPP” into “ DL PRS RSRPP for first detected path” to make sure we’re discussing about first path rather than additional path. |
| CATT | It seems that the proposal1.2b is modified based on Alt.2 instead of Alt.1, since DL PRS RSRPP using absolute reporting in the 1st measurement in this proposal.  Since RAN2’s question in the LS is **“Is there a need to request and provide only the RSRPP measurements for the additional measurements (without legacy RSRP)?”,** we prefer to include the following statements in the reply LS:  **From RAN1 perspective, there is a need to request and provide only the RSRPP measurements for the additional measurements (without legacy RSRP).** |
| FL | Thanks for the early feedback. Let’s update the proposal to clarify that RSRP for additional measurement is kept as in rel-16, i.e. as a optional, differential measurement (the same nr-DL-PRS-RSRP-ResultDiff-r16 should be re-used).  To CATT: please see if the update proposal is ok. I think we can add your propose wording in the LS as well.  **Updated Proposal 1.2b: for the reporting of first path DL-PRS RSRPP in DL AOD,**   * **For the 1st measurement, the report includes DL PRS RSRP and optionally DL PRS RSRPP using absolute reporting** * **For additional measurement, at least one of the two following measurement is reported:**   + **DL PRS RSRPP can be optionally reported using differential reporting with the first measurement of DL PRS RSRPP,**   + **DL PRS RSRP can be optionally reported using differential reporting with the first measurement of DL PRS RSRP.** * **Send the agreement in an LS reply to RAN2 as a reply regarding the question “For RAN1 agreements “The requested PRS measurement can be DL PRS RSRP and/or path PRS RSRP. ”, is there a need to request and provide only the RSRPP measurements for the additional measurements (without legacy RSRP)?”** |
| Qualcomm | We supporth the update from the FL. |
| Vivo | Sorry, we thinkDL PRS RSRP for DL-AOD should be mandatory, we don’t want to change Rel-16 behavior at this stage. So, we propose to change the second sub-bullet of the second bullet as follows.   * + **DL PRS RSRP is mandatorily reported using differential reporting with the first measurement of DL PRS RSRP.**   In addition, the maximum number of DL RSRP or DL RSRPP can be 24, we don’t find there are big benefits to selecting different resources for DL RSRP and DL RSRPP reporting, instead, the signaling will be more complex. |
| ZTE | We have similar view with vivo. We prefer to align the same reporting mechanism between first measurement and additional measurement, i.e. both first measurement and additional measurement include DL PRS RSRP and optionally DL PRS RSRPP. |
| CATT-2 | To FL: We can live with the updated proposal in principle, and prefer to further update it as follows,  We prefer to add the third sub-bullet, since we should discuss how to reply the LS.  **Updated Proposal 1.2b: for the reporting of first path DL-PRS RSRPP in DL AOD,**   * **For the 1st measurement, the report includes DL PRS RSRP and optionally first path DL PRS RSRPP using absolute reporting** * **For additional measurement, at least one of the two following measurement is reported:**   + **DL PRS RSRPP can be optionally reported using differential reporting with the first measurement of first path DL PRS RSRPP,**   + **DL PRS RSRP can be optionally reported using differential reporting with the first measurement of DL PRS RSRP.** * **Note: From RAN1 perspective, there is a need to request and provide only the RSRPP measurements for the additional measurements (without legacy RSRP).** * **Send the agreement in an LS reply to RAN2 as a reply regarding the question “For RAN1 agreements “The requested PRS measurement can be DL PRS RSRP and/or path PRS RSRP. ”, is there a need to request and provide only the RSRPP measurements for the additional measurements (without legacy RSRP)?”** |
| InterDigital | We support the latest proposal from the FL. |
| Huawei, HiSilicon | We support the latest proposal from the FL.  Reply to vivo/ZTE, this is not changing Rel-16 behaviour, but for a UE supporting Rel-17 features, may choose to use another IE that does not need to mandatorily measure RSRP and report RSRP. |
| LGE | We are agree with latest FL’s proposal. |
| vivo2 | We are still concerned to “ DL PRS RSRP can be optionally reported” . In our view, for DL-TDOA and multi-RTT, PRS-RSRP can be optionally, but not for DL-AOD.  On the one hand, we want to reuse the original signaling design as much as possible.  On the other hand, we don't want the UE implementation to be too complicated. If PRS-RSRP is not mandatory, UE may report up to 48 resources. And for the resources that only includes RSRPP, it may break the RAN4 agreement, that using other Rx branches to measure RSRPP because there are no RSRP branch. In addition, I believe we can reach a consensus that the complexity of first path RSRPP measurement is much larger than RSRP measurement. So, if we still needs measured all the branches to select Rx branches for each resources that only includes RSRPP, we wonder it is what we want to do in Rel-17 especially in the case there are no signiicant enhancement in accuracy.  ***RAN4 Agreements:***   * Same Rx branches as applied for PRS-RSRP measurement are used for path PRS-RSRP measurement |

#### Conclusion for proposal 1.2

The following was agreed and captured in the chair’s notes:

|  |
| --- |
| **Agreement**  For the reporting of first path DL-PRS RSRPP in DL AOD,   * For the 1st measurement, the report includes DL PRS RSRP and optionally DL PRS RSRPP using absolute reporting * For additional measurement, at least one of the two following measurement is reported:   + First path DL PRS RSRPP can be optionally reported using differential reporting with the first measurement of DL PRS RSRPP,   + DL PRS RSRP can be optionally reported using differential reporting with the first measurement of DL PRS RSRP. * Send the agreement in an LS reply to RAN2 as a reply regarding the question “For RAN1 agreements “The requested PRS measurement can be DL PRS RSRP and/or path PRS RSRP. ”, is there a need to request and provide only the RSRPP measurements for the additional measurements (without legacy RSRP)?” |

#### Proposal 1.3 (time of arrival)(low priority)

#### Summary of proposals

Regarding the inclusion of time of arrival information in AOD reports, the following is proposed:

* Inclusion of time of arrival for each additional first path PRS-RSRPP [1][3][4 (potentially also for additional paths], [6] (use RSTD between reported resources)[16]
  + Not supporting [2]

|  |  |
| --- | --- |
| Source | Proposal |
| [1] | ***Proposal 7: Support either one of the following***   * ***Option. 1 For each additional first path PRS-RSRPP measurement reporting for DL-AoD, UE also reports the relative TOA for the first path to the first path of the reference PRS.*** * ***Option. 2 UE is expected to ensure that the first path PRS-RSRPP measurement reporting for DL-AoD across the reported DL-PRS resources are from the same path.*** |
| [2] | ***Proposal 1***   * ***Only support first path RSRP reporting in DL-AoD positioning, and reporting multipath RSRP(s) are not introduced for DL-AoD in Rel-17.*** * ***Reporting timing information is not introduced for DL-AoD in Rel-17.*** |
| [3] | ***Proposal 2:*** *In addition to first path DL PRS RSRP measurement for UE-assisted DL-AOD, Rel-17 UE should be able to report information corresponds to the arrival time of the first path, which includes,*   * *Time of arrival( i.e. TOA) for at least one DL PRS resource per TRP* * *Time differences of first detected paths among DL PRS resources from the same TRP (i.e. Intra-TRP TDOA)* |
| [4] | Proposal 2: For each reported PRS RSRPP, the UE can also report the time-of-arrival measurement of the corresponding path. |
| [6] | **Proposal 1**: For DL-AoD support reporting of multiple PRS resources per PRS resource set, with each resource being associated with RSTD. |
| [16] | Proposal 7: The DL PRS-RSRPP is reported together with an associated timing measurement of the corresponding path. |

#### First round of discussion

The issue of TOA measurements inclusion for AOD has been proposed for a few meetings. We have not managed to reach consensus so far. The last proposal from RAN1#107e did not converge, but during the discussion, two tracks were identified for TOA reporting (if agreed):

* The RSRPP is reported for the same TOA for all reported PRS resources
* The RSRPP is reported for different TOA for each reported PRS resources, and then the TOA should be included in the report.

Considering the current proposal and also the discussion from past meetings, the following is proposed. Further discussion regarding use of RSTD to report the TOA for additional measurements/paths can take place at a later stage:

**Proposal 1.3: for first path RSRPP reporting, the UE can optionally be requested to include the first path time of arrival for each reported PRS resource. If TOA is not reported in a measurement report, the LMF can assume all PRS RSRPP measurements for a TRP in a measurement report are reported for the same TOA.**

Companies are encouraged to provide comments in the table below.

**Proposal 1.3**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Qualcomm | Not support |
| Nokia/NSB | We are okay with the first sentence in this proposal. “ **for first path RSRPP reporting, the UE can optionally be requested to include the first path time of arrival for each reported PRS resource.”** We believe that timing measurement reporting is additional and optional feature. Even if the UE does report time measurement information, the LMF cannot assume that all PRS RSRPP measurements are reported for the same TOA. |
| CATT | We are fine with the inclusion of time of arrival information in AOD reports, but we prefer the Proposal to be updated as follows,  **Updated Proposal 1.3: for first path RSRPP reporting, the UE can optionally be requested to include the first path time of arrival for each reported PRS resource.  ~~If TOA is not reported in a measurement report, the LMF can assume all PRS RSRPP measurements for a TRP in a measurement report are reported for the same TOA.~~** |
| OPPO | We are supportive to include TOA informaiton in DL AoD report. And the revision suggested by CATT looks good to us. |
| Huawei, HiSilicon | We are Ok with the proposal, even though from our side, single solution is prefered. |
| vivo | Not support  We don’t think a better selection can be done by LMF based on the ToA reporting. And simple timing information can tell anything, especially considering the TEG error, sync error, or UE moving. |
| Intel | We are not supportive |
| ZTE | The same view as Nokia/NSB. |
| LGE | We are on the same page with CATT. We are generally fine except for last sentence. ( ~~If TOA is not reported in a measurement report, the LMF can assume all PRS RSRPP measurements for a TRP in a measurement report are reported for the same TOA~~.) |
| Ericsson | Support the updated version from LGE/CATT/Nokia |
| Fraunhofer | Support reporting a TOA associated with the DL-RSRPP of the 1st path. |
| ZTE2 | One question for clarification, when we say “for first path RSRPP reporting, the UE can optionally be requested to include the first path time of arrival for each reported PRS resource”, do we mean UE has to report all TOA values from PRS resources of the same TRP? This is not necessary. We think UE only has to report one TOA for a reference measurement and additional timing measurements relative to the reference measurement (i.e. intra-TRP RSTD).  Therefore, we prefer to revise the first sentence of this proposal,  *Support UE to report a TOA value associated with the DL-RSRPP of the 1st path for a reference measurement, then other TOA values associated with additional first path DL-RSRPP(s) from the same TRP are reported relative to the TOA value of reference measurement.* |

#### Second round of discussion

Considering there is a majority supporting the proposal we can continue the discussion including ZTE’s proposal, and removing the last sentence as suggested by several companies:

**Proposal 1.3b: for first path RSRPP reporting, the UE can optionally be requested to include the first path time of arrival for each reported PRS resource as follow:**

* **Support UE to report a TOA value associated with the DL-RSRPP of the 1st path for a reference measurement,**
* **other TOA values associated with additional first path DL-RSRPP(s) from the same TRP are reported relative to the TOA value of reference measurement.**

**~~If TOA is not reported in a measurement report, the LMF can assume all PRS RSRPP measurements for a TRP in a measurement report are reported for the same TOA.~~**

Companies are encouraged to provide comments in the table below.

**Proposal 1.3**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| CATT | We want to clarity that what “ **a reference measurement**” in the proposal refers to? If it means one reference TOA, we prefer to change “ **a reference measurement**” to “ **a reference TOA**”. |
| Qualcomm | Not support |
| Nokia/NSB | We are okay with this proposal. |
| FL | To CATT: in the first sub-bullet, the first path ~~RSRPP~~ TOA is defined as the reference measurement. In the second bullet, additional first path (i.e. reported via the additional measurement IE) are reported relative to the reference first path. |
| Huawei, HiSilicon | From our side, we do not support reporting reference TOA for DL-AoD, which effectively changes DL-AoD to timing based methods.  We are fine with reporting only the relative TOA for DL-AoD of additional first path measurement. |
| ZTE | Support.  We think reference TOA can be a useful information for coarse positioning or single base station based positioning. |
| LGE | According to FL’s above description, “the reference measurement” used in both bullets are different. So, some clear description needs to be added or modified.  In addition, for clear understanding, we also have a question about “referece measurement”. If the “referece measurement” represents “reference timing” which is already used in the current specification. If our understading is right, we prefer to modify it to “reference timing”. |
| vivo | Not support. |
| CATT-2 | To FL: we prefer to change the “ **reference measurement**” in the first bullet and second bullet to concret terms, such as the first path RSRPP or others. Current descpritons are not clear for us. |
| OPPO | Support  TOA value of each path is useful for system to refine the positioning calculation. |

#### Third round of discussion (low priority)

There are still two companies opposed to this enhancement. From the FL point of view, I don’t think there is much change to get an agreement on the issue. We can revise the proposal wording to clarify the reference measurement based on CATT’s feedback, but it seems we won’t make progress on the issue this meeting, so I propose to de-prioritize the issue

**Proposal 1.3c: for first path RSRPP reporting, the UE can optionally be requested to include the first path time of arrival for each reported PRS resource as follow:**

* **Support UE to report the absolute TOA value associated with the DL-RSRPP of the 1st path for the first measurement**
* **Support UE to report relative TOA values associated with additional first path DL-RSRPP(s) from the same TRP, where the reference is the TOA value of the first measurement.**

**Proposal 1.3c**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| OPPO | Support the proposal |
| Nokia/NSB | We are generally okay with this proposal, and we still think this feature is one of important ones for DL-AoD enhancement. In this proposal, the reference is just from the first measurement so we do not see critical issue on what the reference is. |
| Huawei, HiSilicon | Just to clarify the first bullet: How is the absolute TOA values for DL-AoD is defined?  For DL-TDOA, it is defined as the relative value to the reference TOA (reference TRP), while for RTT, it is defined as the relative value to the UL transmission.  From our side, we only think the second bullet is feasible from DL-AoD perspective, although we do not mind to add the following statement in LPP if we do not define any TOA reporting for DL-AoD.  **The LMF can assume all the first path PRS RSRPP measurements for a TRP in a measurement report are associated with the same path.** |
| ZTE | Support.  We think this proposal should be supported so that what we agreed for DL-RSRPP can actually work. If the concern is to define TOA, we’re fine to remove the first bullet. |
| CATT | We tend to let this issue to be low priority. |
| Ericsson | Support the proposal, at least the for the second bullet, but ok to deprioritize for the meeting. |
| Huawei, HiSilicon2 | We still think this is an essential topic to be treated. For those saying „not support“, they did not even mention the reason at all for the issue identified in the contribution. |
| LGE | Support and agree with Huawei’s latest comment. |
| ZTE2 | We also this is high priority issue. |

#### Proposal 1.4 (receiver diversity) (closed)

#### Summary of the proposals

In [1] and [16] it is propose to consider the aspect of receiver diversity. Two aspect are considered:

receiver diversity within a measurement for UL RSRPP:

[1] and [16] discussed two options, following either the RX branch used for the first path PRS RSRPP, or the Rx branch used for the PRS RSRP

Receiver branch used across measurements:

[1] proposes to report measurement over multiple Rx branches if these are associated with multiple Rx or RxTx TEGs

|  |  |
| --- | --- |
| [1] | ***Proposal 2: Option 2 (the same Rx branch as the DL PRS-RSRP) should be adopted for DL-AoD DL PRS-RSRPP reporting.***  ***FL note:*** The following two options are supported by gNB to LMF for *UL SRS RSRPP*:   * Option 1 (RX diversity for the first path UL SRS-RSRPP)   + The same RX branch(es) as applied for the first path UL SRS-RSRPP measurements are used for the additional paths UL SRS-RSRPP measurements if those are provided together   + For frequency range 1 and 2, if receiver diversity is in use by the gNB for UL SRS-RSRPP measurements, then reported UL SRS-RSRPP value for the first path shall not be lower than the corresponding UL SRS-RSRPP for the first pathof any of the individual receiver branches * Option 2 (RX diversity for UL SRS-RSRP)   + The same RX branch(es) as applied for UL SRS-RSRP measurements are used for UL SRS-RSRPP measurements (i.e., the first and additional paths UL SRS-RSRPP if those are provided)   ***Proposal 4: For DL-TDOA and Multi-RTT, when receiver diversity is in use, support UE to report PRS-RSRPP for multiple Rx branches for the same target PRS, if the TOA measurement for the target PRS is associated with multiple Rx or RxTx TEGs.***  For additional paths RSRPP reporting for DL-TDOA and Multi-RTT, we think the same Rx branch and potentially the same Rx TEGs should be assumed as the first path.  ***Proposal 5: For DL-TDOA and Multi-RTT, when receiver diversity is in use, the Rx branch for the RSRPP associated with the additional paths should be the same as that associated with the first path.*** |
| [16] | Proposal 6 The following is added to the definition of DL PRS RSRPP:  For frequency range 1 and 2, if receiver diversity is in use by the UE for DL PRS-RSRPP measurements:  - The reported DL PRS-RSRPP value for the first and additional paths shall be provided for the same receiver branch(es) as applied for DL PRS-RSRP measurements, or  - The reported DL PRS-RSRPP value for the first path shall not be lower than the corresponding DL PRS-RSRPP for the first path of any of the individual receiver branches and the reported DL PRS-RSRPP for the additional paths shall be provided for the same receiver branch(es) as applied DL PRS-RSRPP for the first path. |

#### First round of discussion

We can start the Rx Diversity discussion by focusing on the case of receiver diversity within a measurement for UL RSRPP. We note that there is a connection to the discussion on reporting PRS RSRPP with or without a relation to PRS RSRP.

Regarding the proposal for multi-RTT and DL-TDOA, the discussion can be taken as part of the 8.5.1 agenda. If the 8.5.1 agenda is too busy, we can consider it for discussion in 8.5.3.

**Proposal 1.4: For path DL PRS RSRPP measurement reporting, when receiver diversity is in use, the reported path DL PRS RSRPP shall be corresponding to the same Rx branch associated with the reported DL PRS RSRP.**

Companies are encouraged to provide comments in the table below.

**Proposal 1.4**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Nokia/NSB | In case the DL PRS RSRPP is reported together with a PRS RSRP for the same PRS resource, we are okay with this proposal. We have the same comment what we had on proposal 1.2: we would like to first clarify one thing. If the UE reports first path DL-PRS RSRPP in the main measurement, should the PRS resource for this PRS RSRPP be the same as the PRS RSRP reporting introduced in Rel-16? Or, is this feature a new feature, so the PRS resource ID for PRS RSRPP can be different than the PRS resource ID for PRS RSRP? |
| CATT | Support |
| OPPO | The proposal shall be ok only when they are reported together. For a RSRPP and RSRP reported in totally separate report, there is no need to require to use same Rx brach. |
| Huawei, HiSilicon | We think that option was already agreed by RAN4, and given that the „main“ RSRP is already mandatory for DL-AoD, we do not see a big problem for first path RSRPP reporting following proposal 1.4.  Reply Nokia, our understanding is that the reference resource (reported with absolute value) for RSRP and RSRPP could be different, which requires separate IDs in the main report. |
| Vivo | Okay with FL proposal based on RAN4 agreement  ***RAN4 Agreements:***   * Same Rx branches as applied for PRS-RSRP measurement are used for path PRS-RSRP measurement * Update the RSRPP definition to reflect that it is the path power on RE level * PRS-RSRPP measurement requirements in Rel-17 are defined for first path (i=1).   + Note: RAN4 understanding that PRS-RSRPP definition is generic and applicable to all paths (i≥ 1). * Sent following LS reply to RAN1 containing above agreements:   + R4-2202681, LS reply on definition of DL PRS path RSRP, Nokia |
| Intel | We are supportive of the proposal. But, we belive that both cases of RX diversity for the DL PRS-RSRP and DL PRS-RSRPP should be considered similar as it was agreed at the previous meeting for the UL SRS-RSRP and UL RSR-RSRPP. |
| ZTE | Support |
| LGE | We are generally fine with the proposal. |
| Ericsson | Support, with a similar view as intel that the cases supported for SRS should be supported for PRS, at least for DL methods with additional paths. |
| Fraunhofer | Support |
| InterDigital | Support |
| NTT DOCOMO | Support |
| FL | We can try to convert the proposal to an agreement at the GTW call. |
| Qualcomm | RAN4 agreement is clear. What would RAN1 add in addition to RAN4 agreement? |

#### Proposed conclusion

Since during the discussion it was identified that the RAN4 agreement was clear enough and that no further RAN1 agreement was required to update the specifications, we can stop the discussion.

Please put your comments in the table below if you think we should continue/capture an agreement in RAN1:

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Huawei, HiSilicon | We wonder the diversity issue for DL-TDOA/Multi-RTT is covered by this or not. Clearly our understanding is that they should be treated differently. |
| FL | In my view, the case for DL-TDOA and multi RTT is different and can be addressed separately. |
| Intel | We still have a question for clarification:  For the UL SRS-RSRPP reporting, we agreed to support two cases for RX diversity:   * Note: The following two options are supported by gNB to LMF:   + Option 1 (RX diversity for the first path UL SRS-RSRPP)     - The same RX branch(es) as applied for the first path UL SRS-RSRPP measurements are used for the additional paths UL SRS-RSRPP measurements if those are provided together     - For frequency range 1 and 2, if receiver diversity is in use by the gNB for UL SRS-RSRPP measurements, then reported UL SRS-RSRPP value for the first path shall not be lower than the corresponding UL SRS-RSRPP for the first pathof any of the individual receiver branches   + Option 2 (RX diversity for UL SRS-RSRP)     - The same RX branch(es) as applied for UL SRS-RSRP measurements are used for UL SRS-RSRPP measurements (i.e., the first and additional paths UL SRS-RSRPP if those are provided)   It looks that for the DL PRS RSRP(P) we support Option 2 only. We believe that we need to align UL and DL cases and support Option 1 as well for the DL case.  Could FL clarify the conclusion, what is a difference? |

### Aspect #2 extension of number of reported RSRP measurements (low priority)

#### Summary and Proposal 2.1

The following remaining issues are treated in the proposals:

* + [2] and [3 ]proposes to extend the “same Rx Beam” flag that can currently be used to flag measurements in the same resource set to all the resources set under a PFL. This was also proposed by another company during the RAN1#107e discussions.
    - [9] propose not to further extend the exisiting framework for Rx beam indication.

|  |  |
| --- | --- |
| Source | Proposal |
| [3] | ***Proposal 4****: When the UE reports DL PRS-RSRP measurements from DL PRS resource sets associated with the same positioning frequency layer and the same TRP, the DL PRS-RSRP measurements associated with the same DL PRS Rx beam index have been performed using the same spatial domain filter for reception.* |
| [9] | **Conclusion: No need to extend the Rx beam index indication of DL PRS-RSRP measurement reporting defined in Rel-16.** |
|  |  |

#### First round of discussion

The discussion was already taken during last meeting and did not converge. We can try one more time to reach an agreement, starting with the proposal last discussed in the past meeting.

**Proposal 2.1 To extend the application scope of DL PRS Rx beam index, when the UE reports DL PRS-RSRP measurements from DL PRS resource sets associated with the same positioning frequency layer and the same TRP, the UE indicates which DL PRS-RSRP measurements associated with the same higher layer parameter DL PRS Rx beam index have been performed using the same spatial domain filter for reception.**

Companies are encouraged to provide comments in the table below.

**Proposal 2.1**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Qualcomm | Not needed |
| Nokia/NSB | We do not think it is a critical optimization issue. |
| CATT | We prefer this issue to be low priority. |
| OPPO | Looks like not needed.  Reporting a Rx beam index would be sufficient. |
| Huawei, HiSilicon | We think this is a useful clarification given that we already agreed the associate subset indication and the associated subset can be in a different DL PRS resource set from the target PRS. The Rx beam index should be numbered within a TRP measurement results, instead of numbered within a DL PRS resource set. |
| ZTE | In RAN1#107-e, we have the following agreement. For the yellow parts, if UE reports two DL RSRPs from different DL PRS resource sets but associated with the same Rx beam index, can we assume that the two DL RSRPs are received by the same spatial domain filter? According to the description in Rel-16, the answer is NO because “same Rx Beam” currently is only used to flag measurements in the same resource set. We think it’s important to extend the use case so that “same Rx Beam” can be applied to all DL PRS resource sets from the same PFL/TRP.  **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:   + 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.   + UE may report PRS measurements only for the subset of PRS resources.   + 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 |
| LGE | We don’t need to discuss the proposal as high priority. |
| Ericsson | We think the issue has merit at least in the case of PRS reported as part of adjacent bem reporting. Without securing the same Rx beam was used between measurements, the LMF cannot make a good interpolation/AOD refinement. |
| InterDigital | It can be discussed after the details related to Aspect #3 are clarified. |
| ZTE2 | With clarifications from Huawei/ZTE/Ericsson, we hope other companies can accept this minor change on spec so that the features agreed before can really work. |

#### Second round of discussion

There are still diverging opinions on the issue. Let’s try to go a second round to see if progress can be made.

Companies are encouraged to provide comments in the table below.

**Proposal 2.1**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Qualcomm | Not needed |
| Nokia/NSB | Not support |
| Huawei, HiSilicon | Just a clarification question to opponents:  If UE reports Rx beam index #0 for a PRS in PRS resource set #0 of a TRP, and Rx beam index #0 for a PRS resource in PRS resource #1 of the same TRP, should LMF consider they belong to the same Rx beam/spatial filter? |
| ZTE | We support this proposal and have the same question as Huawei. There may be one typo in Huawei’s question,  *If UE reports Rx beam index #0 for a PRS resource in PRS resource set #0 of a TRP, and Rx beam index #0 for a PRS resource in PRS resource set #1 of the same TRP, should LMF consider they belong to the same Rx beam/spatial filter?*  Hope opponents can answer the question raised by Huawei/ZTE rather than simply say NO without any technical reasons. |
| LGE | Not support. |
| CATT | Not needed. |
| OPPO | Not needed  How to map the Higher layer parameter Rx beam index to spatial filter in real hardware implementation is totally up to UE implementation. And we do not see why this is related with the associated subset indidcation. |
| ZTE2 | To OPPO, all  Let’s further explain our concerns.  In Rel-16, 38.214 has following descriptions related to Rx beam index.  **Clause 5.1.6.5 of TS 38.214:**  The UE may be configured to measure and report, subject to UE capability, up to 8 DL PRS-RSRP measurements on different DL PRS resources associated with the same dl-PRS-ID. When the UE reports DL PRS-RSRP measurements from one DL PRS resource set, the UE may indicate which DL PRS-RSRP measurements associated with the same higher layer parameter nr-DL-PRS-RxBeamIndex [17, TS 37.355] have been performed using the same spatial domain filter for reception if for each nr-DL-PRS-RxBeamIndex reported there are at least 2 DL PRS-RSRP measurements associated with it within the DL PRS resource set.  In addition, the following agreement was adopted in RAN1#107e.  **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:   + 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.   + UE may report PRS measurements only for the subset of PRS resources.   + Note: The subset associated with a PRS resource can be in a same or different PRS resource set than the PRS resource   According to above descriptions, there would be some problem. For example, LMF would not understand how to interpret the case when two DL PRS-RSRP(s) measurements associated with the same DL PRS Rx beam index are derived from different DL PRS resource sets. In this case, LMF can’t assume that the two DL PRS-RSRP measurements are associated with the same spatial domain filter for receiving corresponding DL PRS resources based on Rel-16 design. So LMF cannot further interpolate the measurement results to refine the AOD. Then, the feature approved for adjacent beam may be useless.  Therefore, this proposal is actually to solve above problem so that two measurement results derived from different DL PRS resource sets and associated with the Rx beam index can be assumed to have been received by the same spatial domain filter.  *When the UE reports DL PRS-RSRP measurements from DL PRS resource sets associated with the same positioning frequency layer and the same TRP, the UE indicates which DL PRS-RSRP measurements associated with the same higher layer parameter DL PRS Rx beam index have been performed using the same spatial domain filter for reception.* |
| FL | We can continue the discussion, but it seems that the issue can be de-prioritized considering the lack of support. |
| ZTE | Please find our comment in Proposal 7.1. We think this proposal should be discussed together with Proposal 7.1. |
| CATT-2 | About the following proposal in section 2.1.2.1, the source of this proposal is marked as [2], but it seems that there is no this proposal in [2]. Maybe the correct source can be added in the summary for the following proposal.  ***Proposal 6****: To extend the application scope of DL PRS Rx beam index, when the UE reports DL PRS-RSRP measurements from DL PRS resource sets associated with the same positioning frequency layer and the same TRP, the UE indicates which DL PRS-RSRP measurements associated with the same higher layer parameter DL PRS Rx beam index have been performed using the same spatial domain filter for reception.* |
| FL | We can continue the discussion, but it seems that the issue can be de-prioritized considering the lack of support.  To CATT: thanks for catching the editorial error, proposal 6 from [2] is removed. |
| ZTE3 | We’re not sure how to proceed this since opponents haven’t provided any concerns or technical reasons on this. |

### Aspect #3 adjacent beam reporting

#### Summary

The following aspects are discussed in the proposals:

* Prioritization of resources in the PRS subsets
  + Use of High/medium/low priorities for resources in a subset[8]
  + Use Order of resources in the subset for prioritization of resources within a subset.[12][13][14]
  + Use of subset prioritization[15]
* Number of resources per subsets [12]
* Use of the same Rx beam across the resources attached to the same subset. [15]
* Reporting according to boresight information [4][11]

|  |  |
| --- | --- |
| Source | Proposal |
| [2] | **Proposal 5**   * ***Add a new request signaling at least from LMF to UE for subset measurement reporting.*** * ***Component 3 in FG 27-20 should be supported***   ***FL note: FG 27-20 component 3 is*** [3. Support associated subset measurement reporting] |
| [4] | Proposal 3: For the RSRP measurement of the subsets of PRS resource associated with PRS resource, the UE shall use the same Rx beam.  Proposal 4: The RSRP measurement of the subsets of PRS resource shall be reported as differential RSRP with a reference to the RSRP measurement of the associated PRS resource.  Proposal 5: If the UE reports RSRP measurement of one PRS resource, the UE can report the RSRP measurement of PRS resources that are ‘associated’ with the PRS resource according to the boresight direction. |
| [8] | **Proposal 1: In terms of prioritization of measurements, high, middle and low priority level are associated with the PRS resource associated with the subset of PRS resources, the subset of PRS resources and other PRS resources, respectively.** |
| [11] | ***Proposal 2: The PRS within the boresight direction (plus a range) corresponding to the QCLed SSB which is preferred by UE.*** |
| [12] | ***Proposal 10: For UE-A DL-AoD, for each PRS resource, the subset of associated PRS resources should be sorted according to decending priority where the first PRS resource ID in each subset has the highest priority.***   * ***Up to 24 PRS resources can be included in each subset, which can be from the same or different set of a same PFL of the TRP.*** |
| [13] | ***Proposal 3:***   * RAN1 needs to clarify whether the UE should always report all of measurements for PRS resources associated with the subset.   ***Proposal 4:***   * RAN1 should support that LMF can indicate the subset of PRS resources by using priority rule such as descending/ascending order.   FL comment on proposal 3: In general the UE is not mandated to report on a particular PRS if it cannot reliably measure it. |
| [14] | **Proposal 2: Support signaling to the UE a subset of PRS resources for the purpose of prioritization, of DL-TDOA and Multi-RTT measurement reporting.** |
| [15] | ***Proposal 1: RAN1 to support explicit priority of a subset of PRS resources in the LPP ProvideAssistanceData message to differentiate multiple subsets of PRS resources with either same or different priority levels.***  ***Proposal 2: RAN1 to support the priority-based UE measurement configuration and reporting of the subset of PRS resources via the LPP RequestLocationInformation and ProvideLocationInformation messages, respectively.*** |
| [16] | Proposal 9: Path PRS-RSRP measurements of adjacent DL PRS Resources that the UE reports should be performed using the same Rx-beam. |

#### Proposal 3.1 (priority of PRS resources in subsets)

#### First round of discussion

Regarding prioritization of subsets and resources in the subset, an update to the priority framework is needed.

As a starting point, it is proposed to combine the proposals from [15] and [12] :

* the assistance data ordering of the resources in the subset defines the PRS resource priority within a subset
* A subset is given a priority index which can be equal for several subset.

**Proposal 3.1: for the prioritization of the processing and reporting of PRS resources in PRS subsets:**

* + **The priority of the resource within a subset follows the order of the resources in the PRS subset assistance data**
  + **The priority between subsets is indicated with a priority level indicator**
    - **FFS granularity of the indicator**

Companies are encouraged to provide comments in the table below.

**Proposal 3.1:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Qualcomm | We are OK with the 1st subbulet, but we are unclear about the 2nd.  Specifically, it is unclear to us how useful the priority among subsets will be. For each PRS resource, there is going be a single associated subset. Then, if the UE measures that PRS resource, and reports it, it should also try to report the resources in the subset. Why would there be multiple subsets for a single PRS resource? Our understanding is that there is going be single subset for each PRS resource.  Now, with regards to which PRS resource is more important, it was discussed in NR Rel-16, and the proposal there was to order the PRS resources based on their index (similar to the TRP/set ordering). Then, implicitly also the subsets are prioritized; a subset associated with a higher priority PRS resource will be a higher priority subset compared to a subset associated with a lower priority PRS resource. |
| Nokia/NSB | We would like to clarify what the motivation and necessity to define further priority within a subset and between subsets. |
| CATT | We only support the first subbullet as follows:   * + **The priority of the resource within a subset follows the order of the resources in the PRS subset assistance data** |
| OPPO | We do not think defining priority within a subset is needed. The UE is provided with the association between PRS resource and the subset. It is be up to UE to measure the subset. Priority seems not necessary. |
| Huawei, HiSilicon | Do not support further priority rule within a subset and between subsets/target PRS resource. |
| Vivo | Not supported  We think the concept of the subset is introduced for adjacent beams, based on the following figure, it is difficult to say which adjacent resource(E, B, D,F) in a subset is a high priority. |
| Intel | We do not see a strong motivation to introduce the priority within the subset. |
| ZTE | Rel-16 has already defined the prioritization for PRS. We don’t see the need to further enhance this. |
| LGE | We only support the first main bullet. For second main bullet, we think supporting priority level indicator seems quiet unnecessary. |
| Lenovo, Motorola Mobility | Perfer 2nd bullet, of inidicating priority between subsets. If there are multiple subsets, then a explicit priority would be preferred in the event that multiple subsets share the same priority, which cannot be solved via list ordering of resources (as in Rel-16). |
| Ericsson | Support the main bullet for now. Regarding the use of priority, we wonder how the UE will efficiently use the limited processing capability without a prioritization between subsets |
| Fraunhofer | We are fine with the 1st bullet. |
| InterDigital | We are ok with the first bullet. However, before we disucss the first bullet, we believe that an agreement should be made to clarify that if a PRS resource is associated with a subset of PRS resources, the UE should report measurements for the PRS resource first, followed by the measurements corresponding to the subset of PRS resources. Thus the measurement of the PRS is prioritized over the measurement of the buset of PRS resources. We thought that was the intention of “FFS: prioritization of the PRS resources and resource subsets to be measured“ from the agreement made in RAN1#107be. |
| Xiaomi | It is not necessary to define any more priorities within subset or between subsets. |

#### Second round of discussion

The first bullet of the proposal seem to have majority support. There is a question from Interdigital as to how the UE should be expected to process the PRS. From the FL perspective, it is entirely up to the UE. However, it is understandable that if a UE decides to process a given PRS and also is notified of an attached subset, the UE should be prepare to process the PRSs in the subset and report on the PRSs it could detect and measure.

The proposal is updated with the first bullet kept and the second bullet removed, and with a note on the processing of the subset. Hopefully we can improve the wording:

**Proposal 3.1b: for the prioritization of the processing and reporting of PRS resources in PRS subsets, the priority of the resource within a subset follows the order of the resources in the PRS subset assistance data.**

* + **Note: the UE is expected to allocate processing to measure the PRSs in the PRS subset and inclusion of the measurement on the PRS subset in the measurement report is up to the UE.**

Companies are encouraged to provide comments in the table below.

**Proposal 3.1b:**

|  |  |  |
| --- | --- | --- |
| **Company** | **Comment** | |
| CATT | We support the main bullet.  For the note, it seems that it is not needed. And the meaning of “ **the UE is expected to allocate processing to measure the PRSs in the PRS subset**” in the note is not clear for us. | |
| Qualcomm | Sorry for not noticing this earlier, but we shoudl only be talking about „prioritization of reporting“ and not „prioritization of processing“. This is what has been agreed as this feature; its about reporting prioritization. | |
| InterDigital | We would like to thank the FL for explanations. We agree with the proposal and the intention of the note is indicated int the FL’s explanation. Therefore, we would like to propose the following note (instaed of the FL’s note) for clarificaiton  Note : Whether measurements for all PRS resources in the PRS subset are reported or not is up to UE implementation.  With the proposal and above modified note, it should be clear that the UE may report measurements only for higher-priority PRS resources in the subset. In any case, the details are up to UE implementation. | |
| Nokia/NSB | We do not support additional priority between PRS resources in a subtset | |
| FL | Thanks for the early feedback. Let’s try to converge on the issue:  **Revised Proposal 3.1b: for the prioritization of the reporting of PRS resources in PRS subsets, the priority of the resource within a subset follows the order of the resources in the PRS subset assistance data.**   * Note : Whether measurements for all PRS resources in the PRS subset are reported or not is up to UE implementation. | |
| Huawei, HiSilicon | We do not support priority indication within the subset. UE may choose to report the results based on RSRP/RSRPP measurement. | |
| ZTE | We don’t support this proposal. It’s up to UE to report the measurements. | |
| LGE | Agree with above FL’s revised proposal 3.1b. | |
| vivo | Not support | |
| CATT-2 | We can live with the lastest version above. |
| Xiaomi | Support the revised Proposal 3.1b |
| OPPO | We do not support the proposal. The UE is provided with the association between PRS resource and the subset. It is be up to UE to measure the subset. Priority is not needed. |

#### Proposal 3.2 to 3.5 (further details on reporting for PRS subsets)

#### First round of discussion

For the reporting of PRSs measurements from a subsets, we propose to start with the following proposals:

**Proposal 3.2: for the reporting of DL PRS measurements from a PRS subsets, the UE uses the same Rx Beam as for the PRS resource to which the PRS subset is attached.**

**Proposal 3.3: for the reporting of DL PRS measurements from a PRS subsets, the UE may use differential reporting with respect to the the PRS resource to which the PRS subset is attached.**

**~~Proposal 3.4: for the reporting of DL PRS measurements from a PRS subsets, the UE may use differential reporting with respect to the the PRS resource to which the PRS subset is attached.~~**

**Proposal 3.5: the LMF sends a request to the UE when measurement reports based on the PRS subsets are expected from the UE.**

Companies are encouraged to provide comments in the table below.

**Proposal 3.2:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Qualcomm | Not needed; we support leaving the understanding of Nr Rel-16: if the UE uses the same Rx beam, it will report that accordingly, otherwise it should have the option to report a different Rx beam. |
| Nokia/NSB | We do not think this restriction is necessary. If PRS resources within a subset are configured with different QCL source RSs, it is uncelar what QCL assumption UE has to follow. |
| CATT | It seems that such restriction is not need. |
| OPPO | In our view, such restructin is needed. Only if the Tx beams of associated PRS resorces are measured with same Rx beam, the reported RSRP can provide valid information for the LMF to refine the direction of UE. |
| Huawei, HiSilicon | No need. |
| vivo | We think the UE can be requested to use the same Rx beam for subset measurement. |
| Intel | We do not see the need. |
| ZTE | Not needed for the restriction. It’s up to UE to select appropriate Rx beam. |
| Ericsson | The proposal could make the report more useful and remove unnecessary reporting. |
| InterDigital | We do not support the proposal. It’s a restriction and we do not see benefits from the restriction. |
| Xiaomi | Not needed. |
| FL | A large majority does not support the proposal. From the FL side, we can close the issue for this meeting. |

**Proposal 3.3:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Qualcomm | Not needed. There is going to be differential reporting of the RSRPP (there is already for RSRP). No need to have additional “differential reporting” |
| Nokia/NSB | Do not support. According to the current agreement, the UE can report PRS measurements from subset only. This restriction is not aligned with the current agreement in our understanding. |
| CATT | We prefer not to define the addtional differential reporting of the RSRPP within the subset for adjacent beaming reporting. |
| Huawei, HiSilicon | Agree with Qualcomm. That the reporting should follow the existing differential/relative reporting framework. |
| vivo | Not needed. |
| Intel | Not needed. |
| ZTE | Do not support. There should be a single reference for differential reporting., which is applied to all PRS resources from the same TRP. |
| LGE | We don’t need to discuss the proposal since making an too many restriction for UE behaviour would not be desirable. |
| Ericsson | Agree with other this may not be needed. |
| InterDigital | We do not support the proposal. Benefits are not clear. |
| Xiaomi | Not needed. |
| FL | All comments point not to suport the proposal. We can close the discussion for the meeting. |

**~~Proposal 3.4:~~**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Qualcomm | Not needed. There is going to be differential reporting of the RSRPP (there is already for RSRP). No need to have additional “differential reporting” |
| CATT | This proposal is the same as Proposal 3.3. |
| vivo | Not needed. |
| Intel | Looks as duplicated proposal to 3.3 |
| FL | Apologies for the duplicate. Let’s close this proposal. |

**Proposal 3.5:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Nokia/NSB | This proposal is unclear to us. It may be necessary to calarify what the LMF request. |
| CATT | Support the request from LMF to UE for the adjacent beaming reporting. |
| OPPO | It looks like the proposal is that the LMF can configure the UE to report measurement of associated subsets. If so, we support the proposal. |
| Huawei, HiSilicon | We prefer to leave all the subset related assistance data as a best effort catogory.  When we dig into the detailed UE behaviour to handle the assistance data, it really becomes complicated. |
| vivo | Similar view with OPPO, and we agree to add a request from LMF to UE to request associated subset reporting. |
| Intel | The same comment as from Nokia. |
| ZTE | Not needed. As we have discussed in previous meetings, the subset is only used as assistance data. How to report the measurements is up to UE. |
| Ericsson | Support, as it may guide the UE to direct ist processing toward adjacent beams in priority. |
| InterDigital | We do not support the proposal. Our understanding is that when the subset of PRS resources is associated with a PRS resource, the UE is expected to return measurements for both the subset and PRS resource. |
| Xiaomi | We are fine with the proposal |

#### Second round of discussion

We can continue the discussion on proposal 3.5 and close the other proposals for this meeting. Companies are encouraged to continue the discussion below:

**Proposal 3.5:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Nokia/NSB | Still we did not clearly understand the proposals as it is. However, we are okay with the following modified proposal:  **the LMF sends a request ~~to~~ the UE to report ~~when~~ measurement ~~reports based~~ on the PRS subsets ~~are expected from the UE~~** |
| Huawei, HiSilicon | **Proposal 3.5: the LMF sends a request to the UE when measurement reports based on the PRS subsets are expected from the UE.**  For this proposal, is this indication serving the functionality to inform UE that the subset information in the AD should be used?  Should this indication further be composed of requesting UE to select one from 1.report the PRS only in the associated subset  2. report both the target PRS and the PRS in the associated subset |
| ZTE | We don’t see the need to have any further restrictions on reporting. |
| LGE | We think this feature is optional. So, it depends on LMF’s decision. So, we prefer to add 'may' right after 'LMF'. |
| vivo | We are okay with the Nokia version, and also fine with Huawei's suggestion. |

#### Third round of discussion

Based on the feedback received from Nokia and Huawei, a revised wording is proposed. We can continue the discussion including the topic of request type that is mentioned by Huawei:

**Proposal 3.5b:**

**To support reporting of measurement based on the PRS subsets in DL AOD measurement report, the LMF may transmit the following to the UE in a measurement request:**

* + - * **Request the UE to report PRS measurements only based on the PRS associated subsets**
      * **Request the UE to report PRS measurements based on the PRS and its associated subset**

**Proposal 3.5:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| OPPO | The proposal is confusing now, especially the first sub-bullet. „To request the UE to measure only based on the associated subset“? If so, why do we configure the association between one PRS and the associated subset? If the UE only measure the PRS included in the so-called assocaited subset, then we do not need to configure the target PRS. So the first sub-bullet is not aligned with the motivation of preivous agreement. For the 2nd sub-bullet, we are ok.  **To support reporting of measurement based on the PRS subsets in DL AOD measurement report, the LMF the LMF may transmit the following to the UE in a measurement request:**   * + - * **~~Request the UE to report PRS measurements only based on the PRS associated subsets~~**       * **Request the UE to report PRS measurements based on the PRS and its associated subset** |
| Nokia/NSB | We support the FL proposal including the first bullet. We see at least reporting overhead reduction benefit. A minor modification: In the main bullet, we need to remove one of ‘‘the LMF‘‘.  FL: thanks, typo corrected. |
| Huawei, HiSilicon | Agree with Nokia. |
| ZTE | Generally fine with this proposal. We think the first bullet might be useful to fine-tune the beam granularity. LMF may have received the measurement based the target PRS prior to this measurement. So UE doesn’t have to report the measurement of target PRS any more.  We have questions for clarification. Do we expect that LMF only indicate one DL PRS in a measurement request so that UE may only measure/report the PRS and associated subset of the PRS or LMF can indicate multiple DL PRS(s) and their associated subsets in a measurement request? |
| CATT | OK with the proposal, but the redundant ‘‘the LMF‘‘ need to be deleted from the main bullet. |
| FL | To clarify the intention of the first bullet, we refer to this item in the following agreement  **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:   + 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.   + UE may report PRS measurements only for the subset of PRS resources.   + 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 |
| Qualcomm | To FL, the „blue part“ that you are reffering to, means that the UE is not required to report any other measurements outside the subset, not that the UE will not report the first measurement.  We also dont see the need of any additional request and this proposal all together. We are just talking about reporting an additional single measurement; what are we saving if this is not reported? The overhead gain is marginal. |
| InterDigital | We support the proposal. We see a value by agreeing on this proposal (which has eveolved quite a bit compared to the original Proposal 3.5). The LMF can request beam sweeping and ask the UE to report both PRS and its associated subset of PRS resources. Alternatively, the LMF can request beam sweeping after the LMF receives meaurement for the PRS, and additionally requesting the UE to reportm measurements relevant to the subset. We don’t see the purpose of this proposal to be overhead minimization but more about different ways for the LMF to conduct beam sweeping and request UE to report the results. |
| vivo | We are okay with the Proposal, at least, the request is needed for subset PRS measurement reporting based on the following agreement.   * + 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   For the ZTE question, In our view, the reference PRS can be decided by UE. If LMF can indicate one, “for each resource, the UE may be configured, subject to UE capability, with [*DL-AOD-PRS resource-Subset*]….” may be too redundant |
| ZTE | To vivo,  Our previous question is about how to send the measurement request to UE rather than how to configure the reference PRS with subset. For example, in a location measurement request, do we expect that LMF can only indicate one PRS resource so that UE provides the corresponding measurement report only based on the associated subset of PRS resource(assuming first bullet in this proposal)? Or, do we expect that LMF can indicate multiple PRS resources so that UE can provide the corresponding measurement report based on all associated subsets of the multiple PRS resources?  Hope this proposal can further clarify above questions. |
| Xiaomi | Support the proposal and agree that the first sub-bullet can cover the agreement that “ UE may report PRS measurements only for the subset of PRS resources“ |
| vivo | To ZTE: In our view, there may be no PRS ID(s) information in the request message, which may be the simplest enumerated information for whether to request associated subset reporting as follows and similar to additional path requesting.  additionalPaths-r16 ENUMERATED { requested } OPTIONAL, -- Need ON  associatedSubsetReporting ENUMERATED { requested } OPTIONAL, -- Need ON |
| LGE | We think the porposal is also related with proposal 3.1. We sugget to discuss both together. And than we prefer to merge the proposal 3.1 in to the current verion of the proposal as shown in below:  **Proposal 3.5b:**  **To support reporting of measurement based on the PRS subsets in DL AOD measurement report, the LMF may transmit the following to the UE in a measurement request:**   * + - * **Request the UE to report PRS measurements only based on the PRS associated subsets**       * **Request the UE to report PRS measurements based on the PRS and its associated subset**       * **for the prioritization of the processing and reporting of PRS resources in PRS subsets, the priority of the resource within a subset follows the order of the resources in the PRS subset assistance data.**   **Note: the UE is expected to allocate processing to measure the PRSs in the PRS subset and inclusion of the measurement on the PRS subset in the measurement report is up to the UE.** |
| Fraunhofer | Support the proposal |
| ZTE | To vivo,  If each PRS resource is configured a subset, do we expect UE has to measure/report all subsets? This doesn’t make sense. In our understanding, this feature is to fine-tune the beam measured by target DL PRS resource according to the measurements of subset. Which mean LMF might have some prior information of target PRS, so LMF expects UE to measure the subset of the PRS to get finer granularity of AoD.  With above comments, we prefer following modifications to Proposal 3.5b:  **To support reporting of measurement based on the PRS subsets in DL AOD measurement report, the LMF may transmit the following to the UE in a measurement request:**   * + - * **Request the UE to report PRS measurements only based on ~~the PRS~~ associated subset(s) of DL PRS resource(s), where the DL PRS resource(s) should be indicated in the measurement request.**       * **Request the UE to report PRS measurements based on the PRS resource(s) and its associated subset(s), where the DL PRS resource(s) should be indicated in the measurement request.** |

#### Proposal 3.6 (reporting according the boresight information) (low priority)

#### First round of discussion

Based on the proposals in [4] and [11], the following is proposed:

**Proposal 3.6: for the subset reporting based on the boresight information of the PRS resource, the UE may reports the associated PRS measurements which share a common SSB as QCL relation with the PRS resource to which the subset is attached.**

Companies are encouraged to provide comments in the table below.

**Proposal 3.6:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Nokia/NSB | We think it is necessary to clarify motivation and necessity of this feature. |
| CATT | It seems that no need this proposal. |
| OPPO | The proposal is not clear. The boresight informaiton is not provided through QCL. Boresight informaiton is the physical direction of Tx beam but the QCL is the Rx refernece information at the UE side. |
| Huawei, HiSilicon | Not needed. SSB measurement for the purpose of positioning is best effort catogory. |
| vivo | Unclear for us. |
| ZTE | We don’t see the necessity. |
| LGE | The intention of the proposal seems unclear for us. |
| Ericsson | It is not clear how the SSB will help identify adjeacent beams. There could be many beams sharing the same SSB’s coverage. |
| Samsung | Our intention for such proposal is somehow for priority aspect, e.g., related to proposal 3.1.  In some cases, for example, the first level of PRS has been measured by UE and some of them are identified as “good PRS“, e.g., high enough RSRP, then based on the boresight information (let’s say 30 degree) and the QCL related DL beam (let’s say SSB 1) for these good PRS, UE could idenfy which other PRS who shared some QCLed relation should be also good to it thus should be prioritized, which means these PRS who has QCLed relation for SSB1 should be prioritized;  In our original though, there could be a range as well, 30 degree +/- range, e.g., 15 degree, then for the PRS with QCLed SSB corresponding to a boresight information within 30+/-15 degree range, should be priorizied. |
| InterDigital | We understand the intention of the proposal from the explanation from Samsung. However, the reporting behavior seems dynamic and unpredictable. Depending on the number of „good PRS“, the amount the UE report can change. We prefer more static and predictable reporting behavior from the UE. |
| Xiaomi | It is not clear to us. |
|  |  |

#### Second round of discussion

We can continue the discussion based on the clarification from Samsung. Companies are encouraged to provide comments in the table below.

**Proposal 3.6:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Nokia/NSB | Not needed |
| ZTE | Not needed as we already have agreed that UE can configure a subset of PRS for a target PRS |
| LGE | It seems unnecessary for us and we think RAN1 needs to focus on the crucial issue firstly. |
| vivo | Not needed |
| FL | Given the lack of support, we can de-prioritize the issue. |
| CATT | Not needed. |
| FL | Given the lack of support, we can de-prioritize the issue. |

#### Proposal 3.7 (use of subset signalling for DL time-based methods)

In [14] it is proposed to extend the support of subset-based prioritization to DL time based methods (DL TDOA and multi RTT).

**Proposal 3.7: Support signaling to the UE a subset of PRS resources for the purpose of prioritization, of DL-TDOA and Multi-RTT measurement reporting.**

Companies are encouraged to provide comments in the table below.

**Proposal 3.7:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Qualcomm | New feature at this stage that we prefer to de-prioritize. We support to have the basic PRS resource priority that was also discussed in NR Rel-16; going as far as starting talking about subsets for MRTT/TDOA, seems an unnecessary optimization. |
| CATT | Low priority. |
| Huawei, HiSilicon | No need to have this. |
| vivo | Low priority |
| ZTE | Prefer not to introduce this new feature at maintenance phase. |
| LGE | Similar view with Qualcomm and CATT. |
| Ericsson | Prefer to de-prioritize. |
| Fraunhofer | We can’t figure why proposal 5.2 (angle search window) is for the majority advantageous and 3.7 is not for multi-RTT or DL-TDoA; although subset information signaling is more clear on the measurement reports that belongs together.  We also agree that there should be no over optimization for the sake of DL-TDOA and multi-RTT, this can be left for RAN2 to decide on supporting this feature or not (i.e. if additional specification work is expected beyond what is defined for DL-AoD) |
| InterDigital | Our understanding is htat signaling a subset of PRS resources for prioritization is beneficial in angled based positioning. Benefits for identifiying the subset in timing based methods need to be clarified. |
| FL | We can continue the discussion but it seems that a majority is not supporting this proposal. |

#### Proposal 3.8 (number of PRSs in a subset)

During the RRC discussion in AI 8.5, there was a comment regarding the maximum number of PRS in a PRS subset. The initial assessment from the rapporteur for the IE of the PRS subset were as follow:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| DL-AOD-PRS resource-Subset | New |  | A subset of PRS resources, which is assicated with a DL PRS resource~~reoruce~~, for the purpose of prioritization of DL-AOD reporting, in the assistance data (AD), | N/A |  |  |  | FFS RAN2 |
| DL PRS rerouce ID | Existing |  | A list of DL PRS resource ID(s), which is associated with a DL PRS resource~~reoruce~~, for the purpose of prioritization of DL-AOD reporting | INTEGER(0..63) |  | In “DL-AOD-PRS resource-Subset” |  | FFS RAN2 |

The received commens were:

|  |  |
| --- | --- |
| vivo | For row 105, the maximum number of prs subset is integer(0..63), the value is weird for us, firstly, the subset is defined for the adjacent beam, we don’t think the maximum number can be 64, in addition, we don’t think the value has been discussed in ran1, so we prefer to modify as ffs |
| **Moderator** | Row 105 is for the DL PRS rerouce IDs included in the DL-AOD-PRS resource-Subset. The value range of DL PRS rerouce ID should be INTEGER(0..63). I assume vivo’s comment may be related to the maximum number of DL PRS rerouces in the DL-AOD-PRS resource-Subset, which I think we may need to to add a new parameter to define, e.g., “maximum number of DL PRS rerouce IDs is a DL-AOD-PRS resource-Subset”.  DL-AOD-PRS resource-Subset := {  1st DL PRS rerouce ID,  2nd DL PRS rerouce ID, …,  N-th DL PRS rerouce ID}  N <= “maximum number of DL PRS rerouce IDs”. |
| **vivo** | Sorry we can not accept without modification of Row 105  We try to understand the interpretation of FL, but we think our view is different. Based on the following TP, we think the “each resource” can be INTEGER(0..63). But the maximum resource N in DL-AOD-PRS resource-Subset shouldn’t be INTEGER(0..63). The intention of the resource within the subset is for adjacent beam, and the maximum reporting resource is 24, we don’t think 64 is right.  From our view, N can be {2,4,8,16,24}, similar to the maximum number of reporting RSRP or RSRPP  DL-AOD-PRS resource-Subset := {  1st DL PRS resource ID,  2nd DL PRS resource ID, …,  N-th DL PRS rerouce ID}    The TP below for TS 38.214 section 5.1.6.5 is endorsed  ----------------Start of TP for TS38.214---------------------  **5.1.6.5      PRS reception procedure**  ……  For each PRS resource, the UE may be configured, subject to UE capability, with [*DL-AOD-PRS resource-Subset*] that is associated with this PRS resource, where the subset of PRS resources associated with the PRS resource can be in the same or different PRS resource set than the PRS resource. The UE may include UE measurements for the subset of PRS resources in [*NR-DL-AoD-AdditionalMeasurementElement]* if the UE measurements of the associated PRS resource are reported, where the UE measurement can be DL PRS-RSRP and/or DL PRS-RSRPP. The UE may report DL PRS-RSRP and/or DL PRS-RSRPP measurements only for the subset of PRS resources. Subject to UE capability, the UE may be configured with higher layer parameter [DL-AOD Boresight direction] for each PRS resource.  ----------------End of TP for TS38.214--------------------- |
| **Moderator** | To vivo’s comments:  Row 105 is not about the value of N, but the DL PRS resource ID for each element included in the DL-AOD-PRS resource-Subset. Maybe we need to consider adding another parameter for the maximum number of the DL PRS resources in DL-AOD-PRS resource-Subset, which may need to be discussed in AI 8.5.3.  I will check with FL for AI 8.5.3 to see if the issue should be discussed under AI 8.5.3. |

Based on the discussion, it is proposed to discuss and eventually capture the number of resources included in a PRS subset. Additionally, we should discuss the way to identify the PRS in the subset. In the FL understanding, a subset could be build across PFLs and resource sets for the same TRP:

**Proposal 3.8.1: The maximum number of PRS resources in a PRS subset is a UE capability and include the following values: {2,4,8,16,24}**

**Proposal 3.8-2 Each PRS resource in the PRS subset is identified with :**

* **Positioning frequency layer ID**
* **PRS resource set ID**
* **PRS resource ID**

Companies are encouraged to comment in the table below:

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Qualcomm | **Proposal 3.8.1:**Not very sure it is really needed, but we could accept it  **Proposal 3.8.2:** set-ID, and resource-ID is enough; There is no need of a PFL ID, since the associated subsets should be from the same PRS-ID as that of the associated PRS resource. My understanding is the runnign CR has a proposal on this already, and uses the above 2 IDs without creating any ambiguity (from my understnading):  NR-DL-PRS-ResourceSubset-r17 ::= SEQUENCE (SIZE (1..nrMaxFreqLayers-r16)) OF  NR-DL-PRS-ResourcePriorityPerFreqLayer-r17  NR-DL-PRS-ResourcePriorityPerFreqLayer-r17 ::= SEQUENCE (SIZE (1..nrMaxTRPsPerFreq-r16)) OF  NR-DL-PRS-ResourcePriorityPerTRP-r17  NR-DL-PRS-ResourcePriorityPerTRP-r17 ::= SEQUENCE {  dl-PRS-ID-r17 INTEGER (0..255),  nr-PhysCellID-r17 NR-PhysCellID-r16 OPTIONAL, -- Need ON  nr-CellGlobalID-r17 NCGI-r15 OPTIONAL, -- Need ON  nr-ARFCN-r17 ARFCN-ValueNR-r15 OPTIONAL, -- Need ON  nr-DL-PRS-PrioSets-r17 SEQUENCE (SIZE (1..nrMaxSetsPerTrpPerFreqLayer-r16)) OF  NR-DL-PRS-ResourcePriorityPerSet-r17,  ...  }  NR-DL-PRS-ResourcePriorityPerSet-r17 ::= SEQUENCE (SIZE (1..nrMaxResourcesPerSet-r16)) OF  NR-DL-PRS-ResourcePriorityPerResource-r17  NR-DL-PRS-ResourcePriorityPerResource-r17 ::= SEQUENCE (SIZE (1..maxNumPrioResources-r17)) OF  NR-DL-PRSResourcePriorityItem-r17  NR-DL-PRSResourcePriorityItem-r17 ::= SEQUENCE {  nr-DL-PRS-ResourceSetID-r17 NR-DL-PRS-ResourceSetID-r16 OPTIONAL,-- Cond NotSameAsPrev  nr-DL-PRS-ResourceID-r17 NR-DL-PRS-ResourceID-r16,  ...  } |
| vivo | Thanks for the discussion, we are supporting the proposal from FL, and sorry for misunderstanding Ren’s proposal. |
| OPPO | Re 3.8.1: we are ok with the value of 2/4/8, but concern on 16 and 24. What is the use case for 16 and 24? A Tx beam can not have so many ‚adjacent‘ Tx beams.  Re 3.8.2: we share similar view as QC that the frequency layer ID is not needed. Using PRS Resource ID and set ID is sufficient. |
| InterDigital | We support both proposals (Proposal 3.8.1 and Proposal 3.8.2) from the FL. Considering the subset can belong to the different PRS resource set, the subset can contain finer beams than the reference PRS. Thus, the set of values **{2,4,8,16,24}** is ok with us. |
| Huawei, HiSilicon | We do not support any UE capability for it, note that this should not have any measurement impact on the UE, but rather reporting behaviour. When UE is able to measure all PRS resources in the subset should depend on FG 13-3/3a/3b. We only need to agree that the maximum number of resources in a subset is 24. |
| Fraunhofer | Proposal 3.8.1: agree with Huawei views  Proposal 3.8.2: support FL proposal |
| ZTE | Proposal 3.8.1: No need to introduce UE capability  Proposal 3.8.2: There is no positioning frequency layer ID in current spec, the subset should be from the same TRP as target PRS. |

### Aspect #4 Support of additional gnodeB beam information

#### Summary

During RAN1#107e, it was agreed to support additional gNB beam information to be sent to the UE for UE based methods, and a potential TRP-LMF interface was left to RAN3. The following was discussed in this meeting’s proposals:

* Signalling for linear arrays [1]
* Granularity / quantization of the power information per angle [1][7][12]
* Angle resolution, including span of angles and number of angles in the span [2][3][7][12]
* Overhead reduction by signalling of the same information for multiple TRPs [12]

|  |  |
| --- | --- |
| Source | Proposal |
| [1] | ***Proposal 8: For linear array, the angle entry in the gNB beam pattern can be ZoA only in the local coordinate system.***   * ***Send an LS to RAN2 to allow them to consider the signaling optimization.***     ***Proposal 9: The power difference between the target PRS and the peak power PRS is quantized using the existing 5-bit single-side differential mapping table.*** |
| [2] | **Proposal 3**   * ***Support*** ***the following angle range, the maximum number of angles per TRP for relative Power/Angle response***   + ***[-90, 90] for omnidirectional antenna in*** ***horizontal and vertical direction.***     - * + ***0 degree is represented as the boresight angle of the TRP.***   + ***The maximum number of angles per TRP can be {360, 180, 90, 45} for omnidirectional antenna in the horizontal and vertical direction.***   **Proposal 4**   * ***Support*** ***the quantization accuracy of relative power refers to the reporting range of differential PRS-RSRP as defined from -30 dB to 0 dB with 1 dB resolution in TS 38.133.*** |
| [3] | ***Proposal 3****: For beam information provided by LMF for UE based DL-AOD, the range of angles [θ1, θ2] can be determined by expected DL-AoD/ZoD value and uncertainty (of the expected DL-AoD/ZoD value).* |
| [7] | Proposal 5   * + **Support uniform sampling for the azimuth angle *φ* in the spatial sector [*φsec*-(*N*/2)×Δ*φ*, *φsec*+(*N*/2)×Δ*φ*], defined by the parameters, *φsec*, Δ*φ* and *N*, where**     - ***φsec* is the azimuth angle defining the spatial sector direction in deg**     - **Δ*φ* is the spatial resolution, defined in deg**     - ***N* +1 is the total number of samples per azimuth spatial sector**     - **The resolution Δ*φ* can be selected between the 1 deg and 0.1 deg**   + **For a given azimuth angle, support uniform sampling for the zenith angle *θ* in the spatial sector [*θsec*-(*M*/2)×Δ*θ*, *θsec*+(*M*/2)×Δ*θ*], defined by the parameters *θsec*, Δ*θ* and *M*, where**     - ***θsec* is the zenith angle defining the spatial sector direction in deg**     - **Δ*θ* is the spatial resolution, defined in deg**     - ***M* is the total number of samples per zenith spatial sector**     - **The resolution Δ*θ* can be selected between the 1 deg and 0.1 deg**   Proposal 6   * + **Support quantization of the power difference levels in the decibel scale in accordance with the following equation:**     - **Δ*PL*(*n*) = 20×lg(*n*) - 20×lg(2*Nb*), where Δ*PL*(*n*) corresponds to the power difference of the *n*th level with the total number of levels equal to 2*Nb***     - ***Nb* is the number of bits used to signal a power difference level value**     - **Δ*PL* = 0 dB corresponds to the peak power per angle**     - **Δ*PL* = - 20×lg(2*Nb*) dB corresponds to the sensitivity level or the minimum value used to signal a power difference level value**   + ***Nb* parameter can be set as one of the following {2, 3, 4, 5, 6, 7, 8} bits**     - **The choice of the *Nb* parameter provides a trade-off between the required accuracy and signaling overhead** |
| [12] | ***Proposal 5: In the beam antenna Assistance data element, support signaling that 2 TRPs have the same relative beam information when provided in Local Coordinate System (LCS). In other words, introduce an associated-DL-PRS-ID field with the following meaning:***   * ***This field specifies the dl-PRS-ID of the associated TRP from which the beam antenna information is adopted: If the field is present, the field dl-PRS-BeamInfoSet shall be absent, but the field lcs-GCS-TranslationParameter can be provided.***   ***Proposal 6: In the beam antenna Assistance data element, support the beam antenna information to be able to be reported with a resolution of 1 degree, or 0.1 degrees (fine resolution), for the beam antenna information in both azimuth and zenith dimension.***  ***Proposal 7: In the beam antenna Assistance data element, the relative power between 2 PRS resources should at least be reportable with 0.1 dB granularity with a range between 0 and -30 dB.***  ***Proposal 8: In the beam antenna Assistance data element, for each (Azimuth, elevation) angle, the relative ratio of a maximum of 128 PRS resources can be provided in the assistance data, which could be from the same or different set of the same PFL.*** |

#### Proposal 4.1 (angle resolution of beam information)

#### First round of discussion

Based on the received proposals in [12][7][2][3], it is proposed to discuss on the granularity of the angle range is configured:

**Proposal 4.1**

**For the TRP beam/antenna information, the angle resolution of the information can be configured with**

* **Option1: a fixed resolution of Δ*φ* and Δ*θ* for elevation and azimuth, respectively, and a configured number of angles M and N in elevations and azimuth, respectively. the center of the range is given by the boresight angle of the PRS in elevation and azimuth.**
  + **FFS: list of candidate values for the resolutions, including but not limited to [0.1, 1] degrees, and the numbler of angles M and N.**
* **Option 2: a number of angles across a configured angular range**
  + **FFS: list of values, including but not limited to {360, 180, 90, 45} for the number of angles and [-90,90] for the angular range**

Companies are encouraged to provide comments in the table below.

**Proposal 4.1**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Qualcomm | We understand that Option 1 may have smaller overhead since there is no need to send each angle separately; but it is understood implicitly by the lower/upper bounds. However, maybe TRPs/LMF might not be able to provide all the angles in the provided range, so Option 2 has higher flexibility (and more overhead).  Assuming we have the same understanding, We are OK to have both options.  In the first bullet we support having both resolutions (as is done in other related RAN2 signalings), and leave it up to the TRPs/LMF decide which one to use. With regards to the maximum number of angles, it just comes out naturally: if the resolution is 0.1, and in some cases, someone might want to cover 360 degrees -> M<=3600 angles is the maximum that 37.355 should have. Similarly, for a elenvation, N<=1800.  For the 2nd subbulet, the gnB/LMF will have the option to send any set of angles needed, between the [-360,360] for azimuth and [-180,180] for elevation.  We generally don’t want to have FFS, so that RAN2 can finish the signaling sooner than later. |
| Nokia/NSB | We may need to discuss how to define the range and granularity/quantization level and discuss how to reduce signalling overhead considering the same information from TRPs. The angle resolution needs to be defined as a fixed value rather than configuration. |
| CATT | Support Option 1. |
| OPPO | We prefer Option 1, which is simpler and more straighforward. |
| Huawei, HiSilicon | Not sure what else can do that will impact the ASN.1. We believe that RAN2 specification (running CR) is already implementing this feature.  The angle resolution could have two choices, with 1 degree as the mandatory granularity, while 0.1 degree as the optional granularity, while the angle ranges can cover 0-359.9 azimuth and 0-179.9 zenith.  It is really not clear what else RAN1 can achieve. |
| vivo | We share a similar view with QC that TRPs/LMF might not be able to provide all the angles, especially considering the reporting angle should have two PRS resources.  Therefore, we slightly prefer option 2  **Agreement**  From 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. * The relative power is defined with respect to the peak power in each angle * For each angle, at least two PRS resources are reported. * 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 |
| Intel | Option 1 |
| ZTE | The resolution and angle range are separate issue. It’s better to have two proposals   * We prefer to have a fixed resolution( i.e. 0.10 ) for both elevation and azimuth. * For angle range, the overhead reduction should be considered.As we stated in our contribution, the angle range can reuse the uncertainty range determined by expected AOD/ZOD to save overhead. |
| LGE | Support option #1. |
| Ericsson | Support option#1. In our understanding, ran2’s implementation can support both 0.1 and 1 degree of resolution using a “ fine” angle IE on top of the angle IE. |
| Fraunhofer | Option 1 |
| Xiaomi | Prefer Option 1 |

#### Second round of discussion

Based on the feedback, option 1 seem to be supported by a majority. Moreover, it is the FL understanding that RAN2 is also already discussing the implementation of the feature. Therefore, we propose to continue the discussion on option 1, with also the possibility to close the discussion and leave it to RAN2. The revised proposalremoves the FFS and proposes candidate values for the number of angles and resolutions.

**Proposal 4.1b**

**For the TRP beam/antenna information, the angle resolution of the information can be configured with**

* **Option1: a fixed resolution of Δ*φ* and Δ*θ* for elevation and azimuth, respectively, and a configured number of angles M and N in elevations and azimuth, respectively. the center of the range is given by the boresight angle of the PRS in elevation and azimuth.**
* **The resolution for the elevation and azimuth angle is 1 degree (default) or optionally 0.1 degree.**
* **The number of angles can be configured up to 360/resolution for azimuth and 180/resolution for elevation.**

**Proposal 4.1b**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| CATT | Support the proposal with minor changes as follows,  **Updated Proposal 4.1b**  **For the TRP beam/antenna information, the angle resolution of the information can be configured with**   * **Option1: a fixed resolution of Δ*φ* and Δ*θ* for elevation and azimuth, respectively, and a configured number of angles M and N in elevations and azimuth, respectively. the center of the range is given by the boresight angle of the PRS in elevation and azimuth.** * **The resolution for the elevation and azimuth angle includes~~is~~ 1 degree (default) and~~or~~ optionally 0.1 degree.** * **The number of angles can be configured up to 360/resolution for azimuth and 180/resolution for elevation.** |
| Qualcomm | Not support. I think there is confusion what we are agreeing here. Why are we going to restrict gNBs/LMF to provide the power between 2 angles? We should let fully freedom to teh gNBs/LMF provide the power for any angle that they think they want to provide.  Instead of talking generically, can the proponents of Option 1 clarify what is the problem with the running CR? Is a version of the running CR that they are going for, or somethign else?  NR-TRP-BeamAntennaInfo-r17 ::= SEQUENCE (SIZE (1..nrMaxFreqLayers-r16)) OF  NR-TRP-BeamAntennaInfoPerFreqLayer-r17  NR-TRP-BeamAntennaInfoPerFreqLayer-r17 ::= SEQUENCE (SIZE (1..nrMaxTRPsPerFreq-r16)) OF  NR-TRP-BeamAntennaInfoPerTRP-r17  NR-TRP-BeamAntennaInfoPerTRP-r17 ::= SEQUENCE {  dl-PRS-ID-r17 INTEGER (0..255),  nr-PhysCellID-r17 NR-PhysCellID-r16 OPTIONAL, -- Need ON  nr-CellGlobalID-r17 NCGI-r15 OPTIONAL, -- Need ON  nr-ARFCN-r17 ARFCN-ValueNR-r15 OPTIONAL, -- Need ON  lcs-GCS-TranslationParameter-r17 LCS-GCS-TranslationParameter-r16 OPTIONAL, -- Need OP  nr-TRP-BeamAntennaAngles-r17 NR-TRP-BeamAntennaAngles-r17,  ...  }  NR-TRP-BeamAntennaAngles-r17 ::= SEQUENCE (SIZE(1..3600)) OF NR-TRP-BeamAntennaInfoAzimuth-r17  NR-TRP-BeamAntennaInfoAzimuth-r17 ::= SEQUENCE {  azimuth-r17 INTEGER (0..359),  azimuth-fine-r16 INTEGER (0..9) OPTIONAL, -- Need ON  elevationList-r17 SEQUENCE (SIZE(1..1800)) OF ElevationElement-R17,  ...  }  ElevationElement-R17 ::= SEQUENCE {  elevation-r17 INTEGER (0..180),  elevation-fine-r17 INTEGER (0..9) OPTIONAL, -- Need ON  beamPowerList-r17 SEQUENCE (SIZE (2..maxNumResourcesPerAngle-r17)) OF  BeamPowerElement-r17,  ...  }  BeamPowerElement-r17 ::= SEQUENCE {  nr-dl-prs-ResourceSetID-r17 NR-DL-PRS-ResourceSetID-r16 OPTIONAL, -- Need OP  nr-dl-prs-ResourceID-r17 NR-DL-PRS-ResourceID-r16,  nr-dl-prs-RelativePower-r17 INTEGER (0..500), -- FFS  ...  } |
| FL | Based on the received feedback, I wonder if we should proceed with this discussion, or if we should let RAN2 complete their design of the IE, since it seems they have already come a long way. From Qualcomm’s comment, it seems that only the beam power is left to be discussed in RAN2. |
| Huawei, HiSilicon | Similar comments as Qualcomm. Not sure what else RAN1 could/should do. |
| ZTE | Leave it to RAN2 to finalize this feature. |
| OPPO | It can be left to RAN2 for signalling design |
| Ericsson | We think it is still RAN1 responsability to decide on the resolution and range of the parameters. |
| InterDigital | We support to discuss this issue in RAN1. We are not sure which agreements the running CR for LPP spec is based on. We support Option 1 and we agree that RAN1 should agree on the details such as resolution and range. |
| Qualcomm | Just to clarify my previous comment. From QC‘s side, i didnt mean that we should not discuss and explicitly agree on it. I just asked the proponents of Option 1 to discuss how Option 1 relates to the current running CR. Any drawbacks/advantages of Option 1 vs the current proposal in the running CR.  I think the running CR is implementing a solution that is closer to Option 2, rather than Option 1. |
| Intel | The main point from our side is to agree on the resolution for the azimuth and zenith angles, we believe that resolution of 1 degree and 0.1 degree is enough. Therefore, we support Option 1.  The Option 2 says nothing about the resolution, just says about the set of angles.  If RAN2 already agreed on the azimuth/elevation and azimuth-fine/elevation-fine, then we are OK.  The difference between Option 1 and Option 2 is not significant in that case. The Option 1 covers all angles in the sector, the Option 2 covers a variable set of angles, but both with fixed resolution. |
| FL | Given that we don’t really progress, Perhaps a simpler approach would be to only discuss resolution and range, and leave the number of angles to ran2. For example:  **Proposal 4.1c**  **For the TRP beam/antenna information, the beam information is signaled with**   * **Angle Resolution of at least 0.1 or 1 degrees** * **Angle range of elevation is up to [-180,180] for elevation [-360,360] for azimuth** * **Up to RAN2 to design the angle tables, including the number of angles, spacing between angles, etc.** |
| ZTE | If majority companies think is necessary to have this agreement, we’re fine with latest update from FL |

#### Proposal 4.2 (power resolution of beam information)

#### First round of discussion

Based on the received proposals in [1][12][7][2], it is proposed to discuss on the granularity of the beam gain is configured:

**Proposal 4.2**

**For the beam/antenna information the power resolution of the information can be configured with a a fixed resolution and range according to:**

* + **Option 1: a linear range in dB**
    - **FFS: list of candidate values, including but not limited to [0.1, 1] dB resolution from -30 to 0dB.**
  + **Option 2: a log-scale range in dB with 2*Nb* levels, using Nb bits and with maximum value 0dB and with level value acccording to Δ*PL*(*n*) = 20×lg(*n*) - 20×lg(2*Nb*).** 
    - **FFS: values for Nb, including but not limited to {2, 3, 4, 5, 6, 7, 8} bits**
* **The power/angle values for a given PRS can be expressed relative to another reference PRS in the same PFL**

Companies are encouraged to provide comments in the table below.

**Proposal 4.2**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Qualcomm | We tend to see Option 1 to be a simple working solution. |
| Nokia/NSB | In the main bullet, we have a suggestion as follows, and needs to clarify the necessity on the last bullet.  **For the beam/antenna information the power resolution of the information is defined ~~can be configured~~ with a a fixed resolution and range according to:** |
| CATT | Support Option1. |
| OPPO | Support Option 1. |
| Huawei, HiSilicon | Option 1.  To Nokia, we believe the optionality of 0.1 degree granularity was already implemented in Rel-16 specification to reduce the overhead. |
| vivo | Option 1 is preferred and removing ‘a‘ before fixed resolution in the main bullet  For the last bullet, we also think more clarification is needed. Based on the previous agreement, the power is the relative power between PRS resources. Does the bullet mean to change the relative power between PRS and reference PRS? If it is, we doubt the reference PRS resource can be measured by each angle.  **Agreement**  From 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. * The relative power is defined with respect to the peak power in each angle * For each angle, at least two PRS resources are reported. * 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 |
| Intel | Option 2, we believe that Option 2 is more flexible for overhead reduction. We can control the associated overhead by selecting the parameter Nb. |
| ZTE | Option 1 |
| LGE | Option #1. |
| Fraunhofer | Option 1 |
| Xiaomi | Option 1 |
| Nokia/NSB | Based on Huawei’s reply, we understood the overhead reduction perspective. We prefer option 1. |

#### Second round of discussion

Since option 1 has the majority support, it is propose to endorse it. The FFS is removed in the proposal:

**Proposal 4.2b**

**For the beam/antenna information the power resolution of the information can be configured with a fixed resolution and range according to:**

* + **Option 1: a linear range in dB**
    - **The resolution of the range is 0.1 or 1 dB**
    - **Span of the range is from -30 to 0dB.**

Companies are encouraged to provide comments in the table below.

**Proposal 4.2b**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Huawei, HiSilicon | Just for the sake of better understanding, does it require a similar table as the following in TS 38.133 where a codepoint corresponds to a range and a specific codepoint is reserved for out of range (even for -30.0 with 0.1 resolution), or just verbal description in TS 37.355?   |  |  |  | | --- | --- | --- | | Reported value | Measured quantity value | Unit | | DIFFRSRP\_0 | -30≥ΔRSRP | dB | | DIFFRSRP\_1 | -29≥ΔRSRP>-30 | dB | | DIFFRSRP\_2 | -28≥ΔRSRP>-29 | dB | | DIFFRSRP\_3 | -27≥ΔRSRP>-28 | dB | | DIFFRSRP\_4 | -26≥ΔRSRP>-27 | dB | | DIFFRSRP\_5 | -25≥ΔRSRP>-26 | dB |   I guess from the assistance data point of view, there is indeed no such need to provide the relative radiation power of less than -30dB. |
| ZTE | Support. We may need to send LS to RAN4 so that they can design corresponding mapping table. |
| vivo | If 0.1 dB is supported, should RAN4 be involved in the granularity? |
| CATT | Support. | |
| OPPO | Ok | |
| Ericsson | OK. We agree with Huawei’s view that we should not need a „out of range“ code point, since the AD will just signal the table within the [-30 0] range. | |
| Nokia/NSB | Support | |
| Qualcomm | We suppor this proposal, but we dont see the need to send this to Ran4. This is just AD reporting granularity, there is no measurement that RAN4 needs to work on, nor requirements right? I dont see why there is a need of a table from RAN4. | |
| InterDigital | Support | |
| ZTE | After a second thought. We agree with Qualcomm there is no requirement issue. | |

#### Proposal 4.3 (overhead reduction for beam information)

#### First round of discussion

It is proposed to discuss the use of a pointer to another PRS resource using a similar beam shape to reduce ignaling overead. The proposal is based on the discussion in [12]

**Proposal 4.3 In the beam antenna Assistance data element, support signaling enabling to refer the beam information of a TRP with another TRP with the same beam information in Local Coordinate System (LCS) .**

Companies are encouraged to provide comments in the table below.

**Proposal 4.3:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Qualcomm | Support. We think it can reduce a lot the overhead when same beam patterns (in LCS) is being used across multiple TRPs |
| Nokia/NSB | We are generally okay with this to reduce unnecessary signaling to send the same information. |
| CATT | Support it in order to reduce the overhead. |
| OPPO | Ok in principle. Can this be left to RAN3? |
| Huawei, HiSilicon | OK. |
| Intel | Support the proposal. |
| ZTE | Not sure how this function can work if different TRPs can provide different angle ranges for the antenna/beam information. |
| Ericsson | OK. We assume that RAN2 does not need a ran1 agreement for this. |
| Xiaomi | Ok for us |
| FL | Given the support,the proposal can be discussed during the GTW or endorsed by email. |

#### Conclusion for proposal 4.3

This proposal was agreed over email and will captured as follow in the chair notes:

|  |
| --- |
| **Agreement**  In the beam antenna Assistance data element, support signaling enabling to refer the beam information of a TRP with another TRP with the same beam information in Local Coordinate System (LCS). |

### Aspect #5 AoD uncertainty window

#### Summary

|  |  |
| --- | --- |
| Source | Proposal |
| [1] | ***Proposal 10: The feature of angle search window also applies for DL-TDOA and Multi-RTT.***  ***Proposal 11: The expected DL-AoA/ZoA should only be expressed in the global coordinate system.***  ***Proposal 12: Support UE to send the confirmation in the measurement report to the LMF for a TRP whether the PRS are received within the angle search window.***  FL comment: necessary assume proposal 12 is for the AoA window |
| [2] | Proposal 6   * ***The granularity can extend to 1 degree at least for the expected angle and uncertainty of AoD positioning.***   Proposal 7   * ***Only GCS is supported for reference angle for expected angle and uncertainty of DL-AoD positioning.***   **Proposal 8**   * ***Expected DL-AoD is provided to the UE for each TRP instead of ARP.*** |
| [5] | ***Proposal-2: The reference direction of the expected DL-AoD/ZoD or DL-AoA/ZoA, which can be the resource ID(s) of DL/UL reference signals or SSB index, should be indicated to UE.*** |
| [7] | Proposal 3   * + **Uncertainty range for the DL-AOD/ZOD is defined as follows:**     - **Expected azimuth angle of departure as (*φDL-AOD* – Δ*φDL-AOD*/2, *φDL-AOD* + Δ*φDL-AOD*/2)**       * ***φDL-AOD* – expected azimuth angle of departure, Δ*φDL-AOD* – uncertainty range for expected azimuth angle of departure**     - **Expected zenith angle of departure as (*θDL-ZOD* – Δ*θDL-ZOD*/2, *θDL-ZOD* + Δ*θDL-ZOD*/2)**       * ***θDL-ZOD* – expected zenith angle of departure, Δ*θDL-ZOD* – uncertainty range for expected zenith angle of departure**     - **The Global Coordinate System (GCS) is supported for DL AOD/ZOD assistance information indication**     - **Granularity of 0.1 degrees is applied for the expected DL-AOD (*φDL-AOD*), expected DL-ZOD (*θDL-ZOD*) and the corresponding uncertainty values** |
| [12] | ***Proposal 9: With regards to the expected angle indication for DL-AoD, the indication of the***   * ***Expected Azimuth DL-AoD should be with range between 0 to 359.9 degrees, with a scale of 0.1 degrees.*** * ***Expected Zenith DL-AoD should be with range between 0 to 180 degrees, with a scale of 0.1 degrees.*** * ***Expected Azimuth DL-AoD/DL-AoA uncertainty range is [-60,60] with an step size of 1 degrees.*** * ***Expected Zenith DL-AoD/DL-AoA uncertainty range is [-30,30] with an step size of 1 degrees.*** |
| [13] | ***Proposal 1:***   * RAN1 should adopt followings for ignaling of expected DL-AoD/ZoD(AoA/ZoA) assistance information for DL-AoD enhancement:   + Expected azimuth angle of arrival as (φAOA – ΔφAOA/2, φAOA + ΔφAOA/2)     - φAOA – expected azimuth angle of arrival, ΔφAOA – uncertainty range for expected azimuth angle of arrival.   + Expected zenith angle of arrival as (θAOA – ΔθAOA/2, θAOA + ΔθAOA/2)     - θAOA – expected zenith angle of arrival, ΔθAOA – uncertainty range for expected zenith angle of arrival.   + Expected azimuth angle of departure as (φAOD – ΔφAOD/2, φAOD + ΔφAOD/2)     - φAOA – expected azimuth angle of departure, ΔφAOD – uncertainty range for expected azimuth angle of departure.   + Expected zenith angle of departure as (θAOD- ΔθAOD/2, θAOA + ΔθAOA/2)     - θAOA – expected zenith angle of departure, ΔθAOA – uncertainty range for expected zenith angle of departure.   + Both GCS and LCS are supported for DL-AoA/ZoA and DL-AoD/ZoD assistance information indication.   + Granularity of 0.1 degrees is applied for the expected AoA (φAOA), expected ZoA (θZOA ) and the corresponding uncertainty values.   + Granularity of 0.1 degrees is applied for the expected AoD (φAOD), expected ZoD (θZOD ) and the corresponding uncertainty values.   ***Proposal 2:***   * RAN1 should support that the signaling of assistance information (expected value and uncertainty range) for both DL AoA/ZoA and DL-AoD/ZoD is also supported for DL-TDOA and Multi-RTT positioning methods. |

#### Proposal 5.1 (range and resolution of the angle window)

#### First round of discussion

The difference between the proposals lies in whether the resolution of the uncertainty or expected AoD/AoA should be configurable, and what is the resolution to use:

* [2] proposes a fixed value of 1 degree for both the range and expected angle
* [7][13] proposes a fixed value of 0.1 degree for both the range and expected angle
* [12] proposes a fixed value of 1 degree for the range and 0.1 degree for the expected angle. The range is limited to [-60 60] in azimuth and [][-30 30] in elevations

**Proposal 5.1 for the configuration of the AoA/AoD uncertainty window:**

* **The granularity is set as:**
  + **Option 1: the granularity of the uncertainty range for AoD/AoA is 1 degree**
  + **Option 2: the granularity of the uncertainty range and expected AoD/AoA is 0.1 degree**
* **The uncertainty range is**
  + **Option 1: configured with two values, Limited to [-60,60] in azimuth and [-30,30] in zenith**
  + **Option 2: configured with 1 value X and the range is symmetrical θ-X/2, θ+X/2 where θ is the expected elevation or azimuth for AoD or AoA, with potential values between 0 and 360-y where y is the granularity of the range.**
  + **Option 3: configured with two values, with potential values between 0 and 360-y where y is the granularity of the range.**

Companies are encouraged to provide comments in the table below.

**Proposal 5.1**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Qualcomm | 1st subbet: Support both options ; up to the LMF decision.  2nd subbulet: OK to go with Option 1 or 3. But, for Option 2, since there is single value for both azumith and zenith, we don’t support it. |
| Nokia/NSB | We prefer option 1 in the first bullet and option 3 in the second bullet. In our view, option 1 in the second bullet looks like it restrict the ability to send a range and we do not think it is necessary. |
| CATT | For the 1st bullet: we prefer Option1;  For the 2nd bullet: we support Option3. |
| OPPO | First bullet: we prefer Option 1. Do not think 0.1 degree granularity can give us extra benefit.  Sencond bullet: what is the motivation for Option 2? |
| Huawei, HiSilicon | Option 1 for the first bullet.  Option 1 for the second bullet. The uncertainty range should be only be useful if the value is not too large. |
| Vivo | Before discussing the proposal, we would like to confirm whether DL AoA/AoD uncertainty window similar UL AoA uncertainty window as following   * + Expected azimuth angle of arrival as (φAOA – ΔφAOA/2, φAOA + ΔφAOA/2)     - φAOA – expected azimuth angle of arrival, ΔφAOA – uncertainty range for expected azimuth angle of arrival   if it is, we prefer option 1 for the granularity in the first bullet, and we think the second bullet is unclear since some options like the range of φAOA , and some options like the range of ΔφAOA |
| Intel | For granularity: we are OK with both options  For uncertainty range: we have concerns with the proposal:  For option 1, we are confused with the definition of zenith angle in the range [-30, 30]  For option 2, we are confused that the same angle is defined for both azimuth and zenith, we think that they can be different  We support option 2 and propose to correct it for the case, that the range for the azimuth and zenith angles can be different |
| ZTE | Option 1 in the first bullet and Option 3 in the second bullet |
| LGE | 1st subbet: option #2 ( 0.1 degree is already used for configuration expected UL-AoA)  2nd subbulet: we have a question for option #2. If the option #2 indicates followings?  Expected azimuth angle of arrival as (φAOA – ΔφAOA/2, φAOA + ΔφAOA/2)  φAOA – expected azimuth angle of arrival, ΔφAOA – uncertainty range for expected azimuth angle of arrival.  Expected zenith angle of arrival as (θAOA – ΔθAOA/2, θAOA + ΔθAOA/2)  θAOA – expected zenith angle of arrival, ΔθAOA – uncertainty range for expected zenith angle of arrival.  Expected azimuth angle of departure as (φAOD – ΔφAOD/2, φAOD + ΔφAOD/2)  φAOD – expected azimuth angle of departure, ΔφAOD – uncertainty range for expected azimuth angle of departure.  Expected zenith angle of departure as (θAOD- ΔθAOD/2, θAOA + ΔθAOA/2)  θAOD – expected zenith angle of departure, ΔθAOD – uncertainty range for expected zenith angle of departure.  If it is right, we prefer to change the description from option #2 in the current version to above descpription to to avoid confusion. In addition, considering the fact that the above configuration is already used for expected UL-AoA. We do not want to adopt/consider additional way for configuration. |
| NTT DOCOMO | 1st bullet: we prefer Option 1 since 1 degree granularity is enough.  2nd bullet: we support either Option 1 or Option 3 (slightly prefer Option 1). |
| Xiaomi | Option 1 for the 1st bullet and 2nd bullet. |

#### Second round of discussion

The majority of companies agree to support at least 1 degree of resolution of the granularity of the window. The range discussion is less clear. Option 2 is changed to what LGE proposed in its proposal, as it was mentioned that the current wording was not clear enough.

**Proposal 5.1b for the configuration of the AoA/AoD uncertainty window:**

* **The granularity is set as:**
  + **Option 1: the granularity of the uncertainty range for AoD/AoA is 1 degree**
  + **~~Option 2: the granularity of the uncertainty range and expected AoD/AoA is 0.1 degree~~**
* **The uncertainty range is**
  + **Option 1: configured with two values, Limited to [-60,60] in azimuth and [-30,30] in zenith**
  + **Option 2: the angles are configurable as follow ~~configured with 1 value X and the range is symmetrical θ-X/2, θ+X/2 where θ is the expected elevation or azimuth for AoD or AoA, with potential values between 0 and 360-y where y is the granularity of the range.~~** 
    - **Expected azimuth angle of arrival as (φAOA – ΔφAOA/2, φAOA + ΔφAOA/2)**
    - **φAOA – expected azimuth angle of arrival, ΔφAOA – uncertainty range for expected azimuth angle of arrival.**
    - **Expected zenith angle of arrival as (θAOA – ΔθAOA/2, θAOA + ΔθAOA/2)**
    - **θAOA – expected zenith angle of arrival, ΔθAOA – uncertainty range for expected zenith angle of arrival.**
    - **Expected azimuth angle of departure as (φAOD – ΔφAOD/2, φAOD + ΔφAOD/2)**
    - **φAOD – expected azimuth angle of departure, ΔφAOD – uncertainty range for expected azimuth angle of departure.**
    - **Expected zenith angle of departure as (θAOD- ΔθAOD/2, θAOA + ΔθAOA/2)**
    - **θAOD – expected zenith angle of departure, ΔθAOD – uncertainty range for expected zenith angle of departure.**
  + **Option 3: configured with two values, with potential values between 0 and 360-y where y is the granularity of the range.**

Companies are encouraged to provide comments in the table below.

**Proposal 5.1b**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| CATT | Support the proposal.  For the 1st bullet: we prefer Option1;  For the 2nd bullet: we prefer Option3. |
| Qualcomm | We are getting confused with the options. Can we clarify whether there need to be changes over the example shown in the running CR? There are 4 numbers provided, this seems to be Option 2 right? But at the same time Option1 says that the uncertainty will have 2 values which is also shown in the example below. So option 1 and Option 2 point to the same solution, wherein Option 1 also solves the issue of the what should the range be. Option 2 doesnt say what should be the range.  expectedAngle-r17 CHOICE {  expectedAoD-r17 SEQUENCE {  expected-DL-Azimuth-AoD-r17 INTEGER (0..3599),  expected-DL-Azimuth-AoD-Unc-r17 INTEGER (0..FFS),  expected-DL-Zenith-AoD-r17 INTEGER (0..1800),  expected-DL-Zenith-AoD-Unc-r17 INTEGER (0..FFS)  },  expectedAoA-r17 SEQUENCE {  expected-DL-Azimuth-AoA-r17 INTEGER (0..3599),  expected-DL-Azimuth-AoA-Unc-r17 INTEGER (0..FFS),  expected-DL-Zenith-AoA-r17 INTEGER (0..1800),  expected-DL-Zenith-AoA-Unc-r17 INTEGER (0..FFS)  }  },  …  } |
| Nokia/NSB | We have the same comment: We prefer option 1 in the first bullet and option 3 in the second bullet. In our view, option 1 in the second bullet looks like it restrict the ability to send a range and we do not think it is necessary. |
| FL | Let’s reword the proposal for clarity. The intention of option 1 in the second bullet was to capture the proposal in [12]:  **Updated Proposal 5.1b for the configuration of the AoA/AoD uncertainty window:**   * **The granularity is set as:**   + **Option 1: the granularity of the uncertainty range for AoD/AoA is 1 degree**   + **~~Option 2: the granularity of the uncertainty range and expected AoD/AoA is 0.1 degree~~** * **The uncertainty range is**   + **Option 1: ~~configured with two values, Limited to [-60,60] in azimuth and [-30,30] in zenith~~ Expected Azimuth DL-AoD/DL-AoA uncertainty range is [-60,60] with an step size of 1 degrees. Expected Zenith DL-AoD/DL-AoA uncertainty range is [-30,30] with an step size of 1 degrees.**   + **Option 2: the angles are configurable as follow ~~configured with 1 value X and the range is symmetrical θ-X/2, θ+X/2 where θ is the expected elevation or azimuth for AoD or AoA, with potential values between 0 and 360-y where y is the granularity of the range.~~**      - **Expected azimuth angle of arrival as (φAOA – ΔφAOA/2, φAOA + ΔφAOA/2)**     - **φAOA – expected azimuth angle of arrival, ΔφAOA – uncertainty range for expected azimuth angle of arrival.**     - **Expected zenith angle of arrival as (θAOA – ΔθAOA/2, θAOA + ΔθAOA/2)**     - **θAOA – expected zenith angle of arrival, ΔθAOA – uncertainty range for expected zenith angle of arrival.**     - **Expected azimuth angle of departure as (φAOD – ΔφAOD/2, φAOD + ΔφAOD/2)**     - **φAOD – expected azimuth angle of departure, ΔφAOD – uncertainty range for expected azimuth angle of departure.**     - **Expected zenith angle of departure as (θAOD- ΔθAOD/2, θAOA + ΔθAOA/2)**     - **θAOD – expected zenith angle of departure, ΔθAOD – uncertainty range for expected zenith angle of departure.**   + **Option 3: configured with two values, with potential values between 0 and 360-y where y is the granularity of the range.** |
| FL | Based on the comment from qualcomm, I have the similar question regarding continuing the discussion for the angle resolution and number of angles. Do we need to continue the discussion or is RAN2 able to proceed without input? |
| InterDigital | In one of the pre-meeting discussions in RAN2, [Pre117-e][611][POS], it appears from Proposal 22 in the discusison that 8/11 companies prefer that this topic is discussed in RAN1. Although the proposal is not agreed yet, the best wayforward in the current situation may be for RAN1 to make an agreement on this topic.  It is not clear how the running CR for TS 37.355 (R2-2203310) captured the granurality for expected angle and uncertainty for zenith and azimuth to be 0.1 degrees. We could not find any relevant agreements in RAN2.  For granruality, we are ok with Option 1, but as a wayforward we can also accept both Option 1 (corase) and Option 2 (fine), allowing the LMF to choose one of them. We don’t see any problems adopting both since finer granurality can be configured optionally, like boresight angles in the current LPP spec.  For the uncertainty range, we are also ok with Option 1 or Option 3, assuming Option 3 means to [-A,A] in azimuth and [-B,B] in zenith where A and B can be between 0 and 360-y where y is the granurality of the range. |
| Huawei, HiSilicon | From our side, we think that RAN1 should determine the range the uncertainty window, and the resolution of both expected angle and uncertainty.  From our side, we believe the range of the uncertainty window should be 60 for azimuth and 30 for zenith, which only makes sense, while the resolution of expected angle and uncertainty should be 1 degree, which is sufficient. |
| ZTE | Agree with Huawei, RAN1 needs to determine the range the uncertainty window, and the resolution of both expected angle and uncertainty. We’re fine with Option 1 in first bullet and Option 2 in second bullet based on the latest version from FL. |
| LGE | Considering the not enough time and to avoid duplicated discussion, we are okay to left the issue for RAN2. |
| vivo | Saimiler view as Huawei. 0.1 degree for expected window is unnecessary. |
| Xiaomi | Support the first bullet in the Updated Proposal 5.1b.  For the second bullet, in our view, Option 1 focus on the uncertainty only. But Option 2 covers both expected angle and uncertainty. If this proposal only want to talk about uncertainty, Option 1 is OK. If both expected angle and uncertainty want to be covered, Option 2 is better. |
| OPPO | Regarding the 2nd bullet, all three options can give ue a range of the search window and Alt 1 is slightly prefered. |
|  |  |

#### Third round of discussion

Considering the received feedback, the following changes are added:

* Added the expected value to option 1 with the expected value and range having the same resolution of 1 degree.
* Based on interdigital comment, option 2 and 3 should be the same, so option 3 can be removed .

**Updated Proposal 5.1c for the configuration of the AoA/AoD uncertainty window:**

* **The granularity is set as:**
  + **Option 1: the granularity of the uncertainty range and expected AOD/AOA for AoD/AoA is 1 degree**
* **The uncertainty range is**
  + **Option 1: Expected Azimuth DL-AoD/DL-AoA uncertainty range is [-60,60] with an step size of 1 degrees. Expected Zenith DL-AoD/DL-AoA uncertainty range is [-30,30] with an step size of 1 degrees.**
  + **Option 2: the angles are configurable as follow** 
    - **Expected azimuth angle of arrival as (φAOA – ΔφAOA/2, φAOA + ΔφAOA/2)**
    - **φAOA – expected azimuth angle of arrival, ΔφAOA – uncertainty range for expected azimuth angle of arrival.**
    - **Expected zenith angle of arrival as (θAOA – ΔθAOA/2, θAOA + ΔθAOA/2)**
    - **θAOA – expected zenith angle of arrival, ΔθAOA – uncertainty range for expected zenith angle of arrival.**
    - **Expected azimuth angle of departure as (φAOD – ΔφAOD/2, φAOD + ΔφAOD/2)**
    - **φAOD – expected azimuth angle of departure, ΔφAOD – uncertainty range for expected azimuth angle of departure.**
    - **Expected zenith angle of departure as (θAOD- ΔθAOD/2, θAOA + ΔθAOA/2)**
    - **θAOD – expected zenith angle of departure, ΔθAOD – uncertainty range for expected zenith angle of departure.**

Companies are encouraged to provide comments in the table below.

**Proposal 5.1c**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| OPPO | The option 1 for uncertainity range is not correct. It gives fixed range of [-60, 60] and [-30, 30]. I assume that is not the intention of Option 1. Suggest to update it as follow to make it clear:  Option 1: Expected Azimuth DL-AoD/DL-AoA uncertainty range is given within [-60,60] with an step size of 1 degrees. Expected Zenith DL-AoD/DL-AoA uncertainty range is given within [-30,30] with an step size of 1 degrees. |
| Nokia/NSB | Given that the option 3 was exlcuded, we prefer option 1. |
| Huawei, HiSilicon | Option 1. The change of OPPO is acceptable to us, although we do not see any potential misinterpretation raised by OPPO. If the uncertainty range is fixed, why do we need to signal it the first place; clearly the discussion here is about the range of the boundary. |
| InterDigital | We support the FL’s proposal for granulraity and Option 1 for range and modified Option 1 from OPPO is ok with us. |
| ZTE | Option 1 for uncertainty range. |
| CATT | For the first bullet: Option 1 is fine for us.  For the second bullet: Option 2 is OK. |
| Xiaomi | We prefer Option 1 for uncertainty range. |
| Intel | For the expected value – 1 degree is OK  For the uncertainty range – prefer option 2 |
| LGE | Option 2 for uncertainty range. We think the configuration way is already agreed and used for configure expected UL AoA as shown in below.  Agreement:   * Uncertainty range for expected UL AoA/ZoA is defined as follows   + Expected azimuth angle of arrival as (φAOA - ΔφAOA/2, φAOA + ΔφAOA/2)     - φAOA - expected azimuth angle of arrival, ΔφAOA – uncertainty range for expected azimuth angle of arrival   + Expected zenith angle of arrival as (θAOA - ΔθAOA/2, θAOA + ΔθAOA/2)     - θAOA - expected zenith angle of arrival, ΔθAOA – uncertainty range for expected zenith angle of arrival   In addition, signaling overhead for option2 is lower than option 1. So, we think option 2 is more appropriate. |

#### Proposal 5.2 (support of AoA/AoD window for DL time based methods) (closed)

#### First round of discussion

[1] and [13] propose to also use the expected AoD/AoA uncertainty window as part of DL TDOA and multi RTT:

**Proposal 5. 2 The feature of angle search window also applies for DL-TDOA and Multi-RTT.**

Companies are encouraged to provide comments in the table below.

**Proposal 5.2**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Qualcomm | Support |
| Nokia/NSB | Support. It may be also helpful for DL-TDOA and Multi-RTT. |
| CATT | Support. |
| OPPO | Ok |
| Huawei, HiSilicon | Support. |
| Vivo | We would like to confirm whether the UE will be restricted to measuring PRS within the window if the window is configured, or whether the measurement will be impacted by the above assistance data.  If it is not, maybe the following note can be added  Note: This does not imply any restriction on UE measurement |
| ZTE | Support |
| LGE | Support. |
| Ericsson | OK |
| Fraunhofer | Same comment as in P3.7 : We can’t figure why proposal 5.2 is advantageous and proposal 3.7 is not. |
| NTT DOCOMO | Support |
| Xiaomi | Support |
| FL | The proposal can be discussed at the GTW |

#### Second round of discussion

The proposal has majority support and could be discussed for endorsement at the GTW. The note is added as per vivo’s comment.

**Proposal 5. 2b The feature of angle search window also applies for DL-TDOA and Multi-RTT.**

* **Note: This does not imply any restriction on UE measurement**

Companies are encouraged to provide comments in the table below.

**Proposal 5.2b**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| CATT | Support. |
| Samsung | Not support.  We do not think such optimization is necessary at this maintaince stage. The angle search window has been supported in AoD. If UE can support mulitple positioning methods including DL-AoD, the angle information is available. As for the NLOS mitigation there is LOS/NLOS indicator that LMF can use. |
| Qualcomm | Support |
| Nokia/NSB | Support |
| ZTE | Support |
| LGE | Support |
| vivo | We can accept the updated proposal with the note. |
|  |  |

#### Third round of discussion

RAN2 sent an LS (R1-2202620 / R2-2203597) with a question that is treated in this proposal:

|  |  |  |
| --- | --- | --- |
| As for the expected angle value and uncertainty information interaction between LMF and UE, RAN2 made the following agreements (RAN2#116bis).   |  | | --- | | * **Proposal 2.1-6: enhance LPP assistance data ignaling to allow UE to request and LMF to provide the expected angle value and uncertainty.** |   **RAN2 understand “angle assistance information ” applies for DL-AOD positioning method. It is unclear to RAN2 on whether it also applies for DL-TDOA and Multi-RTT?** | **RAN1 provides further clarifications on the issue** |

Thus we update the proposal with a mention to reply to RAN2 with the final agreement. There is still one company in disagreement with the proposal, but given the amount of support, we would like to check if a compromise is possible:

**Proposal 5. 2c The feature of angle search window also applies for DL-TDOA and Multi-RTT.**

* **Note: This does not imply any restriction on UE measurement**
* **Send an LS to RAN2 with this agreement in reply to the question “RAN2 understand “angle assistance information ” applies for DL-AOD positioning method. It is unclear to RAN2 on whether it also applies for DL-TDOA and Multi-RTT?**

Companies are encouraged to provide comments in the table below.

**Proposal 5.2c**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Nokia/NSB | Support |
| Huawei, HiSilicon | Support |
| ZTE | Support |
| CATT | Support. |
| Qualcomm | Support |
| Samsung | Okay but suggest wording changes to align with RAN2 LS  **Proposal 5. 2c The ~~feature of angle search window~~ expected angle value and uncertainty for DL-AoD also applies ~~for~~ to DL-TDOA and Multi-RTT.**   * **Note: This does not imply any restriction on UE measurement** * **Send an LS to RAN2 with this agreement in reply to the question “RAN2 understand “angle assistance information ” applies for DL-AOD positioning method. It is unclear to RAN2 on whether it also applies for DL-TDOA and Multi-RTT?** |

#### Conclusion for proposal 5.2

The issue was concluded with the following agreement captured in the chair’s notes:

|  |
| --- |
| **Agreement**  The expected angle value and uncertainty for DL-AoD methods also applies to DL-TDOA and Multi-RTT   * Note: This does not imply any restriction on UE measurement * Send an LS to RAN2 with this agreement in reply to the question “RAN2 understand “angle assistance information ” applies for DL-AOD positioning method. It is unclear to RAN2 on whether it also applies for DL-TDOA and Multi-RTT? |

#### Proposal 5.3 (coordinate system for the angle search window) (closed)

#### First round of discussion

[2] and [7] propose to also use only GCS for the angle search window.

**Proposal 5. 3 Only GCS is supported for reference angle for expected angle and uncertainty of DL-AoD positioning.**

Companies are encouraged to provide comments in the table below.

**Proposal 5.3**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| OPPO | Ok |
| Huawei, HiSilicon | OK. |
| Vivo | Support |
| ZTE | Support |
| Ericsson | OK |
| FL | We can endorse the proposal at the GTW |
| Qualcomm | OK |
| CATT | We prefer to use DL/UL reference signals or SSB as the reference direction of the expected DL-AoD/ZoD or DL-AoA/ZoA. |

#### Conclusion for proposal 5.3

The following was captured as agreement for proposal 5.3:

|  |
| --- |
| **Agreement**  Only GCS is supported for reference angle for expected angle and uncertainty of DL-AoD positioning. |

#### Proposal 5.4 (further details on the angle search window)

[1] proposes to support a confirmation in the measurement report from the UE to the LMF regarding whether the PRS was received within the window. [2] proposes to limit the angle search window ignaling to a TRP instead of ARP. [5] proposes to support signaling a reference direction for the expected DL AOD/ZOD and DL AOA/ZOA by indicating the resource ID of a reference signal (DL or UL RS, SSB) to the UE.

Since these are single-conpany proposals on the issue, it is propose to check the support in a first step:

**Proposal 5.4-1: Support UE to send the confirmation in the measurement report to the LMF for a TRP whether the PRS are received within the angle search window.**

**Proposal 5.4-2: Expected DL-AoD is provided to the UE for each TRP instead of ARP.**

**Proposal 5.4-3: The reference direction of the expected DL-AoD/ZoD or DL-AoA/ZoA, which can be theresource ID(s) of DL/UL reference signals or SSB index, should be indicated to UE.**

Companies are encouraged to provide comments in the table below.

**Proposal 5.4-1 , 5.4-2 and 5-4-3:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| CATT | We also have one proposal in [5] on the details on the angle search window as follows, and we support the following proposal:  ***Proposal-2: The reference direction of the expected DL-AoD/ZoD or DL-AoA/ZoA, which can be the resource ID(s) of DL/UL reference signals or SSB index, should be indicated to UE.*** |
| OPPO | Do not support 5.4-1: the UE is not able to determine if the PRS resource is within the window or not. The UE is only able to measure the RSRP and time-of-arrival, which can not be used to determine if it is within the expected DL AoD or ZoD. |
| Huawei, HiSilicon | Proposal 5.4-1: Support.  Proposal 5.4-2: We haven’t agree to introduce ARP for DL-AoD, right? |
| Vivo | Proposal 5.4-1: not needed  Proposal 5.4-2: TRP specific |
| Ericsson | Proposal 5.4-1: support  Proposal 5.4-2: same view as Huawei.  Proposal 5.4-3:we think this is already what PRS’s QCL achieves. |
| Qualcomm | Proposal 5.4-1: not needed  Proposal 5.4-2: Why is it only for expectedAoD and not expectedAoA? Shouldn’t that be per TRP also?  Proposal 5.4-3: Not needed |
| Nokia/NSB | Proposal 5.4-1: not needed  Proposal 5.4-2: Okay  Proposal 5.4-3: Not needed |
| ZTE | Proposal 5.4-1: not needed  Proposal 5.4-2: Okay  Proposal 5.4-3: Not needed |
|  |  |

#### Second round of discussion

It seems proposal 5.4.2 is agreeable, with the clarification based on QC’s comment that expected AoA also applies.

Companies are encouraged to provide comments in the table below.

**Proposal 5.4-2: Expected DL-AoD and DL-AOA is provided to the UE for each TRP instead of ARP.**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Huawei, HiSilicon | Support Proposal 5.4-2. |
| ZTE | OK |
| Qualcomm | Support |

### Aspect #6 two-stage beam sweeping

#### Summary and FL proposal

Two companies discuss two-stage beam sweeping with diverging opinion. Since the PRS subset reporting has been agreed in a way to also enable 2-stage beam sweeping, and further enhancement does not have large support, it is proposed not to further discuss the issue considering the late stage of the release.

Companies are encouraged to provide comments in the table below if further discussion should be taken on the issue during RAN1#108e.

|  |  |
| --- | --- |
| **Company** | **Comment** |
|  |  |

|  |  |
| --- | --- |
| Source | Proposal |
| [13] | ***Proposal 5:***   * Apart from adjacent beam reporting (e.g. indication of subset of PRS resources), RAN 1 needs to consider the two-stage PRS beam sweeping in isolation.   ***Proposal 6:***   * Regarding 2-stage PRS beam sweeping, RAN1 should consider the following procedure for 2-stage beam reporting:   + In case of the first PRS resource set, it can be composed of multiple PRS resources and they are associated with wide beams.   + And then, the multiple PRS resources that are in the second PRS resource set can be associated with narrow beams. LMF can configure associated PRS resources based on the measurement report in the first step.   ***Proposal 7:***   * RAN1 needs to consider applying different resolution and range for measured quantity value in each stage respectively. |
| [10] | *Proposal 2: Prefer not to support two-stage beam sweeping.* |

### Text proposals for correction of specifications

This sections lists the proposed TP from the AI 8.5.3 contributions. Based on the collected views on the TPs, we can provide proposals for endorsements with potential updates in the second round.

#### DL AoD uncertainty window

#### Summary and Text Proposal

Summary from [5]:

|  |
| --- |
| In RAN1#107-e meeting, the following agreement was achieved [1]:  **Agreement**  For the purpose of both UE-B and UE-A DL-AoD, and with regards to the support of AOD measurements with an expected uncertainty window, the following is supported   * Indication of expected angle value and uncertainty (of the expected azimuth and zenith angle value) range(s) is signaled by the LMF to the UE * The type of expected angle and uncertainty can be requested by the UE, between the following options   + - Option 1: Indication of expected DL-AoD/ZoD value and uncertainty (of the expected DL-AoD/ZoD value) range(s) is signaled by the LMF to the UE     - Option 2: Indication of expected DL-AoA/ZoA value and uncertainty (of the expected DL-AoA/ZoA value) range(s) is signaled by the LMF to the UE   According to the above agreement, either expected DL-AoD/ZoD (Option 1) or expected DL-AoA/ZoA (Option 2) could be provided to the UE. But it is not supported to provide both Option 1 and Option 2 to the UE. The description in the current specification of TS 38.214 [2] is not adequate. We prefer the following revision. |

----------------Start of TP for TS38.214---------------------

#### 5.1.6.5 PRS reception procedure

……

The UE may request either expected DL-AoD/ZoD and uncertainty range(s) of expected DL-AoD/ZoD, or expected DL-AoA/ZoA and uncertainty range(s) of the expected DL-AoA/ZoA. The UE may be provided with expected DL-AoD/ZoD and uncertainty range(s) of the expected DL-AoD/ZoD, or with expected DL-AoA/ZoA and uncertainty range(s) of the expected DL-AoA/ZoA.

……

----------------End of TP for TS38.214---------------------

#### First round of discussion

Companies are encouraged to provide comments in the table below regarding endorsing the TP in 2.1.7.1.1.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Qualcomm | Not needed |
| Huawei, HiSilicon | Not needed. RAN2 specification is already based on the CHOICE contruction. |
| ZTE | Not essential change. |
| LGE | Not support. |
| Ericsson | Not support. |
| CATT | We prefer to adopt the TP to make the related descriptions in 38.214 more clear and match the agreement better. The reason is:  According to the agreement, there are two cases:   * Case 1: under the request from UE, gNB provide the uncertainty window to UE. This case is clear in the current descriptions in 38.214. * Case 2: without the request form UE, gNB can directly privide the uncertainty window to the UE. In this case, the word of (or) is important to describe that only one of AoD and AoA windows can be provided to UE.   We are also fine with the following updated TP:   |  | | --- | | The UE may request to be provided with either expected DL-AoD/ZoD and uncertainty range(s) of expected DL-AoD/ZoD, or expected DL-AoA/ZoA and uncertainty range(s) of the expected DL-AoA/ZoA. The UE may be provided with expected DL-AoD/ZoD and uncertainty range(s) of the expected DL-AoD/ZoD, or ~~The UE may be provided with~~ expected DL-AoA/ZoA and uncertainty range(s) of the expected DL-AoA/ZoA. | |

#### DL-AoD measurement and reporting

#### Summary and Text Proposal

Summary from [5]:

|  |
| --- |
| In RAN1#107-e meeting, the following agreement was further achived [1]:  **Agreement**  For reporting of DL PRS RSRPP and PRS RSRP in UE-A DL-AOD   * The maximum number of DL PRS RSRPP M is a UE capability and its candidate values include {2,4,8,16,24}. * The capabilities for DL PRS RSRPP (M value) and DL PRS RSRP (N values) are such that M is less than or equal to N   According to the agreement, for a given PRS resource, multiple DL PRS RSRPs could be reported, which may correspond to same or different Rx Beam index and same or different timestamps. This feature should be specified in TS 38.214 [2] for a clear description on UE reporting. In addition, the number of DL PRS RSRPP measurements per TRP could be less than or equal to that of DL PRS RSRP. This is also missed from the current specfication. |

----------------Start of TP for TS38.214---------------------

#### 5.1.6.5 PRS reception procedure

……

The UE may be configured to measure and report, subject to UE capability, up to 24 DL PRS-RSRP measurements on different DL PRS resources associated with the same dl-PRS-ID. When the UE reports DL PRS-RSRP measurements from one DL PRS resource set, the UE may indicate which DL PRS-RSRP measurements associated with the same higher layer parameter nr-DL-PRS-RxBeamIndex [17, TS 37.355] have been performed using the same spatial domain filter for reception if for each nr-DL-PRS-RxBeamIndex reported there are at least 2 DL PRS-RSRP measurements associated with it within the DL PRS resource set. When the UE reports DL PRS-RSRP measurements from one DL PRS resource set, for a DL PRS resource, multiple DL PRS-RSRP measurements associated with the same or different higher layer parameter nr-DL-PRS-RxBeamIndex should be able to be reported with the same or different timestamps. The UE may be configured to measure and report, subject to UE capability, up to 24 DL PRS RSRPP for the first detected path on different DL PRS resources associated with the same dl-PRS-ID. The number of the reported DL PRS RSRPP is less than or equal to the number of the reported DL PRS RSRP.

……

----------------End of TP for TS38.214---------------------

#### First round of discussion

Companies are encouraged to provide comments in the table below regarding endorsing the TP in 2.1.7.2.1.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Nokia/NSB | We think the intentoin of this TP is to capture the previous agreement. We have the following modifed proposal. The last sentence of the above TP is fine.  When the UE reports DL PRS-RSRP measurements from one DL PRS resource set, for a DL PRS resource, the UE may report multiple DL PRS-RSRP measurements associated with the same or different higher layer parameter nr-DL-PRS-RxBeamIndex ~~should be able to be reported~~ with the same or different timestamps. |
| Huawei, HiSilicon | We do not think the Note should be captured in the specification, which is beyond the intention of using Note in the first place.  The last sentence is incorrect, because the agreement only says the capability reporting, instead of the actual measurement reporting. |
| LGE | Similar view with Nokia. |
| Ericsson | Do not support, but could be OK with Nokia’s update. The last sentence is better suited for the capability specification . |
| CATT | We are fine with the updated TP from Nokia/NSB, and also fine to remove the last newly added sentence in the original TP. The modified TP as follows,   |  | | --- | | When the UE reports DL PRS-RSRP measurements from one DL PRS resource set, for a DL PRS resource, the UE may report multiple DL PRS-RSRP measurements associated with the same or different higher layer parameter *nr-DL-PRS-RxBeamIndex* with the same or different timestamps. | |
|  |  |

#### Second round of discussion

Based on the discussion, we can try endorsing the first part of the TP with the changes discussed:

**Proposal 7.1: endorse the following TP for 38.214:**

----------------Start of TP for TS38.214---------------------

#### 5.1.6.5 PRS reception procedure

……

The UE may be configured to measure and report, subject to UE capability, up to 24 DL PRS-RSRP measurements on different DL PRS resources associated with the same dl-PRS-ID. When the UE reports DL PRS-RSRP measurements from one DL PRS resource set, the UE may indicate which DL PRS-RSRP measurements associated with the same higher layer parameter nr-DL-PRS-RxBeamIndex [17, TS 37.355] have been performed using the same spatial domain filter for reception if for each nr-DL-PRS-RxBeamIndex reported there are at least 2 DL PRS-RSRP measurements associated with it within the DL PRS resource set. When the UE reports DL PRS-RSRP measurements from one DL PRS resource set, for a DL PRS resource, the UE may report multiple DL PRS-RSRP measurements associated with the same or different higher layer parameter *nr-DL-PRS-RxBeamIndex* with the same or different timestamps.The UE may be configured to measure and report, subject to UE capability, up to 24 DL PRS RSRPP for the first detected path on different DL PRS resources associated with the same dl-PRS-ID.

……

----------------End of TP for TS38.214---------------------

Companies are encouraged to provide comments in the table below regarding endorsing the TP in 2.1.7.2.3.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| CATT | Support. |
| Nokia/NSB | Support |
| Huawei, HiSilicon | Not support. The Note in the agreement is not intended to be captured in the spec, which is bad precedence. Why would there be a need to have a sentence that does not iterally restrict anything.  Agreement:  The agreement from RAN1#106e on the number of DL PRS RSRP measurements per TRP is extended as follows:   * For UE-A DL-AOD, support reporting ~~more than 8~~ up to ~~16~~ N DL PRS RSRP measurements per TRP, where N is UE capability and candidate values include {16,24}. * For UE-A DL-AOD, support reporting ~~more than 8~~ up to ~~16~~ M first path PRS RSRP measurements per TRP, where M is a UE capability   + FFS: Values of M. Candidate values include {2,4,8,16,24}.   + FFS: Whether M is always equal to N * Note: Multiple RSRPs corresponding to same or different Rx Beam index should be able to be reported for a given PRS resource for same or different timestamps. * Note: the maximum number of DL PRS RSRP associated with the same Rx beam index is up to the UE implementation |
| Nokia/NSB2 | We somewhat understand Huawei’s comment. According to this agreement, however, our understanding is that the UE can report different Rx beam index (nr-DL-PRS-RxBeamIndex) for multiple RSRPs. If I did not interpret it in a wrong way, at least this note might not be aligned with Rel-16 behavior since this field *nr-DL-PRS-RxBeamIndex* should not be present except for a single case where the PRS mesurements have been made with the same Rx beam as captured below. We are okay with not capturing the note in TS 38.214, but maybe we need to clarify if it is okay even if the note is not captured in somwhere in spec.  ***nr-DL-PRS-RxBeamIndex (TS 37.355)***  This field provides an index of the target device receive beam used for DL-PRS measurements. If the value of the receive beam index for two or more DL PRS measurements is the same, it indicates that the target device receive beam for the two or more DL PRS measurements were made with the same RX beam. The field is mandatory present if at least two DL-PRS RSRP measurements from the same DL-PRS Resource Set have been made with the same RX beam by the target device; otherwise it is not present. |
| CATT-2 | We support the TP.  To Huawei:  Since we had the agreement, we had better to capture it into the specs completely, especially the note can clarify the cases which is not limited by the specs. The lack of information is worse for the specs. As the following similar example, it also capture the note (same or different *PRS resource set*) in the agreement into the specs, which just say all the cases are not limited.   |  | | --- | | 38.214 section 5.1.6.5:  *The UE may be configured, subject to UE capability, with [DL-AOD-PRS resource-Subset] that is associated with a PRS resource, where the subset of PRS resources associated with the PRS resource can be in the same or different PRS resource set than the PRS resource.* |  |  | | --- | | **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:   + 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.   + UE may report PRS measurements only for the subset of PRS resources.   + 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 |   In addtion, we prefer the wording of the TP can be further polished to match the note in the agreement as follows,  When the UE reports DL PRS-RSRP measurements from one DL PRS resource set, for a DL PRS resource, ~~the UE may report~~ the reported multiple DL PRS-RSRP measurements associated with the same or different higher layer parameter *nr-DL-PRS-RxBeamIndex* may have~~with~~ the same or different timestamps. |
| Huawei, HiSilicon | If the companies want to discuss the relaxation of the condition of reporting Rx beam index, we prefer to discuss them jointly:   * When the same PRS resource is associated with multiple RSRP/RSRPP each corresponding to a different Rx beam. * When more than one RSRP/RSRPP values are reported accross all (up to 2) PRS resource sets with the same Rx beam for a TRP on a positioning frequency layer.   We would be OK with the following TP. Note that we understand that DL PRS-RSRPP reporting TP should a separate one for this paragraph.  The UE may be configured to measure and report, subject to UE capability, up to 24 DL PRS-RSRP measurements on different DL PRS resources associated with the same dl-PRS-ID. When the UE reports DL PRS-RSRP measurements from one DL PRS resource set, the UE may indicate which DL PRS-RSRP measurements associated with the same higher layer parameter nr-DL-PRS-RxBeamIndex [17, TS 37.355] have been performed using the same spatial domain filter for reception if for each nr-DL-PRS-RxBeamIndex reported there are at least 2 DL PRS-RSRP/PRS-RSRPP measurements associated with it across the DL PRS resource sets on a positioning frequency layer for a *dl-PRS-ID*, or if there are at least 2 DL PRS-RSRP/RSRPP measurements associated with the same DL PRS resource. The UE may be configured to measure and report, subject to UE capability, up to 24 DL PRS RSRPP for the first detected path on different DL PRS resources associated with the same dl-PRS-ID. |
| ZTE | According to Rel-16, the nr-DL-PRS-RxBeamIndex is only reported when 2 DL PRS-RSRP measurements associated with the DL PRS resource set are performed by the same spatial domain filter.  **Clause 5.1.6.5 of TS 38.214:**  The UE may be configured to measure and report, subject to UE capability, up to 8 DL PRS-RSRP measurements on different DL PRS resources associated with the same dl-PRS-ID. When the UE reports DL PRS-RSRP measurements from one DL PRS resource set, the UE may indicate which DL PRS-RSRP measurements associated with the same higher layer parameter nr-DL-PRS-RxBeamIndex [17, TS 37.355] have been performed using the same spatial domain filter for reception if for each nr-DL-PRS-RxBeamIndex reported there are at least 2 DL PRS-RSRP measurements associated with it within the DL PRS resource set.  If we want to extend the application scope so that 2 DL PRS-RSRP measurements are not necessarily to be associated with different DL PRS resources. We prefer to discuss this proposal together with Proposal 2.1. Therefore, 2 DL PRS-RSRP measurements associated with the same nr-DL-PRS-RxBeamIndex can be performed by   * Different DL PRS resources within the same DL PRS resource set, or * The same DL PRS resource in different time stamps, or * Different DL PRS resources associated with the same positioning frequency layer and the same TRP   We support Huawei’s comments above, the discussion point is how to relax the condition. However, we have some suggestions for the change.  The UE may be configured to measure and report, subject to UE capability, up to 24 DL PRS-RSRP measurements on DL PRS resources associated with the same dl-PRS-ID. When the UE reports DL PRS-RSRP measurements from DL PRS resource sets associated with the same positioning frequency layer and the same dl-PRS-ID, the UE may indicate which DL PRS-RSRP measurements associated with the same higher layer parameter nr-DL-PRS-RxBeamIndex [17, TS 37.355] have been performed using the same spatial domain filter for reception if for each nr-DL-PRS-RxBeamIndex reported there are at least 2 DL PRS-RSRP/PRS-RSRPP measurements associated with it. The UE may be configured to measure and report, subject to UE capability, up to 24 DL PRS RSRPP for the first detected path on DL PRS resources associated with the same dl-PRS-ID. |
| Nokia/NSB | In out understanding, the intention of this discussion is whether or not to capture the note in the clear current agreement. We did not intend to discuss relaxation of the condition of reporting Rx beam index in this proposal. We think the above proposals should be separately discussed and we are not supportive of including other features which had not been agreed into this TP. |
| CATT-3 | We are open to discuss the relaxation of the condition of reporting Rx beam index, and think this new feature of relaxation may be useful for the adjacent beam reporting of RSRP/RSRPP. And we prefer to discuss the relaxation issue in proposal 2.1 to avoid duplicated discussions.  For this TP, we have another version for further discussion as follows, in order to match the note in the agreement better.  When the UE reports DL PRS-RSRP measurements ~~from one DL PRS resource set~~, for a DL PRS resource, ~~the UE may report~~ the reported multiple DL PRS-RSRP measurements associated with the same or different higher layer parameter *nr-DL-PRS-RxBeamIndex* may have~~with~~ the same or different timestamps.   |  | | --- | | Agreement:  The agreement from RAN1#106e on the number of DL PRS RSRP measurements per TRP is extended as follows:   * For UE-A DL-AOD, support reporting ~~more than 8~~ up to ~~16~~ N DL PRS RSRP measurements per TRP, where N is UE capability and candidate values include {16,24}. * For UE-A DL-AOD, support reporting ~~more than 8~~ up to ~~16~~ M first path PRS RSRP measurements per TRP, where M is a UE capability   + FFS: Values of M. Candidate values include {2,4,8,16,24}.   + FFS: Whether M is always equal to N * Note: Multiple RSRPs corresponding to same or different Rx Beam index should be able to be reported for a given PRS resource for same or different timestamps. * Note: the maximum number of DL PRS RSRP associated with the same Rx beam index is up to the UE implementation | |

#### Adjacent beam reporting

#### Summary and Text Proposal

Summary from [5]:

|  |
| --- |
| In RAN1#107-e meeting, the following agreement was achieved [1]:  **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:   + 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.   + UE may report PRS measurements only for the subset of PRS resources.   + 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  From option 1 in the above agreement, for each PRS resource, a subet of PRS resources (with [*DL-AOD-PRS resource-Subset*]) could be associated with. This is not adequatedly captured in the current specification of TS 38.214 [2]. It seems that only one subset of PRS resources is allowed to be configured for multiple PRS resources, instead of the one-to-one asscociation. Therefore, we prefer to revise the description related to option 1. |

----------------Start of TP for TS38.214---------------------

#### 5.1.6.5 PRS reception procedure

……

For each PRS resource, the UE may be configured, subject to UE capability, with [*DL-AOD-PRS resource-Subset*] that is associated with this PRS resource, where the subset of PRS resources associated with the PRS resource can be in the same or different PRS resource set than the PRS resource. The UE may include UE measurements for the subset of PRS resources in [*NR-DL-AoD-AdditionalMeasurementElement]* if the UE measurements of the associated PRS resource are reported, where the UE measurement can be DL PRS-RSRP and/or DL PRS-RSRPP. The UE may report DL PRS-RSRP and/or DL PRS-RSRPP measurements only for the subset of PRS resources. Subject to UE capability, the UE may be configured with higher layer parameter [DL-AOD Boresight direction] for each PRS resource.

----------------End of TP for TS38.214---------------------

#### First round of discussion

Companies are encouraged to provide comments in the table below regarding endorsing the TP in 2.1.7.3.1.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Huawei, HiSilicon | OK |
| ZTE | OK |
| LGE | Agree. |
| Ericsson | OK |
| CATT | Support. |
|  |  |

#### Second round of discussion

Based on the comments, the TP can be endorsed:

**Proposal 7.2: endorse the following TP for 38.214**

----------------Start of TP for TS38.214---------------------

#### 5.1.6.5 PRS reception procedure

……

For each PRS resource, the UE may be configured, subject to UE capability, with [*DL-AOD-PRS resource-Subset*] that is associated with this PRS resource, where the subset of PRS resources associated with the PRS resource can be in the same or different PRS resource set than the PRS resource. The UE may include UE measurements for the subset of PRS resources in [*NR-DL-AoD-AdditionalMeasurementElement]* if the UE measurements of the associated PRS resource are reported, where the UE measurement can be DL PRS-RSRP and/or DL PRS-RSRPP. The UE may report DL PRS-RSRP and/or DL PRS-RSRPP measurements only for the subset of PRS resources. Subject to UE capability, the UE may be configured with higher layer parameter [DL-AOD Boresight direction] for each PRS resource.

----------------End of TP for TS38.214---------------------

#### Conclusion for proposal 7.2:

The TP has been endorsed in the chair’s notes as follow:

|  |
| --- |
| The TP below for TS 38.214 section 5.1.6.5 is endorsed  ----------------Start of TP for TS38.214---------------------  **5.1.6.5      PRS reception procedure**  ……  For each PRS resource, the UE may be configured, subject to UE capability, with [*DL-AOD-PRS resource-Subset*] that is associated with this PRS resource, where the subset of PRS resources associated with the PRS resource can be in the same or different PRS resource set than the PRS resource. The UE may include UE measurements for the subset of PRS resources in [*NR-DL-AoD-AdditionalMeasurementElement]* if the UE measurements of the associated PRS resource are reported, where the UE measurement can be DL PRS-RSRP and/or DL PRS-RSRPP. The UE may report DL PRS-RSRP and/or DL PRS-RSRPP measurements only for the subset of PRS resources. Subject to UE capability, the UE may be configured with higher layer parameter [DL-AOD Boresight direction] for each PRS resource.  ----------------End of TP for TS38.214--------------------- |

#### Reporting and definition of DL PRS RSRPP

#### Summary and Text Proposal

Summary from [5]:

|  |
| --- |
| In RAN1#106bis-e [3], the following agreement on PRS-RSRPP has been achieved:  Agreement:  The measured path DL PRS RSRP for ith path delay is defined as the power of the received DL PRS signal configured for the measurement at the ith path delay of the channel response, and   * path DL PRS RSRP for 1st path delay is the power corresponding to the first detected path * FFS: Whether the path RSRP measurement is normalized with PRS RSRP. * FFS: Whether the definition of the ith path delay (other than i=1) is required. * Note: UE may choose to use a time window to compute path DL PRS RSRP by UE implementation (there is no impact to specifications managed by RAN1 for this) * Note: This does not imply that the path delay has to be reported in DL-AoD positioning * Send LS to RAN4 to check the details of the definition and feedback if they identify any update is necessary   According to the above agreement, PRS-RSRPP for ith path delay is defined as the power corresponding to ith detected path. At the UE side, the receiver needs to separate the signal power of each path from the total received signal power. Namely, PRS-RSRPP could be considered as a component of PRS-RSRP. Therefore, PRS-RSRPP should be defined in the same way as that of PRS-RSRP. According to the definition of PRS-RSRP in TS 38.215 [4], we propose the following TP for the modification of PRS-RSRPP definition: |

----------------Start of TP for TS38.215---------------------

### 5.1.35 DL PRS reference signal received path power (DL PRS-RSRPP)

|  |  |
| --- | --- |
| **Definition** | DL PRS reference signal received path power (DL PRS-RSRPP), is defined as linear average of the power contributions (in[W]) of the received DL PRS signal of the resrouce elements configured for the measurement at the i-th path delay of the channel response, where DL PRS-RSRPP for 1st path delay is the power contribution corresponding to the first detected path in time.  For frequency range 1, the reference point for the DL PRS-RSRPP shall be the antenna connector of the UE. For frequency range 2, DL PRS-RSRPP shall be measured based on the combined signal from antenna elements corresponding to a given receiver branch. |
| **Applicable for** | RRC\_CONNECTED,  RRC\_INACTIVE |

----------------End of TP for TS38.215---------------------

#### First round of discussion

Companies are encouraged to provide comments in the table below regarding endorsing the TP in 2.1.7.4.1.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Nokia/NSB | This should be discussed together with section 2.1.1.2 |
| CATT | We share the same view with Nokia/NSB that this TP should be discussed in section 2.1.1.2, since it is related to the definition of DL-PRS-RSRPP. |
| Huawei, HiSilicon | Agree with Nokia. |
| FL | We can close the discussion in this section and continue in 2.1.1.2 |

#### TPs for 38.214 regarding DL PRS RSRPP

#### Summary and Text Proposal

Summary from[14]

|  |  |  |
| --- | --- | --- |
| In RAN1#104-e and RAN1#106b-e we made the following agreements:   |  | | --- | | Agreement (RAN1#104-e)  Support enabling   * A UE to report one or more measurement instances (of RSTD, DL RSRP, and/or UE Rx-Tx time difference measurements) in a single measurement report to LMF for UE-assisted positioning, and * A TRP to report one or more measurement instances (of RTOA, UL RSRP, and/or gNB Rx-Tx time difference measurements) in a single measurement report to LMF, and * Each measurement instance is reported with its own timestamp   + 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   + FFS: N (including N=1) * FFS: Each TRP measurement instance can be configured with M SRS measurement time occasions   + FFS: M (including M=1) * FFS: details of signalling, procedures, and UE capability if any * FFS: whether and how to consider the additional enhancement related to measurement reporting of multi-paths and quality metric * Note 1: A measurement instance refers to one or more measurements, which can either be the same or different types, which are obtained from the same DL PRS resource(s), or the same UL SRS resource(s). * Note 2: This enhancement has no intention to change the mapping of measurement types to Rel-16 positioning techniques and no intention to introduce new positioning techniques either.   Agreement (RAN1#106b-e)  Subject to UE capability, support LMF to explicitly request UE to report the measurement with either M-sample or 4-sample, if RAN4 has supported M-sample measurement.   * FFS signalling details.   Agreement (RAN1#106b-e)  For the PRS processing sample number M, at least M = 1 is supported. |   The above agreements were captured in TS38.214, however DL PRS RSRPP is not included as part of the supported measurements. Additionally in RAN1#107-e following agreement was made:   |  | | --- | | Agreement   * Support the LMF to request DL PRS-RSRPP together with timing measurement as part of DL-TDOA and multi-RTT reporting enhancements   + Note: This applies to the first path and also to additional paths. * Support the LMF to request UL SRS-RSRPP together with timing measurement as part of UL-TDOA and multi-RTT reporting enhancements   + Note: This applies to the first path and also to additional paths. |   this also requires adding DL PRS-RSRPP to the list of DL RSTD, DL PRS-RSRP and UE Rx-Tx measurements to the parts in the TP below. |

**Text Proposal for 38.214:**

============================ Unchanged part omitted ==========================

The UE may be indicated by the network that DL PRS resource(s) can be used as the reference for the DL RSTD, DL PRS-RSRP, DL PRS RSRPP and UE Rx-Tx time difference measurements in a higher layer parameter *nr-DL-PRS-ReferenceInfo*.

============================ Unchanged part omitted ==========================

============================ Unchanged part omitted ==========================

For the DL RSTD, DL PRS-RSRP, DL PRS RSRPP and UE Rx-Tx time difference measurements the UE can report an associated higher layer parameter *nr-TimeStamp*. The *nr-TimeStamp* can include the *dl-PRS-ID*, the SFN and the slot number for a subcarrier spacing. These values correspond to the reference which is provided by *nr-DL-PRS-ReferenceInfo*.

============================ Unchanged part omitted ==========================

============================ Unchanged part omitted ==========================

The UE may be configured to report one or more measurement instances, each with its own timestamp, on DL RSTD, DL PRS-RSRP, DL PRS RSRPP and/or UE Rx-Tx time difference measurements, in a single measurement report.

============================ Unchanged part omitted ==========================

============================ Unchanged part omitted ==========================

The UE may be requested, subject to UE capability, to measure and report the DL RSTD, DL PRS-RSRP, DL PRS RSRPP or UE Rx-Tx time difference measurements with either 1 or 4 samples, as defined in [11, TS 38.133], via higher layer parameter [*numOfSamples-perMeasurement]* [17, TS 37.355].

============================ Unchanged part omitted ==========================

#### First round of discussion

Companies are encouraged to provide comments in the table below regarding endorsing the TPs in 2.1.7.5.1.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Nokia/NSB | We are generally fine with the second and the fourth. We think the first and the third one are new featue and we haven’t discussed yet. In the first TP, it is uncelar what the reference resource for PRS RSRPP means. |
| Fraunhofer | Ok to discuss if it is needed to capture DL-RSRPP in TP1.  Supoort TPs 2,3 and 4. |
| CATT | Support the TP2/3/4 in principle, but the “DL PRS RSRPP” should be changed to “DL PRS-PRSPP”(i.e., adding one additional dash) to keep the consistency.  For TP1, it seems that this TP is not needed. |
| CATT-2 | For the TP3, a same TP is being discussed in section 3.5.5 in AI 8.5.5 as follows, we prefer to merge the two discussions.   |  | | --- | | The UE may be configured to report one or more measurement instances, each with its own timestamp, on DL RSTD, DL PRS-RSRP, DL PRS-RSRPP and/or UE Rx-Tx time difference measurements, in a single measurement report. | |
| FL | It was proposed to endorsed TP. 2 and TP4 during the email discussion. Since there was at least one company opposed to the TP2 (vivo), we can continue the discussion. |

## LS from R1-2200905

From the chairman decision, the LS from R1-2200905 will be treated as part of agenda item 8.5.3. the LS content is copied below for convenience:

|  |
| --- |
| **1. Overall Description:**  RAN4 thanks RAN1 for the LS. RAN4 has discussed the definition of the path DL PRS RSRP measurement and RAN4 would like to provide following feedback. RAN4 would like to inform RAN1 that RAN4 is discussing path DL-PRS RSRP for i-th path delay.  The PRS-RSRPP can be reported in ways below :   * RAN4 understands that PRS-RSRPP should be defined as the path RSRP per RE, in the same way PRS-RSRP is defined as power per RE. RAN4 respectfully asks RAN1 to confirm if this understanding is correct. * PRS-RSRPP may be reported by reusing absolute and differential PRS-RSRP measurement report mapping tables in TS38.133 clause 10.1.24.3.1 and 10.1.24.3.2 respectively. * When differential reporting is used, PRS-RSRPP is reported as the difference in dB with respect to a reference measurement. RAN4 understands that it is up to RAN1/2 to decide what reference measurement would be for the PRS-RSRPP differential reporting.   RAN4 concludes that these ways are possible to support PRS-RSRPP in Rel-17.    **2. Actions:**  **To RAN WG1 & WG2 group.**  **ACTION:** RAN4 kindly requests RAN1/2 to take the above information into consideration in the further specification work, and respectfully asks to inform RAN4 if RAN1/2 finds any issue or update for RAN4 understanding. |

It is the FL understanding that the first bullet of the LS is treated as part of the discussion on proposal 1.1. the second and third bullet is treated as part of the discussion in propoasal 1.2. based on the conclusions of the discussions for these proposal, RAN1 can draft a reply LS to RAN4/RAN2 as an update on the issues.

Companies are encouraged to comment on the table below if discussions on additional proposals beside 1.1 and 1.2 need to be started.

|  |  |
| --- | --- |
| **Company** | **Comment** |
|  |  |

## Other aspects

Two proposals mention the use of PRU. This the discussion is already going on in AI 8.5.1, it is propose to keep it in a single AI. Regarding the issue of beam orientation error, there is only one contribution discussing the issue and we therefore suggest to downprioritize it.

|  |  |
| --- | --- |
| Source | Proposal |
| [6] | **Proposal 4:** RAN1 to introduce/specify correction mechanism of beam orientation errors to improve the positioning accuracy achievable with DL-AoD. Including:   * UE-based positioning: the beam offset (BO) could be signaled to the UE, as either an indicator, e.g. low/medium/high, each specifying an error range or as a specific value computed by the network * UE-assisted positioning: LMF should be aware of the BO and compensate it when computing the position estimate. * Signaling aspects:   + LMF signals to TRPs that a BO beam re-tuning is needed. The BO correction may be explicitly signalled to the TRP by the LMF; alternatively, the LMF may send a Boolean indication that a BO recomputation and adjustement is needed.   + UE measurement reports to facilitate BO identification and potential correction.   **Proposal 5:** RAN1 to specify support for enabling a PRU to support configuration by the network to help with beam offset estimation, among other parameters. In particular, RAN1 should further investigate methods and signaling required to enable the selected reference device to ability of reference device to determine beam offset errors are present. |
| [7] | Proposal 4   * + **For Positioning Reference Unit (PRU), if its antenna orientation is known, define the uncertainty range for the DL-AOA/ZOA as follows:**     - **Expected azimuth angle of arrival as (φDL-AOA - Δ*φDL-AOA*/2, *φDL-AOA* + Δ*φDL-AOA*/2)**       * ***φDL-AOA* - expected azimuth angle of arrival, Δ*φDL-AOA* – uncertainty range for expected azimuth angle of arrival**     - **Expected zenith angle of arrival as (*θDL-ZOA* - Δ*θDL-ZOA*/2, *θDL-ZOA* + Δ*θDL-ZOA*/2)**       * ***θDL-ZOA* - expected zenith angle of arrival, Δ*θDL-ZOA* - uncertainty range for expected zenith angle of arrival**     - **The Global Coordinate System (GCS) is supported for DL AOA/ZOA assistance information indication**     - **Granularity of 0.1 degrees is applied for the expected DL-AOA (*φDL-AOD*), expected DL-ZOA (*θDL-ZOD*) and the corresponding uncertainty values** |

#### Comments

|  |  |
| --- | --- |
| **Company** | **Comment** |
|  |  |

1. Conclusion

TBD

1. References
2. R1-2200922, Maintenance of DL-AoD enhancements, Huawei, HiSilicon
3. R1-2201095, Maintenance on enhancements for DL-AoD method, vivo
4. R1-2201195, Remaining issues on DL-AoD positioning solutions, ZTE
5. R1-2201241, Enhancements for DL-AoD positioning, OPPO
6. R1-2201363, Remaining issues on enhancements for DL-AoD positioning method, CATT
7. R1-2201636, Maintenance of enhancing DL AoD, Nokia, Nokia Shanghai Bell
8. R1-2201699, Maintenance of Rel.17 NR positioning solutions for DL-AoD method, Intel Corporation
9. R1-2201826, Remaining issues for DL-AoD positioning solutions, InterDigital, Inc.
10. R1-2201858, Remaining issues on DL-AoD enhancements, CMCC
11. R1-2201946, Remaining issues on accuracy improvements for DL-AoD positioning solutions, Xiaomi
12. R1-2202016, Discussion on accuracy improvements for DL-AoD positioning solutions, Samsung
13. R1-2202142, Maintenance on Potential Enhancements for DL-AoD positioning, Qualcomm Incorporated
14. R1-2202293, Discussion on accuracy improvement for DL-AoD positioning, LG Electronics
15. R1-2202367, Maintenance for Rel-17 DL-AoD, Fraunhofer IIS, Fraunhofer HHI
16. R1-2202371, DL-AoD Positioning Maintenance, Lenovo, Motorola Mobility
17. R1-2202391, Enhancements of DL-AoD positioning solutions, Ericsson