**3GPP TSG RAN WG1 #110 R1-22NNNNN**

**Toulouse, France, August 22nd – 26th, 2022**

**Source: Moderator (Ericsson)**

**Agenda item: 8.5**

**Title: Feature Lead Summary#1 for Maintenance of NR positioning Enhancements (AOD topics)**

**Document for:**  **Discussion and Decision**

# Introduction

This document presents a summary of the proposals in contributions submitted to AI 8.5 for Rel17 maintenance of NR positioning ehancements. The following proposals have been identified as relevant for the AOD topic:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Tdoc Number | Title | Source | Discussion/CR | Relevant proposals  |
| [**R1-2205773**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2205773.zip) | Maintenance of Rel-17 positioning | Huawei, HiSilicon | discussion | P1 |
| [**R1-2205774**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2205774.zip) | Correction to the condition of Rx beam index reporting | Huawei, HiSilicon | draftCR | CR for 05773 |
| [**R1-2205906**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2205906.zip) | Draft CR on DL-AOD positioning measurement for 38.214 | ZTE | draftCR | CR for 05912 |
| [**R1-2205912**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2205912.zip) | Discussion on some remaining issues for NR positioning | ZTE | discussion | P2 |
| [**R1-2205907**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2205907.zip) | Alignment CR on positioning for 38.214 | ZTE | draftCR |   |
| [**R1-2206368**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206368.zip) | Correction on PRS reception procedure | CATT | draftCR |   |
| [**R1-2206486**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206486.zip) | Maintenance of NR Positioning Enhancements | Nokia, Nokia Shanghai Bell | discussion | P1, P2, P3 |
| [**R1-2206489**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206489.zip) | Correction on PRS RSTD and PRS RSRPP reporting | Nokia, Nokia Shanghai Bell | draftCR | CR for P1/P2 in 06486 |
| [**R1-2206742**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206742.zip) | Correction on accuracy improvements for NR positioning | vivo | draftCR | CR for P2 in 064744 |
| [**R1-2206744**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2206744.zip) | Discussion on accuracy improvements for NR positioning | vivo | discussion | P2 |
| [**R1-2207643**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207643.zip) | Correction of Rx diversity option for DL-PRS RSRPP reporting | Huawei, HiSilicon | draftCR |   |

**Contact information**

**To facilitate remote discussions, companies are kindly requested to provide an email address for the delegate handling the discussions for AI 8.5**

|  |  |  |
| --- | --- | --- |
| **Company** | **Point of contact** | **Email address** |
| Ericsson | Florent Munier | Florent.munier@ericsson.com |
| vivo | Yuanyuan Wang | yuanyuan.wang.txyj@vivo.com |
| Huawei | Su Huang | Huangsu2@huawei.com |

# Discussion

## Rx beam index

### Background

In [1] and its companion CR in [2], it is mentioned that the description of the Rx beam index reporting in both LPP and 38.214. this topics was discussed during RAN1#109e but did not converge due to lack of time.

The following proposal is provided by  [1]

***Proposal 1: Send an LS to RAN2 informing that the following change to the field description of nr-DL-PRS-RxBeamIndex is preferred from RAN1 perspective.***

|  |
| --- |
| ***nr-DL-PRS-RxBeamIndex***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 or at least two DL-PRS RSRPP measurements from the DL-PRS Resource Sets on a positioning frequency layer of the TRP have been made with the same RX beam by the target device; otherwise it is not present. |
|  |

### First round of discussion

 Companies are encouraged to provide their view on the issue highlighted in proposal 1 in [1] and the companion CR in [2]

|  |  |
| --- | --- |
| Company | comment |
| ZTE | We support this draft CR. It should be possible that two PRS resources across two resource sets use different Rx beams. The motivation of the restriction in the current spec for Rel-17 is unclear for us.  |
| Qualcomm | Even though we acknowledge that it should be allowed the 2 PRS resources to be from 2 different sets, we are worried we might create a backward compatibility issue: when a rel-17 UE supports Rel-16 DL-AoD (RSPR measurement reporting) but with this new change, if it reports RSRP for 2 resources across 2 sets, an LMF with the previous specification will not expect such reporting since the specification was not allowing it. Strictly speaking we think that this change, needs a UE capability flag: Reporting of RSRPs We are enhancing a Rel-16 feature in a non-backward compatible sense, and should not be denoted as a “CR only”. The other option is to say that: when the UE reports both "RSRP and RSRPP” or RSRPP only (but not RSRP), then, the new UE behavior is expected. For example, something like: When the UE reports DL PRS-RSRPP only, or DL PRS-RSRP and DL PRS-RSRPP measurements from one DL PRS resource set, the UE may indicate which DL PRS-RSRP or DL PRS-RSRPP 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 or at least 2 DL PRS-RSRPP measurements associated with it within the DL PRS resource sets on a positioning frequency layer with the same *dl-PRS-ID*. |
| vivo | We acknowledge DL PRS-RSRPP should be added, but don’t think associated with different sets is essential since it is a further enhancement. So, we propose only adding DL PRS-RSRPP measurements in TS 38.214, for exampleWhen the UE reports DL PRS-RSRP measurements or DL-PRS RSRPP measurements from one DL PRS resource set, the UE may indicate which DL PRS-RSRP measurements or DL-PRS RSRPP 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 or at least two DL-PRS RSRPP measurements associated with it within the DL PRS resource set.  |
| CATT | We are fine with the CR. The DL-PRS RSRPP measurements was missed in the current specs and it seems that the RSRP/RSRPP measurements should not be limited to the same PRS resource set. |
| Ericsson | We agree with the backward compatibility problem highlighted by Qualcomm. We think it could be avoided with instead allowing reported from two separate sets only for RSRPP or with RSRPP together with RSRP included. The case of RSRP alone (legacy case) should be excluded.  |
| Huawei, HiSilicon | Support the change.To Qualcomm/Ericsson: We agree that LMF may not be aware of the UE access stratum releases unlike gNB, but we do not see any inter-operatiblity issue for the change. Imagine a LMF implemented according to Rel-16 specification receives a (Rel-17) UE reporting RSRP measurement with the Rx beam index that is not supposedly applicable to a Rel-16 UE (due to the condition not satisfied), LMF could simply discard the Rx beam index, similar to any Rel-17 fields (e.g. the UE capability fields) that cannot be understood by the LMF. |
| Nokia/NSB | Similar view to Ericsson and QC.  |

## Multiple RSRP/RSRPP reporting

### background

In [3], it is observed that 38.214 does not capture that multiple measurements may be reported for a given PRS resource for the same or different time stamp. The following is proposed, together with a CR proposal in [4]

***Proposal 2:*** *To align with RAN1’s agreements, allow multiple RSRP or RSRPP measurements for a single PRS resource in TS 38.214.*

### First round of discussion

 Companies are encouraged to provide their view on the issue highlighted in proposal 2 in [3] and the companion CR in [4]

|  |  |
| --- | --- |
| Company | Comment |
| ZTE | Support  |
| Qualcomm | OK |
| vivo | OK |
| CATT | OK |
| Ericsson | OK |
| Huawei, HiSilicon | OK, but the CR should be [3] instead of [4] |

## 38.214 alignment CR

### background

In [5], an alignment CR is provided to align missing reference to clauses and parameter names that were still in brackets during RAN1#109e.

### First round of discussion

 Companies are encouraged to provide their view on the CR in [5]

|  |  |
| --- | --- |
| Company | Comment |
| ZTE | Support  |
| Ericsson | OK |
| Huawei, HiSilicon | We think that all alignment CRs should be merged into a single editor CR, and ZTE’s CR can be considered as the baseline for this WI, including other feature (TEG, Latency).One comment is that the following change does not seem to be parameter name alignment, and should be treated separately. We do not think this change is needed.If the UE is to measure the DL PRS resource outside the active DL BWP or with a numerology different from the numerology of the active DL BWP, the measurement should be made during a configured measurement gap. |
| Nokia/NSB | Agree with Huawei.  |

## Measurements on the same Rx beam with different timestamps

### background

In [6], a CR is provided to capture that measurements may be reported for the same Rx beam index for the same or different timestamps.

### First round of discussion

 Companies are encouraged to provide their view on the CR in [6]

|  |  |
| --- | --- |
| Company | Comment |
| ZTE | This issue seemed discussed before. We are fine to support it to make the spec clear.  |
| Qualcomm | OK |
| vivo | It's been discussed before, it may not need to be revisited |
| CATT | Support. This CR match the first note in the previous agreement in RAN1#106bis-e as follows, so we support it to make the spec clear.

|  |
| --- |
| Agreement:The agreement from RAN1#106-e 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
 |

 |
| Ericsson | OK |
| Huawei, HiSilicon | No need to revisit it. |

## RSRPP and RSTD reporting for the same path

### background

In [7], it is observed that although RSRPP is defined for the first detected path, RSTD reference path of measurement is not defined and is up to implementation. The following is proposed in order to align the measurements when they are reported together:

**Observation 1**: The current RSRPP and RSTD definitions could lead to the LMF misunderstanding the reported values as the “paths” may not be defined the same way for both measurements.

To address this problem, it should be ensured that the UE has the same understanding of paths when reporting to the LMF. As such we make the following proposal

**Proposal 1**: When the UE reports both RSTD and RSRPP measurements it should use the same detected paths for both measurements in the reporting.

**Proposal 2**: Agree to the CR in R1-2206489.

### First round of discussion

 Companies are encouraged to provide their view on proposal 1 in [7] and the CR in [8]

|  |  |
| --- | --- |
| Company | Comment |
| ZTE | This issue seemed discussed before. We are fine to support it to make the spec clear.  |
| Qualcomm | We don’t agree with the CR. We should leave it up to UE implementation. Note that already for RSTD we say: “Multiple DL PRS resources can be used to determine the start of one subframe from a TP.”, so really a UE can make a call what is considered “first detected path”, and we should leave the freedom to the UE.  |
| vivo | The same view as QC |
| Ericsson | We agree with the CR. Even if, as QC mentions, the choice of first detected path is up to UE implementation, we think that it would make little sense to report RSRPP if it is not connected to the RSTD.  |
| Huawei, HiSilicon | We want to understand whether this is related to DL-TDOA positioning with multi-path reporting or DL-TDOA + DL-AoD hybrid positioning.If it is the former, we think that it should be inherent in the current LPP structure.If it is the latter, we do not support this “cross-positioning method” indication. |
| Nokia/NSB | To QC, we are not proposing that the UE is forced to decide what the first path is in any specific way or that the current spec you quote would be changed somehow. What we are saying is that if the UE is reporting both RSTD and RSRPP measurements that the UE should use the same first path (however the UE determines that is totally up to UE implementation). Without the CR the LMF has no way to know that the RSTD path and RSRPP path are the same and therefore this information is totally useless at the LMF as we can’t trust it. To Huawei, we are thinking of the latter. We are okay to drop the final line of the CR and to just agree to the first line as this is what we feel is the most essential part (see our reply to QC above). So we would just add *If the UE is configured to report both PRS RSTD and PRS RSRPP measurements, the same detected paths for both measurements should be used in the reporting.*to the spec. Would that be an acceptable compromise to Huawei?  |

## PRS RSRP request from previous measurements

### background

In [7] it is proposed to allow the LMF to request RSRP measurements from a UE which previously reported RSRPP. The following motivation is given:

|  |
| --- |
| RAN1 finalized how to report RSRPP. For DL-AoD, DL-TDOA, and Multi-RTT technique, the UE can report DL PRS RSRPP value as an absolute value for a PRS resource without reporting DL PRS RSRP for the PRS resource. It might be reasonable to reduce the reporting signalling overhead and might be fine in case there is no ambiguity from the LMF. However, even if a specific PRS resource shows the maximum value of the 1st path PRS-RSRPP between multiple PRS resources, it does not guarantee that the transmission beam direction of this PRS resource is a LoS direction, and LMF may need DL PRS RSRP together. Even for timing measurement-based techniques, the LMF can utilize PRS RSRP and PRS RSRPP information for the TRP selection algorithm. In the current LPP spec, reporting the time-stamp is mandatory. In case the UE reported DL PRS RSRPP for the PRS resources with a specific time-stamp, the LMF may be able to request UE to report DL PRS RSRP for PRS resources at the time-stamp if it needs.**Proposal 3**: The UE can be requested to report PRS RSRP for specifically indicted PRS resources and previous time-stamp(s), if the UE reported DL PRS RSRPP for PRS resources and the time-stamp(s). |

### First round of discussion

 Companies are encouraged to provide their view on proposal 3 in [7]

|  |  |
| --- | --- |
| Company | Comment |
| ZTE | Not support, it is not good to introduce new feature at such late stage.  |
| Qualcomm | Do not introduce new features at this point |
| vivo | Not support |
| Ericsson | Do not support, this is an enhancements.  |
| Huawei, HiSilicon | In general, this creates correlation in two separate UL LPP messages (ProvideLocationInformation), and should not be supported. |
| Nokia/NSB | We are okay to drop this proposal.  |

##  PRS RSRPP Reporting

### background

In [9], it is observed that 38.214 mentions that all 24 path RSRPs are reported via *nr-DL-PRS-FirstPathRSRP-Result*, while RAN2 specification correctly captures that the path may also be reported via *nr-DL-PRS-FirstPathRSRP-ResultDiff.* . in [10] and in proposal 2, a CR is proposed to correct the issue:

|  |  |
| --- | --- |
| * ***Adopt the following modifications into TS 38.214 for PRS RSRPP reporting .***

|  |
| --- |
| < Unchanged parts are omitted >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. The UE may be configured to measure ~~and optionally report via higher layer signaling~~ *~~nr-DL-PRS-FirstPathRSRP-Result~~*~~,~~ 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 UE may be configured to optionally report a differential DL RSRPP for a PRS resource with reference to [*nr-DL-PRS-FirstPathRSRP-Result*] and/or a differential DL PRS RSRP with reference to [*nr-DL-PRS-RSRP-Result*] via higher layer parameter [*NR-DL-AoD-AdditionalMeasurementElement*].< Unchanged parts are omitted > |

 |

### First round of discussion

 Companies are encouraged to provide their view on proposal 2 in [9] and the CR in [10].

|  |  |
| --- | --- |
| Company | Comment |
| ZTE | OK |
| Qualcomm | We prefer to keep the “optionally report”The UE may be configured to measureand optionally report ~~via higher layer signaling~~ *~~nr-DL-PRS-FirstPathRSRP-Result~~*~~,~~ 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*. |
| vivo | Okay with QC version |
| CATT | We are fine with QC’s version. |
| Ericsson | Okay with QC version |
| Huawei, HiSilicon | OK with Qualcomm’s version. |
| Nokia/NSB | Okay with QC version.  |

##  Rx Diversity option for DL PRS RSRPP

### background

in [11], it is observed that 38.215 does not capture the Rx diversity rules for DL AoD which have been agreed by RAN4. The following changes are proposed:

========================= Unchanged parts =========================

### 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 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.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.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 included in the higher layer parameter *NR-DL-AoD-MeasElement* for the first and additional measurements shall be provided for the same receiver branch(es) as applied for DL PRS-RSRP measurements. |
| **Applicable for** | RRC\_CONNECTED,RRC\_INACTIVE |

========================= Unchanged parts =========================

### First round of discussion

 Companies are encouraged to provide their view on the CR in [11].

|  |  |
| --- | --- |
| Company | Comment |
| ZTE | OK with slight change as follows~~For~~based on the same receiver branch(es) |
| vivo | OK |
| CATT | OK |
| Ericsson | OK |
| Huawei, HiSilicon | We slightly prefer the original one over ZTE’s version, because it is written aligned with UL SRS-RSRPP.

|  |  |
| --- | --- |
| **Definition** | UL SRS reference signal received path power (UL SRS-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 the received UL SRS signal configured for the measurement, where UL SRS-RSRPP for 1st path delay is the power contribution corresponding to the first detected path in timeThe reference point for UL SRS-RSRPP shall be:- for type 1-C base station TS 38.104 [9]: the Rx antenna connector,- for type 1-O or 2-O base station TS 38.104 [9]: based on the combined signal from antenna elements corresponding to a given receiver branch- for type 1-H base station TS 38.104 [9]: the Rx Transceiver Array Boundary connector.For frequency range 1 and 2, if receiver diversity is in use by the gNB for UL SRS-RSRPP measurements:- The reported UL SRS-RSRPP value for the first and additional paths shall be provided for the same receiver branch(es) as applied for UL SRS-RSRP measurements, or- The reported UL SRS-RSRPP value for the first path shall not be lower than the corresponding UL SRS-RSRPP for the first path of any of the individual receiver branches and the reported UL SRS-RSRPP for the additional paths shall be provided for the same receiver branch(es) as applied UL SRS-RSRPP for the first path. |

 |
| Qualcomm | OK |

Conclusions

TBD

References

1. R1-2205773, Maintenance of Rel-17 positioning, Huawei, HiSilicon
2. R1-2205774, Correction to the condition of Rx beam index reporting, Huawei, HiSilicon
3. R1-2205906, Draft CR on DL-AOD positioning measurement for 38.214, ZTE
4. R1-2205912, Discussion on some remaining issues for NR positioning, ZTE
5. R1-2205907, Alignment CR on positioning for 38.214, ZTE
6. R1-2206368, Correction on PRS reception procedure, CATT
7. R1-2206486, Maintenance of NR Positioning Enhancements, Nokia, Nokia Shanghai Bell
8. R1-2206489, Correction on PRS RSTD and PRS RSRPP reporting, Nokia, Nokia Shanghai Bell
9. R1-2206742, Correction on accuracy improvements for NR positioning, vivo
10. R1-2206744, Discussion on accuracy improvements for NR positioning, vivo
11. R1-2207643, Correction of Rx diversity option for DL-PRS RSRPP reporting, Huawei, HiSilicon