**3GPP TSG RAN WG1 #109-e R1-22NNNNN**

**e-Meeting, May 9th – 20th, 2022**

**Agenda item:** **8.5.1**

**Source: Moderator (Ericsson)**

**Title: Moderator Summary for [109-e-R17-ePos-03] maintenance on accuracy improvements for UL-AoA and DL-AoD positioning solutions**

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

## Introduction

This summary documents the email discussion for the maintenance of accuracy improvements for UL-AoA and DL-AoD positioning solutions, as per the following chairman decision:

[109-e-R17-ePos-03] Email discussion under 8.5.1 for maintenance on accuracy improvements for UL-AoA and DL-AoD positioning solutions, for issues 2-2, 3-1, 3-2, 3-3, 3-5, 3-6, 3-8, 3-10 and 3-15 in R1-2205097 – Florent (Ericsson)

* 1st check point: May 13 (any RRC impact by May 12)
* Final check point: May 18

## Discussion

## Issue #2-2 LS response for Rx diversity of first path UL SRS RSRPP

Options for reporting of UL SRS RSRPP Rx diversity were agreed in RAN1 #108e as follow:

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| --- |
| Agreement  Apply the following changes to the definition for UL SRS-RSRPP in the previous agreement:  Definition  UL SRS reference signal received path power (UL SRS-RSRPP) is defined as the power of the received UL SRS signal configured for the measurement at the i-th path delay of the channel response, where UL SRS-RSRPP for 1st path delay is the power corresponding to the first detected path.   * Working assumption: For frequency range 1, the reference point for the UL SRS-RSRPP shall be the antenna connector of the gNB. For frequency range 2, UL SRS-RSRPP shall be measured based on the combined signal from antenna elements corresponding to a given receiver branch. * FFS: For frequency range 1 and 2, if receiver diversity is in use by the gNB, the reported UL SRS-RSRPP value shall not be lower than the corresponding UL SRS-RSRPP of any of the individual receiver branches * FFS: Note: First and additional paths RSRP, when provided in the same report, use the same RX branch(es) selected for the first arrival path and for the UL SRS-RSRP if the UL SRS-RSRP is reported   + FFS: whether/how to capture the note in the specifications   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) |

In R1-2203040, RAN3 sent the following question for clarification:

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| --- |
| RAN3 will define the value range of the UL-SRS-RSRPP measurement for the i-th path as an INTEGER (0..126).  Some companies question whether the information on the RX Diversity options, captured as a note in the RAN1 agreement, need to be signalled to LMF along with the UL-SRS-RSRPP measurement.  RAN1 to feedback if information on the Rx Diversity options needs to be signalled to LMF and to comment on the UL-SRS-RSRPP value range, if needed? |

It is thus proposed to discuss whether the Rx diversity option for UL SRS RSRPP imply any signaling of the options.

## First round of discussion

**Question 2.1.1: should the use of option 1 or option 2 be signaled to the LMF when reporting UL SRS RSRPP?**

Companies are encouraged to respond in the table below:

**Question 2.1.1:**

|  |  |
| --- | --- |
| company | comment |
|  |  |

## Issue #3-1 reporting of PRS RSRPP and PRS RSRP for the first path from different resources

In [1], proposal 5 suggests supporting reporting RSRPP and RSRP for the first path from different resources:

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| --- |
| **Proposal 5:** For DL-AoD, introduce a separate DL PRS resource set ID and resource ID for the first RSRPP measurement when the resource is not same as that for the first RSRP measurement.  ● The additional RSRPP measurement still takes (0..30) as the reporting range in reference to the first RSRPP measurement. |

## First round of discussion

We can start by discussing the proposal as it is in [1] and see what update it may need:

**Proposal 2.2.1: For DL-AoD, introduce a separate DL PRS resource set ID and resource ID for the first RSRPP measurement when the resource is not same as that for the first RSRP measurement.**

* **The additional RSRPP measurement still takes (0..30) as the reporting range in reference to the first RSRPP measurement.**

Companies are encouraged to respond in the table below:

**Proposal 2.2.1**

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| --- | --- |
| company | comment |
|  |  |

## Issue #3-2 TP clarifying reception of the DL PRS-RSRPP in 38.214

The following TP was proposed in [4] as a clarification for 38.214:

**TP2.3:**

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| --- |
| ----------------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 multiple DL PRS-RSRP measurements for a DL PRS resource, the multiple DL PRS-RSRP measurements, which can be associated with the same or different higher layer parameter nr-DL-PRS-RxBeamIndex, may have 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--------------------- |

## First round of discussion

Companies are encouraged to comment on the TP2.3 in the table below:

**TP2.3**

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| --- | --- |
| company | comment |
|  |  |

## Issue #3-3 maximum number of PRS resources in a subset

In [6] the authors propose to limit the maximum number of PRS resources in a subset to 8. Previous discussion on the issue during RAN1#108e did not converge.

## First round of discussion

We can start the discussion with the proposal in [6]. In order to respond to the questions asked during the UE feature discussion in RAN1#108e, we can also discuss how each PRS resource is identified. At the end of RAN1#108e, the latest version of the proposal was to include PRS resource set ID and resource ID.

**Proposal 2.4.1:**

* **The maximum number of PRS resources in a PRS subset is 8.**
* **The number of resources within a subset transmitted to UE should not be larger than the maximum number of resources that UE reporting**
* **Each PRS resource in the PRS subset is identified with a PRS resource set ID and PRS resource ID**

Companies are encouraged to comment on proposal 2.4.1 in the table below:

**Proposal 2.4.1:**

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| --- | --- |
| company | comment |
|  |  |

## Issue #3-5 Reference for additional path DL PRS RSRPP

In [9], the reference for additional paths DL PRS RSRPP is discussed. It is proposed to support differential reporting of additional path DL PRS RSRPP using the DL PRS RSRPP of the first path for the same resource. The proposal corresponds to alt.2 of the following proposal in RAN1#108:

|  |
| --- |
| **Proposal 4.1-C**   * Support reporting differential RSRPP for the PRS-RSRPP measurement in DL-TDoA and multi-RTT for at least the additional paths.   + Alt. 1: The reference for all the additional paths PRS-RSRPPs is the PRS-RSRPP of the first path associated with the nr-RSTD-r16 or nr-UE-RxTxTimeDiff-r16 measurement.   + Alt. 2: The reference for the additional path PRS-RSRPP is the PRS-RSRPP of the first path of the same PRS resource as the additional path PRS-RSRPP. |

## First round of discussion

We can continue the discussion from RAN1#108e. Both alternatives in the proposal from RAN1#108e can work. Looking at the current use of differential reporting in LPP, alt-1 is closer to what is done for additional path and additional measurements in 37.355.

**Proposal 2.5.1: Support reporting differential RSRPP for the PRS-RSRPP measurement in DL-TDoA and multi-RTT for at least the additional paths.**

* + **Alt. 1: The reference for all the additional paths PRS-RSRPPs is the PRS-RSRPP of the first path associated with the nr-RSTD-r16 or nr-UE-RxTxTimeDiff-r16 measurement.**
  + **Alt. 2: The reference for the additional path PRS-RSRPP is the PRS-RSRPP of the first path of the same PRS resource as the additional path PRS-RSRPP.**

Companies are encouraged to comment their preferred alternative in proposal 2.5.1 in the table below:

**Proposal 2.5.1:**

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| --- | --- |
| company | comment |
|  |  |

## Issue #3-6 TP for 38.214 regarding the AOD window

The following TP was proposed in [13] as a clarification for 38.214:

**TP2.6**

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| --- |
| TP for TS 38.214:  ***Reason for change:*** The text specificaton on expected DL-AoD/AoA is not complete  ***Summary of change:*** Add text to specify the method of calculating range of expected DL-AoD/AoA.  Consequences if not approved: Ambiguity in UE behavior. |
| 5.1.6.5 PRS reception procedure  <Unchanged parts are omitted>  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 with granularity of 1 degree. The UE may be provided with expected DL-AoA/ZoA and uncertainty range(s) of the expected DL-AoA/ZoA with granularity of 1 degree. The uncertainty range(s) of the expected DL-AoD/DL-AoA may be configured within [0, 60]. The uncertainty range(s) of expected DL-ZoD/DL-ZoA may be configured within [0, 30]. The UE may calculate the range of expected DL-AoD/DL-ZoD as (expected DL-AoD/ZoD – uncertainty range of expected DL-AoD/ZoD/2, expected DL-AoD/ZoD + uncertainty range of expected DL-AoD/ZoD/2) and may calculate the range of expected DL-AoA/DL-ZoA as (expected DL-AoA/ZoA – uncertainty range of expected DL-AoA/ZoA/2, expected DL-AoA/ZoA + uncertainty range of expected DL-AoA/ZoA/2)  <Unchanged parts are omitted> |

## First round of discussion

Companies are encouraged to comment on the TP2.6 in the table below:

**TP2.6**

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| --- | --- |
| company | comment |
|  |  |

## Issue #3-8 Proposed correction to the PRS RSRPP definition

[1] and [24] observe that the definition of DL PRS RSRPP does not correctly capture the fact that the measurement should be performed at the first path delay in the following sentence

**38.215:**

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| --- |
| 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. |

[1] propose to add the following sentence to complete the definition:

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| --- |
| The channel response at the i-th path delay on a resource element corresponds to the response on the resource element of a shifted version of the channel where the i-th path delay is shifted to 0. |

[24] proposes to reword the definition

|  |
| --- |
| DL PRS reference signal received path power (DL PRS-RSRPP) is defined as the power of the PRS channel response at the ith path delay, where   * The PRS channel response is obtained by a time-domain transform of the resource elements that carry the received DL PRS signal configured for the measurement * DL PRS-RSRPP for 1st path delay is the power contribution corresponding to the first detected path in time. |

## First round of discussion

It is proposed to start the discussion by checking whether any change is needed and if so, what change should be implemented.

**Question 2.7.1: should the DL PRS RSRPP in 38.215 be modified, and if so, which of the following option for changes is preferred:**

* **Alt 1: proposal in [1]**
* **Alt2: proposal in [24]**
* **Alt3: other proposal (please specify in your comment)**

Companies are encouraged to comment on question 2.7.1 in the table below:

**Question 2.7.1**

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| --- | --- |
| company | comment |
|  |  |

## Issue #3-10 DL PRS RSRPP and Rx Diversity:

The Rx diversity options for DL PRS RSRPP were discussed during RAN1#108e in the context of DL AOD. The captured definition of the measurement did not include Rx diversity consideration since, in the context of DL AOD, no additional paths was considered.

[1] proposes to introduce an Rx branch set ID reported with the measurement when the UE uses multiple rx branches set. In [24] it is proposed to mirror the definition for rx diversity for SRS RSRPP in the PRS RSRPP definition.

## First round of discussion

We can start by checking whether there is a preferred alternative between the two proposals from [1][24]:

**Proposal 2.8.1: For DL PRS RSRPP measured with Rx diversity, select between the following (if any):**

**- Alt1: 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.**

**Alt2: Support the following Rx diversity scheme for RSRPP reporting for DL-TDOA and Multi-RTT**

**- For both frequency range 1 and frequency range 2, if receiver diversity is in use by the UE, the reported RSRPP may be associated with an Rx branch set ID.**

**- The RSRPP measurements associated with the same Rx branch set ID for a TRP correspond to the same set of Rx branches.**

Companies are encouraged to comment on proposal 2.8.1 in the table below:

**Proposal 2.8.1**

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| --- | --- |
| company | comment |
|  |  |

## Issue #3-15 TP clarifying reception of the DL PRS-RSRPP in 38.214

The following TP was proposed in [1] as a clarification for 38.214:

**TP2.9:**

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| --- |
| ================== Start of TP ==================  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*. 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*].  When the UE reports DL PRS-RSRP/DL PRS-RSRPP measurements, the UE may indicate which DL PRS-RSRP/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*.  ================== End of TP ================== |

## First round of discussion

Companies are encouraged to comment on the TP2.9 in the table below:

**TP2.9**

|  |  |
| --- | --- |
| company | comment |
|  |  |

## Conclusion

TBD

## References

1. [R1-2203099](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203099.zip) Maintenance of Rel-17 positioning accuracy improvements Huawei, HiSilicon
2. R1- 2205095 Maintenance of NR Positioning Accuracy Nokia, Nokia Shanghai Bell
3. [R1-2203176](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203176.zip) Maintenance of Other NR positioning enhancements Nokia, Nokia Shanghai Bell
4. [R1-2203436](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203436.zip) Maintenance on enhancements of accuracy improvements for NR positioning CATT
5. [R1-2203437](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203437.zip) Maintenance on latency reduction for NR positioning CATT
6. [R1-2203515](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203515.zip) Maintenance on accuracy improvements for NR positioning enhancements vivo
7. [R1-2203516](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203516.zip) Discussion on other maintenance issues on NR positioning enhancements vivo
8. [R1-2203619](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203619.zip) Remaining issues on accuracy improvement for Rel-17 positioning ZTE
9. [R1-2203620](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203620.zip) Remaining issues other than accuracy improvement for Rel-17 Positioning ZTE
10. [R1-2203786](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203786.zip) Remaining issues on PRS collision detection xiaomi
11. [R1-2203864](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203864.zip) Maintenance on accuracy improvement related enhancement Samsung
12. [R1-2203865](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203865.zip) Maintenance on latency and efficiency improvement related enhancement Samsung
13. [R1-2203960](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203960.zip) Maintenance of Rel-17 Positioning Accuracy Enhancement OPPO
14. [R1-2203961](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203961.zip) Maintenance of Rel-17 Positioning enhancement other than accuracy enhancement OPPO
15. [R1-2204127](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2204127.zip) Remaining issues for accuracy enhancements for NR positioning InterDigital, Inc.
16. [R1-2204128](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2204128.zip) Remaining issues for NR positioning InterDigital, Inc.
17. [R1-2204275](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2204275.zip) Remaining issues on accuracy improvements CMCC
18. [R1-2204276](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2204276.zip) Remaining issues on latency improvements CMCC
19. [R1-2204346](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2204346.zip) Remaining issue on accuracy improvements NTT DOCOMO, INC.
20. [R1-2204522](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2204522.zip) Discussion on maintenance for NR positioning other enhancements LG Electronics
21. [R1-2204903](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2204903.zip) Maintenance of Rel-17 positioning latency and efficiency improvements Huawei, HiSilicon
22. [R1-2204942](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2204942.zip) Maintenance of accuracy improvements for NR positioning enhancements Ericsson
23. [R1-2204943](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2204943.zip) Remaining issues for NR positioning enhancements Ericsson
24. [R1-2204985](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2204985.zip) Maintenance on Accuracy Improvements Qualcomm Incorporated
25. [R1-2204986](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2204986.zip) Maintenance on Other Issues in NR Positioning Enhancements Qualcomm Incorporated
26. [R1-2203040](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203040.zip) (R3-222721), “Questions concerning the implementation of RAN1 agreements in NRPPa,” RAN3 (Ericsson)
27. R1- 2205095 (revision of R1- R1- 2205075) Maintenance of NR Positioning Accuracy Nokia, Nokia Shanghai Bell