**3GPP TSG RAN WG1 #108e R1-2202520**

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

**Source: Moderator (Intel Corporation)**

**Title: Feature Lead Summary#1 for E-mail Discussion [108-e-NR-ePos-02]**

**Agenda item: 8.5.2**

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

# Introduction

This document provides overview of contributions submitted for AI 8.5.2 UL-AOA enhancements [1]-[13] as a part of R17 NR Positioning maintenance work. In addition, document provides feature lead inputs and summary for the following RAN1 e-mail discussion:

[108-e-R17-ePos-02] Email discussion for maintenance on accuracy improvements for UL-AoA positioning solutions – Alexey (Intel)

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

# Proposed Priority Order of Discussion

## Round #1

It is proposed to prioritize discussion on the first five aspects in the first round of discussion:

Aspect #1: Reference Point for UL SRS-RSRPP Measurements

Aspect #2: Definition of UL SRS-RSRPP – Linear Average of REs

Aspect #3: UL SRS-RSRPP Normalization and RX Diversity

Aspect #4: UL-AOA Measurement Definition

Aspect #5: Measurement Report Enhancements for Hybrid Positioning

# Overview of Contributions

## Aspect #1: Reference Point for UL SRS-RSRPP Measurements

RAN4 has provided response LS to RAN1 (R1-2200901) with information on reference point of SRS-RSRP and SRS-RSRPP measurements according to different gNB types.

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| Working assumption: The reference point for UL SRS-RSRPP shall be:* for type 1-C base station TS 38.104 [1]: the Rx antenna connector,
* for type 1-O or 2-O base station TS 38.104 [1]: based on the combined signal from antenna elements corresponding to a given receiver branch,
* for type 1-H base station TS 38.104 [1]: the Rx Transceiver Array Boundary connector.
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The following views were expressed by companies in RAN1:

[Huawei, [1]]:

* + Revert the working assumption and update the reference as below.

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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. * The reference point for UL SRS-RSRPP shall be:
	+ for type 1-C base station TS 38.104: the Rx antenna connector,
	+ for type 1-O or 2-O base station TS 38.104: based on the combined signal from antenna elements corresponding to a given receiver branch,
	+ for type 1-H base station TS 38.104: the Rx Transceiver Array Boundary connector.
* ~~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)
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[Huawei, [1]]:

* + Agree to the following TP to section 5.2.5 and 5.2.6 of TS 38.215.

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| 5.2.5 UL SRS reference signal received power (UL SRS-RSRP)

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| **Definition** | UL SRS reference signal received power (UL SRS-RSRP) is defined as linear average of the power contributions (in [W]) of the resource elements carrying sounding reference signals (SRS). UL SRS‑RSRP shall be measured over the configured resource elements within the considered measurement frequency bandwidth in the configured measurement time occasions.The reference point for UL SRS-RSRP 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, the reported UL SRS-RSRP value shall not be lower than the corresponding UL SRS-RSRP of any of the individual receiver branches. |

5.2.6 UL SRS reference signal received path power (UL SRS-RSRPP)

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| **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.The 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. |

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[OPPO, [4]]:

* + Update the definition of UL SRS-RSRPP as follows:

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| **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.~~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.~~The reference point for UL SRS-RSRPP shall be:- for type 1-C base station TS 38.104: the Rx antenna connector,- for type 1-O or 2-O base station TS 38.104: the Rx antenna (i.e. the centre location of the radiating region of the Rx antenna),- for type 1-H base station TS 38.104: 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. |

[CATT, [5]]:

* + Apply the following changes to the definition of reference point for UL SRS-RSRPP in the previous agreement and also make corresponding changes in TS 38.215.

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| 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. The reference point for ULSRS-RSRPP shall be:* for type 1-C base station TS 38.104: the Rx antenna connector,
* for type 1-O or 2-O base station TS 38.104: based on the combined signal from antenna elements corresponding to a given receiver branch,
* for type 1-H base station TS 38.104: the Rx Transceiver Array Boundary connector.
* ~~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.~~
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[Nokia, [6]]:

* + In TS 38.215, put a square bracket into the current definition on the reference point description.

[Ericsson, [13]]

* + Endorse TP 2.1 for inclusion in 38.215

TP 2.1:

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| 5.2.6 UL SRS reference signal received path power (UL SRS-RSRPP)

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| **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.The reference point for UL SRS-RSRPP shall be:* for type 1-C base station TS 38.104 [1]: the Rx antenna connector,
* for type 1-O or 2-O base station TS 38.104 [1]: based on the combined signal from antenna elements corresponding to a given receiver branch,
* for type 1-H base station TS 38.104 [1]: 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. |

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### Round #1

**FL comment:**

It seems measurement definitions of SRS-RSRP and SRS-RSRPP need to be updated to include information on reference point.

Note: necessary changes for R16 SRS-RSRP measurement are in scope of the RAN1 e-mail thread [108-e-R16-Pos-01]

**Proposal 1-1**

Measurement definition of UL SRS-RSRPP is revised to include information on reference point as shown below:

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| **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.The 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. |

Comments from companies:

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## Aspect #2: Definition of UL SRS-RSRPP – Linear Average of REs

Based on the LS from RAN4 (R4-2202780) on DL-PRS RSRPP definition several companies have proposed to make similar changes in UL SRS-RSRPP definition to reflect how the per-RE power is measured. The following views were provided:

[Huawei, [1]]

* + Agree to the following TP to section 5.2.6 of TS 38.215.

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| 5.2.6 UL SRS reference signal received path power (UL SRS-RSRPP)

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| **Definition** | UL SRS reference signal received path power (UL SRS-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 UL SRS signals, where UL SRS-RSRPP for 1st path delay is the power corresponding to the first detected path.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.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. |

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[CATT, [5]]:

* + Apply the following changes to the definition for UL SRS-RSRPP in TS 38.215

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| **Definition** | UL SRS reference signal received path power (UL SRS-RSRPP) is defined as linear average of the power contributions (in [W]) of the received UL SRS signal of the resource elements 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 contribution corresponding to the first detected path.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.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. |

[Nokia, [6]]:

* + RAN1 to consider modification of the current SRS RSRPP definition. E.g.,
		- UL SRS reference signal received path power (UL SRS-RSRPP) is defined as the linear average over the power contributions of the resource elements that carry ~~of the received~~ UL SRS signal configured for the measurement at the i-th path delay of the channel response within the considered measurement frequency bandwidth, where ~~UL SRS-RSRPP for~~ the 1st path delay is the ~~power corresponding to the~~ first detected path.

### Round #1

**FL comment:**

It is worthwhile to align UL SRS-RSRPP and DL PRS-RSRPP definitions, if RAN1 confirms RAN4 understanding expressed in LS (R4-2202780)

**Proposal 2-1**

Definition for UL SRS-RSRPP measurement is modified as follows:

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

Comments from companies:

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## Aspect #3: UL SRS-RSRPP Normalization and RX Diversity

* + [vivo, [2]]:
	+ For the two options of RX diversity for the first path UL SRS-RSRPP and UL SRS-RSRP,
		- Option 1 can be adopted when UL SRS-RSRP is not reported;
		- Option 2 should be adopted when UL SRS-RSRP is reported, which makes the Rx branches and normalization can be referred to UL SRS-RSRP.
	+ UL SRS-RSRP reporting is the prerequisite of UL SRS-RSRPP:
		- Normalization: UL SRS-RSRP reporting is reported as the difference in dB with respect to UL SRS-RSRP.
	+ [Intel, [7]]:
		- For the UL-AOA positioning, the gNB can be requested to measure and report to the LMF the UL SRS-RSRPP of the first path using the following options:
			* Option 1: if the UL SRS-RSRPP of the first path is reported only, then the UL SRS-RSRPP of the first path is reported using the absolute values
			* Option 2: if both UL SRS-RSRP and UL SRS-RSRPP of the first path are reported, then the UL SRS-RSRP is reported using the absolute values and the UL SRS-RSRPP of the first path is reported using the differential values, where the UL SRS-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

[InterDigital, [8]]:

* + Confirm the working assumption for the definition of UL SRS-RSRPP with the following changes, “For frequency range 1, if applicable, the reference point for the UL SRS-RSRPP shall be the antenna connector of the gNB. If applicable, for frequency range 1, UL SRS-RSRPP shall be measured based on the combined signal from antenna elements corresponding to a given receiver branch. For frequency range 2, UL SRS-RSRPP shall be measured based on the combined signal from antenna elements corresponding to a given receiver branch.”

**Association between UL SRS-RSRP and UL SRS-RSRPP**

[LGE, [12]]:

* + RAN1 needs to support reporting of both UL SRS-RSRPP and UL SRS-RSRP and needs to agree that UL SRS-RSRPP (P value) and UL SRS-RSRP (Q values) are such that P is less than or Q like a as shown below:
		- For reporting of UL SRS-RSRPP and UL SRS-RSRP in UL-AoA
	+ Regarding, the maximum number of DL PRS RSRPP, it is up to RAN4.
		- 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.

### Round #1

Companies are invited to express their views to continue discussion.

**FL comment:**

Normalization details of UL SRS-RSRPP reporting need to be finalized. The following is proposed to initiate discussion

**Proposal 3-1**

* + For the UL-AOA positioning, the gNB can be requested to measure and report to the LMF the UL SRS-RSRPP of the first path using the following options:
		- Option 1: if the UL SRS-RSRPP of the first path is reported only, then the UL SRS-RSRPP of the first path is reported using the absolute values
		- Option 2: if both UL SRS-RSRP and UL SRS-RSRPP of the first path are reported, then the UL SRS-RSRP is reported using the absolute values and the UL SRS-RSRPP of the first path is reported using the relative values, where the UL SRS-RSRP is selected as a reference measurement
		- The absolute values are reported in the range [-156 dBm, -31 dBm] with 1 dB resolution
		- The relative values are reported in the range [-30 dB, 0 dB] with 1 dB resolution

Comments from companies:

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## Aspect #4: Clarification of UL-AOA Measurement Definition

In [7], it is noticed that the current definition for the UL-AOA measurement in the TS 38.215 is not completely correct with respect to the additional path measurements. In case if the UL-AOA is measured for the additional path, then the UL-AOA does not define the azimuth and vertical angle of a UE. The UL-AOA angle corresponds to the reflected path with respect to a reference direction, which may not correspond to the direction of a UE.

* + [Intel, [7]]:
		- Update the UL-AOA measurement definition in the TS 38.215, adding the following:
			* In case if the UL Angle of Arrival (UL-AOA) is measured for the additional path, it is defined as the estimated azimuth and vertical angle of a reflected path with respect to a reference direction, which may not correspond to the direction of a UE
			* Note: Multiple UL-AOA pairs can be reported per single channel path

### Round #1

**FL comment:**

Considering that UL AOA measurement definition is not aligned with UL AOA measurement for additional paths, it seems RAN1 needs to introduce per path UL AOA measurement or modify R16 definition

**Proposal 4-1**

* + Update the UL-AOA measurement definition in the TS 38.215, adding the following:
		- In case if the UL Angle of Arrival (UL-AOA) is measured for the additional path, it is defined as the estimated azimuth and vertical angle of a reflected path with respect to a reference direction, which may not correspond to the direction of a UE

Comments from companies:

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## Aspect #5: Measurement Report Enhancements for Hybrid Positioning

* [vivo, [2]]:
	+ For the first arrival path measurements on SRS for positioning resource,
		- Do not support gNB to report to LMF the following set of measurements {multiple SRS-RSRP, multiple UL-AOAs (AoA/ZoA pairs), one UL-RTOA, one-gNB Rx-Tx time difference}.
	+ For the first arrival path measurements on SRS for MIMO resource,
		- Do not support gNB to report to LMF the following set of measurements {multiple SRS-RSRP, multiple UL-AOAs (AoA/ZoA pairs), one UL-RTOA}.

[ZTE, [3]]:

* + There is no need for gNB/TRP to report multiple path SRS RSRPs for the first arrival path since the path SRS RSRP should be defined in time domain rather than spatial domain.
	+ Don’t support gNB/TRP to report one UL-RTOA and one gNB Rx-Tx time difference simultaneously for the first arrival path

[OPPO, [4]]:

* + Support the gNB to report the following path-specific measurement on one path:
		- the gNB can report {SRS-RSRPP, multiple UL-AoAs, one UL-RTOA or one gNB Rx-Tx time difference} measured from that path.

[Nokia, [6]]:

* + For the first arrival path measurements on SRS for positioning resource or SRS for MIMO resource,
		- gNB can report to LMF the set of measurements {multiple SRS-RSRP, multiple UL-AOAs (AoA/ZoA pairs)}

[CMCC, [9]]:

* + For the first arrival path measurements on SRS for positioning resource, gNB can report to LMF the following measurement tuples {multiple SRS-RSRPPs, multiple UL-AOAs (AoA/ZoA pairs), one UL-RTOA or one gNB Rx-Tx time difference};
	+ For the first arrival path measurements on SRS for MIMO resource, gNB can report to LMF the following measurement tuples {multiple SRS-RSRPPs, multiple UL-AOAs (AoA/ZoA pairs), one UL-RTOA or one-gNB Rx-Tx time difference}.
	+ For the first arrival path measurements on SRS for positioning resource, do NOT support gNB to report to LMF the following set of measurements {multiple SRS-RSRP, multiple UL-AOAs (AoA/ZoA pairs), one UL-RTOA, one-gNB Rx-Tx time difference}.

[Samsung, [10]]:

* + The following Alt.1 should be supported.
		- Alt.1:
			* For the first arrival path measurements on SRS for positioning resource, gNB can report to LMF multiple sets of the following measurement tuples {one SRS-RSRPP, multiple UL-AOAs (AoA/ZoA pairs), one UL-RTOA or one gNB Rx-Tx time difference}
			* For the first arrival path measurements on SRS for MIMO resource, gNB can report to LMF multiple sets of the following measurement tuples {one SRS-RSRPP, multiple UL-AOAs (AoA/ZoA pairs), one UL-RTOA or one-gNB Rx-Tx time difference}

[LGE, [12]]:

* + Reporting multiple SRS-RSRP for each UL-AoA seems not only appropriate for LMF to estimate which UL-AoA is used for corresponding one UL-ROTA/ gNB Rx-Tx time difference but also helpful for LMF to use reported multiple UL-AoAs more properly.
	+ RAN1 needs to support reporting multiple SRS-RSRP together with together with {multiple UL-AOA, UL-RTOA/gNB Rx-Tx measurements}.

[Qualcomm, [11]]:

* + Support the following:
		- For the first arrival path measurements on SRS for positioning resource, gNB can report to LMF multiple sets of the following set of measurements {multiple SRS-RSRPP, multiple UL-AOAs (AoA/ZoA pairs), one UL-RTOA ***~~or one gNB Rx-Tx time difference~~*** }
		- For the first arrival path measurements on SRS for MIMO resource, gNB can report to LMF multiple sets of the following set of measurements {multiple SRS-RSRPP, multiple UL-AOAs (AoA/ZoA pairs), one UL-RTOA or one-gNB Rx-Tx time difference}

### Round #1

**FL comment:**

This aspect was discussed at the previous meetings. There is no common view to support multiple SRS-RSRPP values.

Companies are invited to continue discussion aiming to converge on common proposal

**Proposal 5-1**

Continue discussion aiming to converge on agreeable proposal

Comments from companies:

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## Aspect #6: LS to RAN4 on Rel 15 SRS for Multi-RTT Positioning

RAN1 has received LS from RAN4 (R1-2200900) asking to clarify the potential usage of the R15 SRS for NR positioning. The following views were expressed:

* + [Intel, [7]]:
		- Send reply to LS from RAN4 with the following content:
			* Rel-15 SRS is not supported for NR Multi-RTT positioning
			* Rel-15 SRS can be supported for NR UL-TDOA and UL-AOA positioning starting from Rel.16
			* Rel-15 SRS is supported for serving cell UE/gNB Rx-Tx time difference measurements in context of NR RTT-based PDC
				1. This functionality is supported starting from the Rel.17

### Round #1

**FL comment:**

RAN1 needs to provide reply to LS from RAN4 and clarify the use of R15 SRS for NR Multi-RTT positioning

It is up to RAN1 chair to decide whether to treat this under AI 8.5.2. The topic may be treated in another AI.

## Aspect #7: Reporting of Estimated Range of AoA

[OPPO, [4]]:

* + For linear antenna array, in addition to the ZoA relative to the z-axis, the TRP also reports an estimated range of AoA.

### Round #1

**FL comment:**

Seems to be an optimization aspect rather than essential correction.

Companies are invited to provide their views on proposal to report an estimated range of AoA.

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## Aspect #8: Enhancements of ARP Framework

[Nokia, [6]]:

* + LMF may provide a threshold to the gNB to determine the AoA measurement report and its associated ARP information.
		- Note: the threshold value is related to near-field/far-field discrimination
		- If difference of the AoA measurements from different ARPs are less than the threshold, the gNB may report a single AoA measurement and a single ARP, where the ARP includes all reception antennas of the different ARPs.
		- If difference of the AoA measurements from different ARPs are greater than the threshold, the gNB may report those AoA measurements and ARP IDs.
	+ LMF may provide the gNB with level/size of an antenna group of an ARP per TRP to help the gNB implementation for AoA estimation.
		- Note: When TRP peforms AoA measurements for the target UE, it may start with the recommended antenna group size assuming a single incident angle for each antenna group.
	+ LMF requests the gNB to report angle measurement for a specific ARP ID of a TRP.

### Round #1

**FL comment:**

Seems to be an optimization aspect rather than essential correction

Companies are invited to provide their views on additional ARP related enhancements

Comments from companies:

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| Company Name | Comments |
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## Aspect #9: Expected UL-AoD/ZoD

**Expected UL-AoD/ZoD**

[LGE, [12]]:

* + If expected UL-AoD and uncertainty is proved for UE, UE does not need to transmit all of SRSs within configured SRS resource(s) and it would be helpful for UE to determinate the Tx beamforming.
	+ RAN1 should support expected UL-AoD/ZoD which is signaled from LMF to UE and the detail configuration needs to follow the way for configuration of expected UL-AoA and its uncertainty (or details up to RAN2).

### Round #1

**FL comment:**

Seems to be an optimization aspect rather than essential correction

Companies are invited to provide their views on additional ARP related enhancements

Comments from companies:

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Conclusions

In this document, we have provided overview of the contributions submitted to RAN1#108e for R17 NR positioning maintenance on UL AOA enhancements.

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