3GPP TSG-RAN WG3 Meeting #114-e draft R3-215876

Online, 1 – 11 November 2021

**Agenda item: 19.2.1**

**Source: Nokia (moderator)**

**Title: Summary of offline: positioning accuracy improvements**

**Document for: Discussion and Decision**

# 1 Introduction

This paper summarizes the following email discussion:

**CB: # 1901\_Pos\_Acc\_Imp**

**- Details on exchange of AoA/AoZ:**

**-Inclusion of AoA/ZoA (and related information) in signaling between RAN and LMF**

**- What changes to the agreed BL are needed (if any)?**

**- Other proposals on Positioning Enhancements:**

**- Neighbour information exchange?**

**- TRP Information exchange?**

**- Outdoor/Indoor Indication?**

**- ARP Information exchange?**

**- Converge on Stg3 TP where/if possible**

(Nok - moderator)

Summary of offline disc [R3-215876](file:///C:\Users\ezlyamo\Downloads\Inbox\R3-215876.zip)

# 2 For the Chair’s Notes

There is no need to introduce the “ZoA” codepoint in the *TRP Measurement Type* IE.

The uncertainty range values in the *UL-AoA Assistance Information* IE are mandatory.

Remove the FFS for the expected AoA information in the MEASUREMENT UPDATE message and make associated corrections to the procedural description.

The *LCS to GCS Translation* IE should be changed from mandatory to optional in the *Zenith Angle of Arrival* IE, and FFS removed from semantics description.

R3-214977 rev in R3-21xxxa (TP for NRPPa) – agreed

# 3 Discussion (Phase 1)

Please provide your Phase 1 views by **14:00 UTC Friday November 5th**, so that they may be taken into account during the online session.

## 3.1 UL AoA: cleanup and open issue resolution

Related proposals from Nokia [1], Huawei [2], CATT [3], and CMCC [4].

A text proposal for NRPPa is provided in [7] addressing the following changes proposed in one or more papers:

1) There is no need to introduce the “ZoA” codepoint in the *TRP Measurement Type* IE [1][2][3][4].

2) The uncertainty range values are mandatory [1][2][4].

3) Remove the FFS for the expected AoA information in the MEASUREMENT UPDATE message [2][3] and make associated corrections to the Measurement Update procedural description and tabular [1].

4) The *LCS to GCS Translation* IE should be changed from mandatory to optional in the *Zenith Angle of Arrival* IE [1].

5) The semantics description of the *LCS to GCS Translation* IE within the *Zenith Angle of Arrival* IE should include “The z-axis of LCS is defined along the linear array axis”, i.e. remove the FFS [2][3].

6) The gNB can inform LMF about the AoA/ZoA uncertainties range in the TRP measurement Result UL AoA IE (9.2.38)

**Question 1: Is the TP in [7] agreeable? If not, which of the above changes (#1-5) requires further discussion?**

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| **Company** | **Comments** |
| Ericsson | 1) Agree  2) Agree, otherwise sending the assistance data won’t make sense?  3) Although we are fine with the intention and the proposed procedural texts, we believe that, for future-proofing, we should keep the name of the IEs as *TRP Measurement Update List/Item*, as the specification may later evolve to include new information to be sent in the Update message. This avoids creating a list/item for every new information and would make asn.1 easy to update.  4) we miss a bit on the justification, but if there is majority view, we can perhaps factorize the IE and use as reference the new IE proposed in **R3-215385** with the semantics.  5) OK  6) We hope this proposal can be considered, as we had proposed it in our previous paper during last meeting in R3-213851. In our view the gNB can “correct” the AoA assistance information sent by LMF by responding with the values of the AoA/ZoA uncertainty ranges. This can help to enhance the AoA assistance information at LMF when it is for e.g. used in other methods where the window is sent to the UE.  9.2.38 UL Angle of Arrival  This information element contains the uplink Angle of Arrival measurement.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **IE/Group Name** | **Presence** | **Range** | **IE Type and Reference** | **Semantics Description** | | Azimuth Angle of Arrival | M |  | INTEGER(0..3599) | TS 38.133 [16] | | Zenith Angle of Arrival | O |  | INTEGER(0..1799) | TS 38.133 [16] | | **LCS to GCS Translation** |  | *0..1* |  | If absent, the azimuth and zenith are provided in GCS. | | >Alpha | M |  | INTEGER (0..3599) |  | | >Beta | M |  | INTEGER (0..3599) |  | | >Gamma | M |  | INTEGER (0..3599) |  | | Azimuth AoA Uncertainty Range | O |  | INTEGER(0..3599) |  | | Zenith AoA Uncertainty Range | O |  | INTEGER(0..1799) |  | |
| Huawei | Here are few comments:   * We do not see the need for the abnormal condition, and prefer to rely on criticality as usual mechanism. This will allow to ignore unknown value without failed the procedure. * We prefer to keep “TRP Measurement Update List” for future proof and more generic term. It is notable that RAN1 is discussing positioning measurement window, which might also need to be included in the Measurement Update message. * For *LCS to GCS Translation* IE it is a Sequence factorized per ASN definition we have correction for that (R3-215385), we can check at implementation of the BL CR   With that update is agreeable  The proposal from Ericsson to add the *~~Expected~~ Azimuth AoA Uncertainty Range* IE  *~~Expected~~ Zenith AoA Uncertainty Range* IE, as optional, is acceptable for us. |
| Qualcomm | In general proposals look ok. Two comments   * P6 from Ericsson makes sense * P1 we would still prefer to introduce the ZoA codepoint or keep open |
| Nokia | 1. OK 2. OK 3. OK (also to keep the Measurement Update List name if that is preferred by the majority). Regarding the procedural text, if we introduce a TRP list in the MEASUREMENT UPDATE message, we must specify what should happen if the list includes a TRP ID that is not associated with any ongoing measurement. We believe this can only be captured as an abnormal condition (since criticality does not help here) but we can further discuss what the gNB should do (e.g. fail the procedure? Ignore the TRP ID and continue with the procedure?) 4. OK, note that usage of LCS is not mandated and therefore this translation is optional everywhere else in NRPPa. 5. OK 6. This does not seem needed. The UL Angle of Arrival measurement can already (R16) be associated with an *Angle Measurement Quality* (within the *Measurement Quality* IE), so we would first like to understand why this existing mechanism is not enough. |
| ZTE | We fine with the proposals listed above. |
| Ericsson2 | To Nokia on P6, if the AoA Assistance Data coming from LMF is unusable (e.g., if the UE has moved from its initial position), the gNB can send a correction to the LMF of the range. This simplifies the ‘tracking’ at LMF side than using the angle measurement quality. |
| CATT | In general, the TP looks ok for us, but two comments as below:   1. prefer to keep “TRP Measurement Update List” for future proof   2）Regarding return of the updated uncertainty window back to LMF, as mentioned in the previous contribution [R3-213673], we don’t see the special benefits, because LMF may itself update the information once it obtains the measurement report. |
| **Moderator Summary**:  Changes 1-5: These seem generally agreeable except the following comments:   * For the “ZoA” codepoint, one company does not support removal. * For the MEASUREMENT UPDATE, most companies do not want to rename the TRP Measurement Update List. One company does not see the need for the abnormal condition and prefers to rely on criticality instead. * For making *LCS to GCS Translation* IE optional, there is potential interaction with a proposed R16 correction in R3-215385, this can be checked at implementation of the BL CR.   Change 6 (proposed at last RAN3 meeting):   * 4 companies support the change while 2 companies are not (yet) convinced. | |

## 3.2 Response time

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| **Company** | **Comments** |
| Ericsson | This is being discussed in another CB # 1904\_Pos\_LatencyImprovement. We suggest taking it there. |
| Huawei | Sorry about that. Ericsson proposal is fine |
| Moderator | I am removing this question since the same proposal was submitted in a different agenda item. |

## 3.3 UL-AoA measurements with ARP

Related proposals from ZTE [5][6].

In the recent RAN1#106bis-e meeting, the following was agreed: “*Association of UL-AoA positioning measurements with gNB ARP is supported in Rel-17*”. The agreement is reflected in the NR higher-layers parameter list [8] and marked as stable (rows 59-60).

An analysis of the RAN3 impacts is provided in [5], and it is proposed to enable reporting ARP (Antenna Reference Point) information with a UL measurement result. Two solution options are described:

**Option #1**: “A TRP should be allowed to provide a list of ARPs in TRP INFORMATION RESPONSE message. The ARP position is defined relative to the associated TRP position. Then, TRP is expected to optionally provide the ARP ID for the TRP measurement result in MEASUREMENT RESPONSE/REPORT message.”

**Option #2**: “A TRP doesn’t have to provide ARP information in TRP INFORMATION RESPONSE message. Instead, the TRP can directly provide the ARP position for the TRP measurement result in MEASUREMENT RESPONSE/REPORT message. Likewise, the ARP position is defined relative to the associated TRP position.”

The two options appear to be functionally equivalent, with main differences highlighted in yellow.

**Proposal 3: Introduce relative position of the ARP to TRP in the *TRP Measurement Result* IE.**

**Question 3: Is the above proposal agreeable? If so, please indicate a preference among solution option #1, option #2, or other (please specify).**

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| **Company** | **Comments** |
| Ericsson | There are some common aspects with the DL AoD LS discussion that also tackles about transmitting antenna information to the LMF over NRPPa. We believe that this can be left to OAM because 1) ARP are static information and 2) any change of antenna status (switching on and off some of the panels) leads to coverage (and connectivity) gaps. Thus the best way is to leave it be set up by OAM at specific hours of the day |
| Huawei | We are not comfortable with the proposal. We understand RAN1 agreement applies only to UL-AOA. The current proposal seems the ARP is not for UL-AOA only but for all positioning measurements. This proposal is not satisfying for now, and prefer a careful check of the implementation of RAN1 agreement. |
| Qualcomm | Agree with Huawei’s view |
| Nokia | We can think further about solutions until next meeting. |
| ZTE | RAN1 agreed that “*Association of UL-AoA positioning measurements with gNB ARP is supported in Rel-17*.” Hence, RAN3 should discuss how to support it in the NRPPa spec. Perhaps the proposal could be reworded as  “For UL-AOA, introduce relative position of the ARP to TRP in the TRP Measurement Result IE.” |
| CATT | Agree with Huawei’s view |
| **Moderator Summary**: Companies prefer to further check the RAN1 agreement (“Association of UL-AoA positioning measurements with gNB ARP is supported in Rel-17”) and consider potential RAN3 impacts at next meeting. | |

## 3.4 Other enhancements (unrelated to RAN1 agreements)

Some additional proposals for positioning accuracy improvement are described in [2].

Observation 1: Selecting neighbouring cells based on the coordinates or distance cannot guarantee the selected TRPs are appropriate for positioning.

Observation 2: LMF triggering additional E-CID only for obtaining neighbouring information would cause extra latency for subsequent UL-TDOA or UL-AoA procedures and the E-CID positioning method may not always be supported by the UE.

Observation 3: The neighbouring information can be changing, in which case the neighbouring information from E-CID method would be outdated. It is necessary to let the serving gNB to send the updated neighbouring information

**Proposal 4**: **The serving RAN to provide neighbouring information to LMF to support the LMF selecting measuring TRPs in order to increase the positioning accuracy.**

**Question 4: Please provide your views on the above proposal (e.g., is it agreeable? If not, why?).**

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| **Company** | **Comments** |
| Ericsson | Neighbor info is a superset of the potentially prepared target cells for a handover, which in turn may or may not be a superset of the cell(s) where the UE actually lands after a HO. Transmitting such information to LMF is useless. Over time, the LMF will have all this info anyway. |
| Huawei | Agreeable; only the serving gNB know the best neighbouring cells and it would be interesting to provide early the information to the LMF. The LMF will need to select TRPs in the neighbouring cells for measurements. The best neighbouring cell would be those having the strong signal strength between the UE and the gNBs. How does LMF have this neighbouring information if gNB does not provide? |
| Qualcomm | Believe we have discussed this before, and our view is similar to Ericsson. |
| Nokia | The LMF already has a lot of information available to it that enables accurate TRP selection via implementation. |
| ZTE | Agree with E///. |
| CATT | Agree with Nokia |
| Huawei | Let close then this issue for this meeting, we do not exclude to come back with supporter, if any. |
| **Moderator Summary**: No consensus on proposal 4 (6 companies do not see the benefit). | |

Observation 4: The TRP information can be collected before a LCS request for a single UE and used for a period of time.

Observation 5: The TRP information is used for all the UEs in multiple cells so that it should be accurate to guarantee the performance, otherwise all those UEs are impacted.

**Proposal 5**: **Support gNB to send the TRP information change notification to the LMF.**

**Question 5: Please provide your views on the above proposal (e.g., is it agreeable? If not, why?).**

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| **Company** | **Comments** |
| Ericsson | We think this is not needed. The TRP Information exchange procedure can be re-used. |
| Huawei | Agreeable  (ha … shorter response then…)  The TRP Information exchange procedure is triggered by the LMF, isn’t?  How to solve the problem of TRP information changing, which will causing UE positioning failure? How LMF know there is change in RAN to trigger the TRP information exchange? LMF should make it periodically? |
| Qualcomm | In principle the TRP change should be a relatively rare event, and maybe indeed an occasional refresh would be enough.  One option – if we want to avoid LMF triggered refresh – would be to have an indication potentially piggybacked on other messages e.g. like option 1 in the paper but with no new messages. Or just a single message indicating change / need to refresh. |
| Nokia | There is no issue for LMF to occasionally “refresh” its stored TRP information.  Regarding the proposal itself, it is unclear how it works (i.e. an NRPPa procedure that is autonomously initiated by the gNB doesn’t seem allowed by the NRPPa protocol). |
| ZTE | Agree that the gNB can notify the TRP information change to LMF. |
| CATT | We also think that the TRP Information exchange procedure can be triggered occasionally. |
| Huawei | To Nokia and Ericsson:  1. The issue is the positioning will fail if the LMF has not timely refreshed the information when TRP information changes.  2. Only the gNBs, who received TRP information request before, can notify the change to the LMF.  About Qualcomm proposal, we have doubt on piggybacking option currently the non-UE associated message only include TRP information exchange procedure and assistance information procedure. Regarding to option 1: a single message indicating change / need to refresh or option 2: a single message indicating change / need to refresh, we are open. Other proposals addressing this issue are welcome. |
| **Moderator Summary**: No consensus on proposal 5 although there is some support. | |

Observation 6: The A-GNSS positioning method outperforms the RAT-dependent positioning methods in the outdoor scenario while in the indoor scenario the RAT-dependent positioning methods have much better accuracy than the A-GNSS positioning method.

**Proposal 6**: **Let the gNB to provide the outdoor/indoor information along with the cell ID to the LMF; the TRP information exchange procedure can be enhanced to support the outdoor/indoor information exchange.**

**Question 6: Please provide your views on the above proposal (e.g., is it agreeable? If not, why?).**

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| **Company** | **Comments** |
| Ericsson | The LMF knows very well which cells are indoors and which are outdoors, since it is well aware of the network deployment. Nothing is needed. |
| Huawei | Agreeable, same topic as usual for RAN3 save OAM configuration effort …  How does LMF know very well which cells are indoors and which are outdoors?? Currently LMF obtains cell information via TRP exchange procedure. |
| Qualcomm | Not sure this is needed, but ok to keep it open. TRPs are not necessarily cell related, and indeed some may be placed indoors etc. Whether LMF needs to have this as explicit information is however not super clear, noting LMF may also not know if UE is indoor/outdoor precisely (and there are grey areas e.g. an outdoor UE may have LOS to an indoor TRP etc). |
| Nokia | The benefit is unclear. It seems more relevant whether the UE (rather than TRP) is outdoors/indoors when selecting the A-GNSS positioning method… is the assumption that if a TRP is indoors than it is likely serving UEs that are also indoors? |
| ZTE | Not sure whether it is needed. |
| CATT | Agree with QC |
| Huawei | Indeed UE position outdoors/indoors, is unknown, we also cannot tackle with all scenarios. However some information like all TRPs indoor, all TRPs outdoor, significant number of TRPs outdoor with one indoor, etc … are already good enough information for the selection of the positioning method.  We let to the moderator the decision to continuing this discussion this meeting, or postponed it to let more time for companies to check. |
| **Moderator Summary**: No consensus on proposal 6. | |

# 4 Discussion (Phase 2, if needed)

*Moderator Note: Phase 2 topics (if any) to be decided during online session, e.g. possible TPs for baseline CRs, additional topics for discussion, etc.*

# 5 Conclusions, Recommendations

Based on the discussion in section 3.1 on UL AoA open issues, it is proposed to agree to the NRPPa TP in R3-21xxxa reflecting the following agreements:

- There is no need to introduce the “ZoA” codepoint in the *TRP Measurement Type* IE.

Note: One company preferred to keep the FFS. However, there have been no papers (at this meeting or previous meetings) proposing the “ZoA” codepoint. This can still be considered based on company contribution.

- The uncertainty range values in the *UL-AoA Assistance Information* IE are mandatory.

- Remove the FFS for the expected AoA information in the MEASUREMENT UPDATE message and make associated corrections to the procedural description.

Note: Regarding the abnormal condition, one company commented that usage of criticality is preferred. However, criticality does not work in this case, so the abnormal condition was kept but with FFS added.

- The *LCS to GCS Translation* IE should be changed from mandatory to optional in the *Zenith Angle of Arrival* IE, and FFS removed from semantics description.

Based on the discussion in section 3.3 on UL-AoA measurements with ARP, the RAN1 agreement (“*Association of UL-AoA positioning measurements with gNB ARP is supported in Rel-17*”) should be further checked by companies and potential RAN3 impacts discussed at next meeting.

Based on the discussion in section 3.4 on other enhancements, there was no consensus on any of the following proposals (any further discussion is contribution-driven and hopefully takes into account the feedback in section 3.4):

- The serving RAN to provide neighbouring information to LMF to support the LMF selecting measuring TRPs in order to increase the positioning accuracy.

- Support gNB to send the TRP information change notification to the LMF.

Note: There was some sympathy expressed for the above. The proponent clarified that change notifications would be under LMF control based on a previously received TRP Information Request.

- Let the gNB to provide the outdoor/indoor information along with the cell ID to the LMF; the TRP information exchange procedure can be enhanced to support the outdoor/indoor information exchange.

Therefore, it is recommended to capture the following in the Chair’s Notes:

There is no need to introduce the “ZoA” codepoint in the *TRP Measurement Type* IE.

The uncertainty range values in the *UL-AoA Assistance Information* IE are mandatory.

Remove the FFS for the expected AoA information in the MEASUREMENT UPDATE message and make associated corrections to the procedural description.

The *LCS to GCS Translation* IE should be changed from mandatory to optional in the *Zenith Angle of Arrival* IE, and FFS removed from semantics description.

R3-214977 rev in R3-21xxxa (TP for NRPPa) – agreed

# References

1. R3-214977, (TP for NR\_pos\_enh BL CR for TS 38.455) Resolution of open issues for UL AoA (Nokia, Nokia Shanghai Bell)
2. R3-215390, (TP for POS BL CR for TS 38.455, TS 38.473) on positioning enhancement (Huawei)
3. R3-215605, Further Consideration of UL-AOAZOA Assistance Information (CATT)
4. R3-215682, (TP for TS 38.455) Positioning Accuracy Improvements (CMCC)
5. R3-215646, Discussion on supporting UL-AoA positioning measurements with gNB ARP (ZTE Corporation)
6. R3-215648, TP for TS38.455 on supporting UL-AoA positioning measurements with gNB ARP (ZTE Corporation)
7. R3-21xxxx, (TP for TS 38.455) (TP for NR\_pos\_enh BL CR for TS 38.455) Resolution of open issues for UL AoA, (TBD) => draft TP in the Drafts folder
8. R3-215793, LS on Rel-17 LTE and NR higher-layers parameter list (RAN1)