3GPP TSG-RAN WG3 #127 R3-25xxxx

Athens, Greece, 17 – 21 February, 2025

Agenda Item: 20.2

Source: Nokia (moderator)

Title: Summary of Offline Discussion for CB # AIPHY

Document for: Approval

# Introduction

This document summarizes the discussion for the following comeback:

**CB: # AIPHY**

**- Continue the discussion on the solution options for Case3a**

**- Capture agreements and open issues**

(moderator - Nok)

# For the Chairman’s Notes

[TBD]

# Background

This CB focuses on Case 3a. Below are the relevant RAN3 agreements from previous meetings:

|  |
| --- |
| *The existing LCS framework is re-used for AI/ML positioning.*  *The AI/ML model (inference and training functions) is at the gNB.*  *WA: The LMF starts a NRPPa transaction. The gNB determines that data collection is needed.*  *FFS how the gNB requests the LMF and whether this request triggers positioning for the UE being requested for part B information (as defined by RAN1).*  *FFS on the protocol used (NRPPa or NGAP) for the data collection request. FFS how the UE is identified.*  *LMF provides ground truth label and related data (i.e., part B information as called by RAN1) to NG-RAN.*  *FFS on the content of the ground truth label and related data pending on RAN1 progress. FFS on the signalling design.*  *How the LMF obtains the ground truth label and related data information is outside of RAN3 scope.*  *NG-RAN obtains measurements from TRP (i.e., part A information as called by RAN1).* |

It is proposed in [2] to convert the highlighted WA to an agreement, and many other papers have the same proposal. Therefore:

**Proposal 1: Turn the “WA: The LMF starts a NRPPa transaction. The gNB determines that data collection is needed.” to an agreement.**

There are many different solutions proposed for case 3a. During the online session, solutions were categorized into “RAN selects UE” and “LMF selects UE”. Five solutions are summarized in the following sub-sections (based on text extracted from proponents tdocs), with some details omitted to focus on the **solution direction and its key characteristics**.

Note 1: Solutions may not be mutually exclusive.

Note 2: Some companies propose both “RAN selects UE” and “LMF selects UE” (see e.g. CEWiT, Tejas Networks in [9]).

## RAN selects UE (summary for information)

The primary characteristic is that the gNB triggers positioning of a specific UE for the purpose of collecting model training data.

**Solution 1**: gNB triggers AI/ML data collection for a specific UE via a UE-associated NGAP procedure (e.g., Ericsson in [11]).

1. gNB is currently serving a UE for which part A information (i.e., UL SRS measurements) is available and wishes to receive the part B information, consisting of labels to form a data set for training.
2. The DATA COLLECTION REQUEST message is an NGAP UE associated message containing the NGAP UE IDs
3. The AMF receives the request message from the NG-RAN node and initiates positioning for the UE for data collection after selecting an appropriate LMF.
4. The AMF invokes the Nlmf\_Location\_DetermineLocation service operation towards the LMF to request the current location of the UE.
5. The LMF performs one or more of the positioning procedures described in clause 6.11.1, 6.11.2 and 6.11.3 of TS 23.273.
6. The LMF returns the Nlmf\_Location\_DetermineLocation Response towards the AMF with the current location of the UE.
7. The AMF returns the requested label to the NG-RAN node in a DATA COLLECTION RESPONSE message. If for some reason (e.g., no UE consent, positioning failed, etc.), the AMF returns instead a failure message with appropriate cause value.
8. The gNB combines the received label with the TRP measurements to form the data training sets.

**Solution 2**: gNB triggers AI/ML data collection for a specific UE via an NRPPa message (e.g., Qualcomm in [10]). Slightly different flavors are in Lenovo in [6], China Telecom in [7], CMCC in [12], Nokia in [14], Samsung in [15]).

1. The LMF sends a new Class 2 (non-UE associated) NRPPa message which may include a list of available UEs/PRUs, possibly together with other known information (e.g., stationary PRU location).

*Moderator Note: From online session, it seemed there was convergence that LMF must first send an NRPPa message to the gNB (with Routing ID) before the gNB can send an NRPPa message to the LMF (containing the same Routing ID).*

1. The NG-RAN node determines that model (re-)training is required and selects a suitable UE. The NG-RAN node may send a request to an LMF for the ground truth label ("Part B Information") of the selected UE.
   1. If the NG-RAN node selects a UE from the list provided at Step 1, the NG-RAN node sends a new Class 1 NRPPa message to the LMF to request ground truth label information (UE location information). The NG-RAN node sends the NRPPa PDU to the AMF in an NGAP Uplink Non UE Associated NRPPa Transport message. The NG-RAN node includes the Routing ID related to the LMF received at Step 1 and the UE ID received at step 2 for which the ground-truth label is requested.
   2. If the NG-RAN node does not select a UE from the list provided at Step 1, the NG-RAN node sends the NRPPa PDU to the AMF in an NGAP Uplink UE Associated NRPPa Transport message (i.e., the UE is identified by the corresponding NGAP ID). FFS whether the NG-RAN node includes the Routing ID received at Step 1 or assigns a Routing ID for this UE that enables an AMF to distinguish a Routing ID assigned by a NG-RAN node from Routing IDs assigned by an AMF.
2. The AMF then performs the LMF selection and forwards the NRPPa message to this selected LMF.
3. The LMF may perform any of the UE positioning procedures defined in TS 23.273 [4] and 38.305 [5] to obtain the UE location (to determine/calculate the ground truth label information).
4. The LMF provides the UE/PRU location ('ground-truth label' information) to the serving gNB (via the serving AMF).
5. The serving gNB configures a required SRS for model training in the UE/PRU.
6. The NG-RAN performs the UL SRS measurements and derives any data required for model training ("Part A Information").

## LMF selects UE (summary for information)

**Solution 3**: LMF triggers AI/ML data collection and provides both Part A and Part B to the gNB in a new NRPPA message (e.g., CATT in [2]).

* LMF selects the labels, collects necessary information of the labels, and provides both Part A and Part B of the labels to the gNB.
* gNB should provide some assistance information to LMF when it requests for training data, e.g. TRP IDs, expected amount of labels, expected measurement type/result (e.g. UL-RTOA, Multi-RTT).
* For data collection in Case 3a, it’s beneficial for gNB to provide the preferred UL SRS characteristics/configuration for training data collection to LMF.

**Solution 4**: LMF triggers AI/ML data collection and provides Part B to the gNB in the MEASUREMENT REQUEST message (e.g., Xiaomi in [4], Huawei in [8]).

* if gNB wants to collect data for training, it indicates the needs to the LMF. There may be multiple gNBs in a desired area that may want to collect training data. LMF can have the comprehensive requirements from all gNB(s), it performs the UE selection considering the UE information and TRP information in step 1, same mechanism as in LMF-side data collection is used, LMF can select PRU or UE with user consent, and the LMF initiates UL related positioning procedures by reusing existing mechanism, E.g. LMF may initiate UL SRS configuration for the selected UE in step 2, the selected UE may or may not be served by the gNB that collects data.
* LMF sends measurement request including the ground truth label for the gNB(s) to indicate the request for data collection, the gNB perform the measurement to obtain part A, and then correlate part A and part B for model training.

**Solution 5**: gNB requests Part B in the MEASUREMENT RESPONSE and LMF subsequently provides Part B in a new NRPPa message (e.g., ZTE in [5]).

* The NG-RAN node can inform the LMF about its data collection requirements through one of the NRPPa positioning procedures, preferably using the MEASUREMENT RESPONSE message.
* If consent is granted, the LMF reports the UE's training data information via the new DATA COLLECTION REPORT message; otherwise, it sends a new DATA COLLECTION FAILURE message to the NG-RAN node with a failure cause.

# Discussion

Although there were no agreements during the online session, there were several comments which have not (yet?) been challenged:

* Model training may require data from many (e.g., 1000+) UEs.
* An “opportunistic” method (i.e., using available data from ongoing positioning sessions) alone may not be sufficient for a gNB to acquire all needed training data.
* A “proactive” method (i.e., triggering positioning sessions to obtain data) alone may not be suitable for collecting data from a large number of UEs.
* Model training may require data from UEs that are outside the gNB’s serving area (since positioning may require measurements from a set TRPs spanning multiple gNBs). In other words, collecting data only from served UEs may create model bias.

In order to evaluate the various solutions, it would be helpful to first agree on solution “requirements”. Based on the online discussion, the following is proposed:

**Proposal 2: It should be possible collect data in both an “opportunistic” and “proactive” manner.**

**Proposal 3: It should be possible to collect data from both served and non-served UEs.**

Based on the moderator’s understanding of the five solutions, the table below captures some key characteristics of the solutions:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Solution #1 | Solution #2 | Solution #3 | Solution #4 | Solution #5 |
| gNB selects UE | YES | YES |  |  |  |
| LMF selects UE |  | Partial1 | YES | YES | YES |
| Opportunistic |  | Partial1 | YES | YES | YES |
| Proactive | YES | YES | Partial2 |  |  |
| Data from served UEs | YES | YES | YES | YES | YES |
| Data from non-served UEs |  | Partial1 | YES | YES | YES |

1For e.g. PRUs.

2gNB may provide assistance information to LMF, up to LMF whether to trigger positioning.

As can be seen from the above table, there may not be a single solution having all desired characteristics.

**Moderator’s suggestion:**

* We can attempt to select a single solution at this meeting, but this may be challenging and may result in little/no progress.
* Alternatively, as a first step we can discuss selecting (or merging) among:
  + Solution 1 & Solution 2 (i.e., how to best support proactive?); and
  + Solution 3, Solution 4, and Solution 5 (i.e., how to best support opportunistic?)

Then, as a second step, we discuss how to further progress (e.g., Further down selection? Support two solutions? Merge two solutions into one somehow?).

Assuming that we make progress on selection of solution(s), the following would be proposed:

**Proposal 4: Agree to Stage 2 TP(s) for selected solution(s) with FFSes and Editor’s Notes as needed.**

# Conclusion, Recommendations

[TBD]

# References

1. R3-250085 Discussion on support of AIML based positioning accuracy enhancement (Baicells)
2. R3-250114 (TP to BL CRs) Support of gNB-based AI positioning (CATT)
3. R3-250146 [TP to 38.455 & 38.473 & 38.401] Support of AI/ML assisted Positioning (case 3a & 3b) (ZTE Corporation)
4. R3-250155 (TP for TS 38.455) Support of gNB-side model (case 3a) (Xiaomi)
5. R3-250179 Discussion on AI/ML based Positioning Accuracy Enhancements (NEC)
6. R3-250291 AIML for gNB assisted positioning (Lenovo)
7. R3-250346 Discussion on support of AI/ML assisted positioning (Case 3a) (China Telecom)
8. R3-250378 (TP for AI/ML BLCR to TS 38.455 for Case 3a and TP for AI/ML BLCR to TS 38.455 for Case 3b) Discussion on RAN3 impacts for AI/ML positioning (Huawei)
9. R3-250388 Discussion on AI/ML-based Positioning Accuracy Enhancements (CEWiT, Tejas Networks)
10. R3-250414 AI/ML based positioning accuracy enhancements (Qualcomm Incorporated)
11. R3-250490 Discussion on NRPPa signalling design for AI/ML for PHY (Ericsson)
12. R3-250515 Support Assisted AI ML Positioning (CMCC)
13. R3-250562 AI/ML-based Positioning (Jio Platforms (JPL))
14. R3-250578 (TP to TS 38.300, TS 38.305, TS 38.455) AI/ML Positioning Case 3a (Nokia)
15. R3-250624 Discussion on Case 3a in AI/ML for positioning (Samsung)