**3GPP SA WG2 Meeting #153eS2-xxxxxxx**

**e-meeting, Oct 10-14, 2022**

**Source: Nokia, Nokia Shanghai Bell**

**Title: KI#9 : Location Accuracy– Enhancements & Evaluation/Conclusion**

**Document for: Approval**

**Agenda Item: x.xx**

**Work Item / Release: FS\_eNA\_Ph3 / Rel-18**

*Abstract of the contribution: This paper proposes update to the solution #59 and evaluation/conclusion for KI#9.*

# Discussion

This paper addresses the open questions in solution #59 for key issue 9

# Proposal

It is proposed to update TR 23.700-81 as follows

\*\*\* Start of changes \*\*\*

## 6.59 Solution #59: Enhancement of NWDAF with location accuracy prediction

### 6.59.1 Functional Description

#### 6.59.1.1 General

This solution addresses the KI "Key Issue #9: Enhancement of NWDAF with finer granularity of location information".

Editor's note: This paper is only focused on NWDAF enhancement. For LCS related part coordination with eLCS\_ph3 is needed and eNA\_ph3 will start work only if eLCS\_ph3 makes progress with stable outcome.
In eLCS\_ph3 KI#4 interim conclusion relying on the present solution proposal have been agreed:
*NWDAF provides new analytics for Location Estimation Accuracy (e.g. horizontal or vertical accuracy, indoor/outdoor indication). LMF as a consumer of such analytics uses Location Estimation Accuracy analytics to determine Position Method in the area where a UE is located*.

TS 23.273 [13] defines LCS QoS to have the following attributes: (1) Location Accuracy, (2) Response time and (3) QoS Class. Among these, the QoS Class attribute gives the requirement on the other attributes like accuracy or response time. It could take as values Best Effort, Multiple QoS Class or Assured. While the Best Effort class is the least stringent one, the other two require the LMF to determine how accurate its location estimate is.

For example:

- in the case of "Multiple QoS Class", if the accuracy is less than what is required, the LMF selects an appropriate localization method (e.g. with more TRP measurements) and re-runs the location estimate in order to reach the required accuracy.

- in the case of "Assured" QoS Class, the procedure fails if the accuracy required is not met.

To provide a real-time estimate of location accuracy without need for benchmark/ground truth location, we propose a data analytics-based solution running in the NWDAF with a supervised Machine Learning model (e.g. Neural Network).

A training should be first performed on the selected ML model with labelled data, i.e. input data with corresponding output data:

- Input data: positioning estimate by two positioning methods, one of them (e.g. GPS information) used as ground truth to evaluate the accuracy of the other method and optionally: used positioning method, assistance data, UE ID, Area, see Table 6.59.1-1.

- Output data: corresponding accuracy (calculated with benchmark method such as the output of MDT), see Table 6.59.1-2.

Once the model is trained, there is no more need for ground truth (e.g. GPS information). This model is then subsequently used by the LMF to determine if its location estimate meets the accuracy required and take appropriate action. To enable this, the LMF makes use of a Service Based API that is exposed by the NWDAF.

The input data for the Location Accuracy analytics is shown in Table 6.59.1-1

Table 6.59.1-1: Data collection for "Location accuracy" analytics

|  |  |  |
| --- | --- | --- |
| Information | Source | Description |
| UE location determined by two positioning methods | LMF | UE location as estimated by the LMF with the selected localization method. |
| UE ID | LMF | UE identifier. |
| Location methods/Assistance Data | LMF  | Selected location method and corresponding parameters. |
| Area  | LMF | The region of interest where the UE is located (e.g. could be list of cell IDs). |

The Location Accuracy service output is defined in Table 6.59.1-2.

Table 6.59.1-2: Output analytics for "Location accuracy"

|  |  |
| --- | --- |
| Information | Description |
| Location accuracy | Predicted location accuracy (could be in % or in unit meters). |
| Applicable Area | A list of TAIs or Cell IDs as well as below cell level location information that the analytics applies to. |
| Confidence | Confidence of the prediction. |

### 6.59.2 Procedure



Figure 6.59.2-1: Location accuracy prediction and usage

Pre-condition: NWDAF has a trained supervised ML model for predicting location accuracy.

1. LCS Client requests to LMF the UE location with QoS Class set as either "Multiple QoS Class" or "Assured" along with the location accuracy required. The expected behaviour from the LMF is as given in clause 6.59.2.

2. The LMF initiates the LCS session as given in TS 23.273 [13] and derives the UE location estimate.

3. The LMF queries the NWDAF for the location accuracy giving as inputs the corresponding Analytics ID . Other inputs could be - location estimate, UE positioning method/assistance data and area (cell ID/TAI).

NOTE 1: Both Nnwdaf\_AnalyticsSubscription and Nnwdaf\_AnalyticsInfo services can be used to implement step 3. above. The Nnwdaf\_AnalyticsSubscription service can be used by a service consumer to receive notifications about location accuracy, e.g. when a change is detected.

4. The NWDAF uses the corresponding model trained in the precondition and provides the location accuracy as the output to the LMF.

5. LMF compares the location accuracy received in step 3 with the required location accuracy received in step 1 from the LCS Client.

6. If the required location accuracy is not met, the LMF takes subsequent actions like re-executing the LCS procedure with more stringent parameters (for example: higher periodicity measurements).

7. The LMF returns the location estimate with the required accuracy.

NOTE 2: The offline training gives the ML model the ability to predict the location accuracy without the need for a reference location estimate. This is made possible by the extensive training done using various accuracy/reference values, which result in the computing of weights in the ML model. Such a trained model can then be used for an inference/prediction of the location accuracy in this step 3.

### 6.59.3 Impacts on services, entities and interfaces

NWDAF:

- Supports a new Analytics ID for determining Location Accuracy.

- Supports subscription from NFs like LMF to make use of this Analytics.

- Supports data collection from LMF to generate the output of this Analytics.

# \*\*\* End of changes \*\*\*