**3GPP TSG-RAN WG4 Meeting #112bis R4-2417187**

**Hefei, Anhui, China, 14th – 18th October, 2024**

**Agenda item:** 6.17.6

**Source:** Qualcomm Incorporated

**Title:** WF on AI/ML

**Document for:** Approval

# Introduction

This WF captures the agreements for the discussion carried out on AI/ML under the [112-Bis][127]NR\_AIML\_air thread.

# Agreements

## General Issues

### Agreements in main session:

**Issue 1-4: AI/ML Performance**

Agreement:

* For CSI prediction, AI/ML based performance requirement should not be worse than the legacy (non-AI/ML based) if a relevant equivalent legacy requirement/feature exists.
  + FFS which legacy requirement/feature are relevant
  + FFS whether AI/ML based performance should be better than the legacy
* FFS on target for AI/ML based beam management

### Other Agreements:

**Issue 1-2: Post deployment testing**

When operating in the field, two aspects of UE operation may impact performance:

* Update or fine tuning or addition/removal of models, if applicable, resulting in a change of functionality which may impact functionality performance
* Data drift / mismatch between the conditions encountered by the UE in the field and the training data, which may impact functionality performance.

For dealing with potential changes in the performance of functionalities two options may be available. The options are not mutually exclusive:

* **Option 1**: Conduct the validation of a change in ~~AI model/~~functionality before its deployment/activation in already deployed UEs
  + Validation takes into account the UE hardware in which the model is to be deployed/activated.
  + FFS whether the validation takes place in the field (i.e., on each individual device) or in the lab conditions (i.e., per device type/model)
  + FFS whether validation can be done at the device along with inference for another active functionality(ies)
  + FFS on the feasibility
  + One possibility for consideration for option 1 is to capture model input (and if needed other test data such as ground truth) during conformance testing. This stored data can later be used to validate new or updated models.
  + Other aspects not precluded.
* **Option 2**: Using performance monitoring and LCM procedures
  + Performance monitoring will be designed in other groups
  + RAN4 may consider the need and feasibility of requirements and tests to ensure consistency and accuracy of monitoring metrics or other monitoring related data sent from the UE, and set requirements as feasible/needed.
  + Monitoring can be used for managing fallback, changes in functionality, model update/model switching/model transfer, if applicable

RAN4 needs to clarify whether changed functionalities that did not pass conformance testing are expected to be activated at the device.

For dealing with drift / mismatch between the conditions encountered by the UE in the field and the training data for the model, which may impact functionality performance, monitoring is needed.

* + Performance monitoring will be designed in other groups
  + RAN4 may consider the need and feasibility of requirements and tests to ensure consistency and accuracy of monitoring metrics or other monitoring related data sent from the UE, and set requirements as feasible/needed.
  + Monitoring can be used for managing fallback, change in functionality, model update/model switching/model transfer, if applicable

## Testability and interoperability issues for beam management

### Agreements in main session:

**Issue 2-3: RSRP Absolute accuracy**

Agreement:

* If the absolute RSRP is agreed to be metric for the beam management prediction, the absolute RSRP accuracy for AI/ML based beam prediction = predicted L1-RSRP of beam index i – groundtruth of L1-RSRP of beam index i. The index i may be any beam index [in top-K beams based on groundtruth L1-RSRP].

**Issue 2-5: Requirements for beam predictions**

Agreement:

* + Requirements to be defined:
    - Measurement period for prediction (how long will set B be measured before making a prediction)
      * FFS on whether the legacy measurement period can be reused or not.
    - Prediction accuracy
      * FFS how/what to define depending on the chosen KPI (e.g. predicted RSRP, beam ID, Top-K/1 or Top 1/K, etc)
    - TCI state known/unknown
  + FFS on whether the other requirements are needed
* **Issue 2-9: Test setup requirements**

**Agreement:**

* For CDL or simplified CDL channel model, RAN4 to study the relationship between AoD range [and granularity], number of beams and number of probes.
  + Set A and B should be generated in the chamber for ground-truth extraction.
* For TDL channel model, RAN4 to study the relationship between [dynamic power range], number of beams and number of probes.
  + Set A and B should be generated in the chamber for ground-truth extraction.
    - For single AoA, FSS how to derive Set A

### Agreements in ad-hoc session (R4-2417188)

**Issue 2-6: Measurement error impact evaluation**

RAN4 to perform study to assess the impact of measurement errors on prediction accuracy

Perform LLS to evaluate the RSRP prediction accuracy and other KPIs

* + - * UE Model trained using ideal measurements

Simulation assumptions can be found in R4-2417189

## Testability and interoperability issues for positioning accuracy enhancement

### Agreements in ad-hoc session (R4-2417188)

**Issue 3-1: Requirements for case 1**

Agreement:

Companies are invited to bring further analysis on feasibility of defining requirements for case 1 and how to define requirements, if feasible

**Issue 3-3: Report applicability for existing reported metrics**

Agreement:

Extend applicability of existing report mappings for UL-RToA and UL SRS-RSRPP to report UL measurements for AI/ML based positioning use cases.

## Testability and interoperability issues for CSI compression and CSI prediction

### Agreements in ad-hoc session (R4-2417188)

**Issue 4-1: Simulation results discussion for Option 3**

Agreement:

Next step:

Interested companies to share decoder ML models and dataset in next meeting (RAN4#113)

* Model and dataset used to generate the data submitted to RAN4#112-bis

Additional data to be submitted:

* CDF of SGCS per subband
* CDF of the largest eigen value of the channel matrix of training data for each subbands (preferably to be submitted in an xls format)

### Other agreements

Interested companies are invited to bring proposals for the next steps for the feasibility study of Option 4(for any of the sub-options of Option 4)

* Analysis of commonality with option 3(whether any steps or data generated for Option 3 can be reused) would be useful