3GPP TSG-RAN WG3#125bis R3-245683

Hefei, China, 14-18 October 2024

Agenda Item: 8.1

Source: ZTE Corporation

Title: Summary of Discussion on CB: #AI/ML\_Training

Document for: Discussions & Approval

# Introduction

**CB: # 1\_AI/ML-Training**

**- Whether to send LS to SA5 on the meaning of AI/ML training? Any spec updates needed?**

(moderator - ZTE)

Summary of offline disc [R3-245683](file:///D:\3GPP\TSGR3_125-bis\TSGR3_125-bis\Inbox\CB%23%20Term\Inbox\R3-245683.zip)

# For Chairman’s notes

Conclusion during 1st Discussion:

Proposal 1: To avoid introducing lifecycle management (LCM) in RAN3,it is not necessary to explicitly mention "ML model testing" in our RAN3 specification.

Proposal 2: Capture “An AI/ML model needs to be trained, validated and tested before deployment for AI/ML Model Inference.” in the TS38.300.

Proposal 3: No need to send LS to SA5.

Conclusion during 2nd discussion:

After offline discussion, no update is needed in TS38.401.

# 2nd Discussion

**Companies are invited to provide your views on whether it is also needed to capture “**An ML model needs to be trained, validated and tested before deployment for Model Inference.” in the TS38.401.

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| --- | --- | --- |
| Company | Yes/No | Comments |
| ZTE | Perhaps no. | In current 38.401  *7.11 Support of AI/ML for NG-RAN*  *The support of AI/ML for NG-RAN is specified in TS 38.300 [2].*  *In case of CU-DU split architecture, the following scenarios may be supported:*  *- AI/ML Model Training is located in the OAM and AI/ML Model Inference is located in the gNB-CU.*  *- AI/ML Model Training and Model Inference are both located in the gNB-CU.*  The support AI/ML for NG-RAN is specified in TS38.300. Since this principle is captured in the TS38.300, it is no needed to capture the same principle repeatedly. |
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Conclusion:

<TBD>

# 1st Discussion

## 4.1 Model testing

In the TR37.817 (RAN3 TR), the definition of the AI/ML model training is described below:

*Model Training is a function that performs the AI/ML model training, validation, and testing which may generate model performance metrics as part of the model testing procedure.*

In the Section 3 “Term” in the TS28.105 (SA5 Spec), the definition of the ML training is described below:

***ML model training:*** *a process performed by an ML training function to take training data, run it through an ML model algorithm, derive the associated loss and adjust the parameterization of that ML model iteratively based on the computed loss and generate the trained ML model.*

In the Section 4a “AI/ML management functionality and service framework” in the TS28.105 (SA5 Spec), ML model training and ML model testing is described below:

## *4a.0 ML model lifecycle*

*AI/ML techniques are widely used in 5GS (including 5GC, NG-RAN, and management system), the generic AI/ML operational workflow in the lifecycle of an ML model, is depicted in Figure 4a.0-1.*

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*Figure 4a.0-1: ML model lifecycle*

*The ML model lifecycle includes training, emulation, deployment, and inference. These steps are briefly described below:*

***- ML model training:*** *training, including initial training and re-training, of an ML model or a group of ML models. It also includes validation of the ML model to evaluate the performance when the ML model performs on the training data and validation data. If the validation result does not meet the expectation (e.g., the variance is not acceptable), the ML model needs to be re-trained.*

***- ML model testing:*** *testing of a validated ML model to evaluate the performance of the trained ML model when it performs on testing data. If the testing result meets the expectations, the ML model may proceed to the next step If the testing result does not meet the expectations, the ML model needs to be re-trained.*

During the online session, several companies proposed updating our specification to further clarify the definition of AI/ML model training, e.g., mentioning “ML model testing” in the specification.

**Question 1**: Companies are invited to share their views on whether it is necessary to explicitly mention "ML model testing" in our specification.

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| --- | --- | --- |
| Company | Yes/No | Comments |
| ZTE | No | Model testing is a part of model training. From a technical perspective, during ML model training, the dataset is typically divided into a training set, validation set, and testing set. Only when the model successfully passes the testing phase is it considered well-trained and ready for deployment. In RAN3, it has been acknowledged that the process of AI/ML algorithms is out of scope. Therefore, we do not believe it is essential to include details of the ML model training process in our specification, as it relates to AI/ML model implementation.  Moreover, ML model testing, as described in SA5, is part of Lifecycle Management (LCM). RAN3 has not discussed LCM, and introducing model testing could lead to further discussions in RAN3 regarding 'model inference evaluation' and other related topics. |
| QC | NO | ML Model testing is part of LCM. We don’t have to mention that as we have agreed not to handle LCM in NG-RAN AI/ML |
| Nokia | Yes | Our baseline for Model Training is that it performs training, validation and testing. In TR 37.817 we had defined Model Training as follows:  Model Training is a function that performs the AI/ML model training, validation, and testing which may generate model performance metrics as part of the model testing procedure. The Model Training function is also responsible for data preparation (e.g., data pre-processing and cleaning, formatting, and transformation) based on Training Data delivered by a Data Collection function, if required.  - Model Deployment/Update: Used to initially deploy a trained, validated, and tested AI/ML model to the Model Inference function or to deliver an updated model to the Model Inference function.  We had captured in our high level principles of the Rel-17 study that: “An AI/ML model used in a Model Inference function has to be initially trained, validated and tested by the Model Training function before deployment.” With the conclusion of TR 37.817 stating that “The high-level principles captured in section 4.1 of TR37.817 shall remain valid during normative phase, while the functional framework captured in section 4.2 of TR37.817 should be used as a guideline in normative phase.”  In TS 38.300 and TS 38.401 we point to SA5 definition in clause 3.1:  “AI/ML Model Training follows the definition of the "ML model training" as specified in clause 3.1 of TS 28.105 [64].”  But as can be seen from Figure 4a.0-1 above (compared to the previous version), SA5 has not only updated their clause 3.1 but also their LCM to separate ML Testing from ML Model Training (which also does validation). Hence, our current pointer in our stage 2, TS 38.300 and TS 38.401 is wrong after SA5 updates and needs to be corrected. |
| CMCC | No | 1. The architecture impact of ML model testing is never discussed in RAN3. Changing the terminology may result in the change in architecture. 2. It is common sense that testing part of implementation for algorthim, RAN3 has agreed this part should be out of scope. 3. SA5 defines ML model testing in OAM as part of LCM, which is not the same concept as here we discussed in RAN3 which may exist in gNB-CU. Refer to the same terminology in SA5 is not accurate but dangerous. |
| NEC | No/Yes | Pls see the answer to Q2. |
| China Telecom | Yes | From the technical perspective, Training, Validation, and Testing are separately different stages for generation of the model, and TS 28.105 follows this principle.  But from RAN3 perspective, we defined Model Training as a function that performs the AI/ML model training, validation, and testing.  It is confusing. |
| Huawei | No | We prefer to keep the references to SA5 spec as they are now, there is no need to mention “ML model testing” along with “ML model training” because it may create ambiguity on whether testing is performed in same location as for training or it can be done in a different location. Our understanding is that SA5 spec does not preclude that testing is performed in a different location than training, which could contradict the RAN3 principle that training is the function that, once deployed in a certain location (gNB or OAM), also performs validation and testing. |
| Telecom italua | No/Yes | No: we prefer not to modify current definition  Yes: testing can be mentioned, as per Q2 |
| Samsung | NO | Model testing is a part of LCM which has not discussed in RAN3. |

**Conclusion:**

To avoid introducing lifecycle management (LCM) in RAN3,it is not necessary to explicitly mention "ML model testing" in our RAN3 specification.

**Question 2**: If yes, companies are invited to share their views how to explicitly mention "ML model testing" in our specification.

* Option 1: Update references: AI/ML Model Training: comprises of “ML model training” and “ML model testing” as specified in clause 3.1 of TS 28.105.
* Option 2: Add the Note for ML model testing, e.g. AI/ML Model Inference is performed after the AI/ML model is well-trained. (Can be modified much better).
* Option 3: AI/ML Model Training follows the definition of the "ML model training" as specified in clause 3.1 of TS 28.105 [64]. Note: An ML model needs to be trained, validated and tested before deployment for Model Inference.

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| --- | --- | --- |
| Company | Option 1 or Option 2 | Comments |
| ZTE | Not needed |  |
| QC | Not Needed |  |
| Nokia | Option 1 or Option 3 | We prefer Option 1 because it is the most clear and accurate way.  Well-trained is not clear to us with respect to what it means.  We could also agree a text like the one below (proposed as an option 3):  AI/ML Model Training follows the definition of the "ML model training" as specified in clause 3.1 of TS 28.105 [64]. Note: An ML model needs to be trained, validated and tested before deployment for Model Inference. |
| CMCC | Not Needed |  |
| NEC | Not Needed or Option 3 | We prefer to keep Training and Testing separate instead of mixing terms together. Option 1 will cause more confusion later. Since Testing has no impact on RAN3, we think it’s ok to keep it just as it is. But if companies really want to reflect the agreement in TR, we’re also fine with adding a note. |
| China Telecom | Option 3 | Based on our answer to Q1, the Training, Validation, and Testing are separately different stages for generation of the model. So, Option 1 is confusing for us. Option 3 is clearer and more aligned with the technical principle that Training, Validation, and Testing are separately different stages. Moreover, since we do not discuss Testing, we are fine with Option 3 adding a note. |
| Huawei | Option 3 | We are fine with the clarification as it is in the note proposed by Nokia, which reflects an important principle from the Rel-17 SI that should be captured in Stage2 as well. |
| Telecom Italia | Option 3 | Option 1 maight clarify but has the cons. that it needs to be aligned again in case of further revision by SA5. So, since Testing has no impact in RAN3, ew are fine with Option 3. |
| Samsung | Not needed | As the reason in Q1 |

Conclusion:

Moderator think option3 may be the way to go forward to reflect a principle which was already agreed in RAN3.

Capture “An ML model needs to be trained, validated and tested before deployment for Model Inference.” in the stage2 specification.

**Question 3**: If we update something in our RAN3 specification, do we need to send LS to SA5 to inform them about our updates.

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| --- | --- | --- |
| Company | Yes/No | Comments |
| ZTE | Not needed |  |
| QC | Not Needed |  |
| Nokia | Not Needed |  |
| CMCC | Not Needed |  |
| NEC | Not Needed |  |
| NEC | Not Needed |  |
| Huawei | Not Needed |  |
| Telecom Italia | Not Needed |  |
| Samsung | Not Needed |  |

Conclusion:

No LS to SA5 is needed.