**3GPP TSG-SA5 Meeting #157 *S5-246004***

Hyderabad, India, 14 - 18 October 2024

**Source: ZTE Corporation**

**Title: Rel-19 pCR TR 28.858 Add New Requirement Management of Federated Learning Use Case**

**Document for: Approval**

**Agenda Item: 6.19.1**

# 1 Decision/action requested

***In this box give a very clear / short /concise statement of what is wanted.***

# 2 References

[1] 3GPP TR 28.858: " Study on Artificial Intelligence / Machine Learning (AI/ML) management Phase 2"

# 3 Rationale

In last SA5 meeting, the use case of Management of Federated Learning is agreed, which is a generic use case for FL, i.e., both HFL and VFL are needed to be supported. But in the existing description, description of training process for VFL is missing.

Besides, Maintaining Federated Learning Processeshas been already defined in SA2 in Rel-18, see clause 6.2C.2.3 of TS 23.288, which specifies how to maintain a Federation Learning process in FL execution phase, including FL Server NWDAF triggers reselection, addition, or removal of FL Client NWDAF(s). Maintaining Federated Learning Processes also raises new management requirements

This contribution proposes to update the description and add new requirement to Management of Federated Learning use case.

# 4 Detailed proposal

***Start of First change***

#### 5.1.10 Management of Federated Learning

#### 5.1.10.1 Description

Federated Learning (FL) is a distributed machine learning approach that allows multiple FL clients to collaboratively train an ML model on local datasets contained in each FL client without explicitly exchanging data samples.

FL is supported by a group of FL clients and FL server wherein FL client keeps the data localized and private, and trains the ML model directly on the local nodes (client) where the data is generated or stored.

Federated learning can be categorized into two main types: Horizontal federated learning (HFL) and Vertical federated learning (VFL), based on the nature of the data distribution and the way the model training is orchestrated among participants.

For HFL, the process typically includes FL Client discovery and selection, and ML model distribution and aggregation.



**Figure 5.1.10.1-1: ML model distribution and aggregation for HFL**

NOTE: A prior agreement needs to exist between the FL server and the FL clients to exchange ML models.

#### 5.1.10.2 Use cases

##### 5.1.10.2.1 Management of different roles in Federated Learning

For FL, an ML model is collaboratively trained by a group of FL clients (e.g., MTLF in NWDAFs) including one acting as FL server and the others acting as FL clients. Federated Learning training allows multiple FL clients to collaboratively train an ML model on local datasets, it means that the local training of each FL client needs to start and complete almost at the same time to ensure the performance of ML model aggregation performing in FL server.

For managing the FL, the ML training MnS consumer needs to know the FL clients and FL server involved in the FL, so that the consumer understands the impact of each one of them and can manage it correspondingly.

When receiving an ML Training request, the ML Training MnS Producer should evaluate whether FL process needs to be started according to the training requirements (e.g., minimal number of FL Clients, minimal number of total iterations, minimal number of data samples and available time of the FL Clients) provided by the ML training consumer. Based on the received requirements, the FL server may select appropriate FL Clients.

To evaluate the performance of FL, the consumer needs to know the performance of the final global ML model running on the local training data set of participating FL clients. For instance, if an FL server cannot generate a global ML model with satisfied performance for the FL clients, the consumer may interact with the MnS ML training producer to optimize the FL for future training, e.g., updating the criteria for selecting FL clients.

In addition, the consumer needs to get the information about the contribution of each FL client to the FL process, for instance, number of iterations the FL client participated in the FL, number of data examples the FL client used, training duration the FL Client performed.

#### Maintaining a Federation Learning process in FL execution phase is helpful to make the FL training efficient, which may include reselection, addition, or removal of FL Client(s). The consumer needs to get the information of candidate FL clients and contribution of each FL client to maintain the FL process.5.1.10.3 Potential requirements

**REQ-FL\_MGMT-01:** The ML training MnS producer should have a capability allowing an authorized consumer to discover the FL roles (FL server or FL client) in Federated Learning.

**REQ-FL\_MGMT-02:** The ML training MnS producer should have a capability allowing an authorized consumer to provide FL training requirements to the MnS Producer.

**REQ-FL\_MGMT-03:** The ML training MnS producer should have a capability allowing an authorized consumer to provide requirements for selecting FL clients in Federated Learning to the MnS Producer.

**REQ-FL\_MGMT-04:** The ML training MnS producer should have a capability allowing an authorized consumer to get the performance of ML model on each participating FL client.

**REQ-FL\_MGMT-05:** The ML training MnS producer should have a capability to report the information about the contribution of each FL client to the FL process to MnS consumer.

**REQ-FL\_MGMT-06:** The ML training MnS producer should have a capability to report the candidate FL Clients for the FL process.

**REQ-FL\_MGMT-07:** The ML training MnS producer should have a capability allowing an authorized consumer to reselect, add, or remove the FL Clients in the FL Process according to the candidate FL clients.

***End of First change***