**3GPP TSG-SA5 Meeting #156 *S5-244817***

Maastricht, NL, 19 - 23 August 2024

**Source: Intel, ZTE, Nokia, China Mobile, NEC, HUAWEI**

**Title: pCR 28.858 Add use case for management of Federated Learning**

**Document for: Approval**

**Agenda Item: 6.19.1**

# 1 Decision/action requested

***The group is asked to discuss and approve.***

# 2 References

None.

# 3 Rationale

When FL is used in 5GS, such as by NWDAFs, an ML model is collaboratively trained by a group of ML training functions including one acting as FL server and the others acting as FL clients. The ML training functions involved in FL need to be managed considering their roles.

This contribution is to add the use case and potential requirements for management of Federated Learning in 5GS.

# 4 Detailed proposal

It proposes to make the following changes to TR 28.858 for AI/ML management phase 2.

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| **1st modified section** |

## 5.x Management Capabilities for ML training

### 5.x.1 Management of Federated Learning

#### 5.x.1.1 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.

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Figure 5.x.1.1-1: 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.x.1.2 Use cases

##### 5.x.1.2.1 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.

#### 5.x.1.3 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.

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| **End of modified sections** |