**3GPP TSG-SA5 Meeting #154S5-242143**

**Changsha, China, 15 - 19 April 2024**

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| *CR-Form-v12.0* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **28.908** | **CR** | **-** | **rev** | **-** | **Current version:** | **-** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **X** | Core Network | **X** |

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| ***Title:*** | Input to draft TR Rel-29 28.9xy Add use case for management of Federated Learning | | | | | | | | | |
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| ***Source to WG:*** | Intel, ZTE, Nokia, China Mobile | | | | | | | | | |
| ***Source to TSG:*** | S5 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | FS\_AIML\_MGT\_Ph2 | | | | |  | ***Date:*** | | | 2024-04-05 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-19 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)*  *Rel-19 (Release 19)* | |
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| ***Reason for change:*** | | 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. | | | | | | | | |
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| ***Summary of change:*** | | Add use case and potential requirements for management of Federated Learning. | | | | | | | | |
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| ***Consequences if not approved:*** | | The FL cannot be managed. | | | | | | | | |
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| ***Clauses affected:*** | | 5.x (new) | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **x** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

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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 ML training functions to collaboratively train an ML model on local datasets contained in each ML training function without explicitly exchanging data samples.

FL is supported by a group of ML training functions, which contains an ML training function acting as FL server and multiple ML training functions acting as FL clients. The 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.



Figure 5.x.1.1-1: Horizontal Federated Learning

For horizontal Federated Learning, the FL process is as follows:

* Client Discovery and Selection: The FL Server discovers and selects FL Clients in an FL process;
* FL Initialization: The FL server initiates the federated learning process and distributing an initial global model to the FL clients for local training.
* ML model distribution and aggregation: FL clients train the ML model locally, and send the interim local ML model to FL server. FL server receives interim ML models from the FL clients, aggregates these interim ML models to update the global ML model, and then distributes the updated global ML model back to the FL clients. This step is repeated for a number of iterations, until the global ML model meets the training requirements.
* Stop: The FL server coordinates with FL clients to stop the FL process.

In 5G system, the deployment options for FL are shown in Table X.

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| --- | --- | --- |
|  | FL server | FL client(s) |
| Case 1 | NWDAF | NWDAF(s) |

Table X: Federated Learning deployment options in 5G system

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 ML training functions (e.g., MTLF in NWDAFs) including one acting as FL server and the others acting as FL clients.

For managing the FL, the ML training MnS consumer needs to know the ML training functions involved in the FL, and the role (FL server, FL client) of each ML training function, so that the consumer understands the impact of ML training function 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 provided by the ML training consumer. Then, based on the received requirements, the ML training function acting as 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 on the 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.

#### 5.x.1.3 Potential requirements

**REQ-FL\_MGMT-1** The ML training MnS producer should have a capability allowing an authorized consumer to get the FL role (FL server or FL client) of an ML Training Function in Federated Learning.

**REQ-FL\_MGMT-2** The ML training MnS producer should have a capability allowing an authorized consumer to provide FL training requirements to the ML Training Function acting as FL server.

**REQ-FL\_MGMT-3** 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 ML Training Function acting as FL server.

**REQ-FL\_MGMT-4** The ML training MnS producer should have a capability allowing an authorized consumer to get the performance about final global ML model on each participating FL client.

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| **End of modified sections** |