**3GPP TSG-SA Meeting #109SP-251225**

**Beijing, China, September 16 – 19, 2025 Revision of SP-251122**

**Source: Nokia**

**Title:** **pCR TR 22.850: Updates to terminology, evaluation and conclusions**

**Document for: Approval**

**Agenda Item: 8**

# 1 Introduction

This contribution proposes to:

- update ML to AI/ML in some places where “ML” occurrences were still available,

- update definitions for horizontal federated learning and vertical federated learning,

- progress evaluation and conclusion parts from TR 22.850.

# 2 Detailed proposal

The following changes are proposed to be included into TR 22.850.

\*\*\*\*\* START OF CHANGES \*\*\*\*\*

### 6.2.2 Analysis on Federated Learning

The term 'Horizontal Federated Learning' and 'Vertical Federated Learning' have been defined in SA WG2 and RAN WG1 as well as SA WG5 defines 'Federated Learning', as illustrated in Table 6.2.2-1.

Table 6.2.2-1: Definition of Federated Learning as defined across 3GPP WGs

|  |  |
| --- | --- |
| TSG (TS/TR) | Federated Learning |
| SA WG2 TR 23.700-84 [4] | *Horizontal Federated Learning*: A federated learning technique without exchanging/sharing local data set, wherein the local data set in different FL clients for local model training have the same feature space for different samples (e.g. UE IDs). |
| SA WG2 TR 23.700-84 [4] | *Vertical Federated Learning*: A federated learning technique without exchanging/sharing local data set, wherein the local data set in different VFL Participant for local model training have different feature spaces for the same samples (e.g. UE IDs). |
| RAN WG1 TR 38.843 [3] | *Federated Learning*: A machine learning technique that trains an AI/ML model across multiple decentralized edge nodes (e.g. UEs, gNBs) each performing local model training using local data samples. The technique requires multiple interactions of the model, but no exchange of local data samples. |
| 3GPP SA5 TS 28.105 [9] | *Federated Learning*: a distributed machine learning approach where the ML model is trained collaboratively by multiple ML training functions. This includes multiple FL clients, which perform training on local data, and one FL server, which aggregates model outcomes from the clients iteratively without exchanging data samples. |

The definition of Federated Learning provided by RAN WG1 appears to only apply to Horizontal Federated Learning, as the phrase "each performing local model training using local data samples" implies that the data samples at individual nodes are distinct. The key difference between Horizontal Federated Learning and Vertical Federated Learning lies in the characteristics of the local datasets:

- Horizontal Federated Learning: Local datasets have the same features but different samples.

- Vertical Federated Learning: local data sets have different features but share same samples.

The definition of Federated Learning provided by SA WG5 highlights the collaborative training process among multiple FL participants, including an FL server and FL clients, without specifying the characteristics of the client datasets. This broader definition facilitates a more comprehensive understanding of both Horizontal Federated Learning (HFL) and Vertical Federated Learning (VFL) that are already defined in the specifications and also offers greater flexibility across more general scenarios, see definitions in clause 5.2.1.2.

The terms "distributed learning" and "federated learning" are often used together as "distributed/federated learning" in SA WG1 TS 22.261 [6]. "Distributed learning" typically refers to a broader set of learning techniques including "federated learning". Although the two terms are related, they are not identical and should be used appropriately based on the context.

The following unified definition for 'Federated Learning' is proposed:

**Federated Learning:** A distributed machine learning approach where the ML model(s) are collaboratively trained by multiple participants, including one acting as an FL server and multiple acting as FL clients, iteratively without exchanging data samples.

The following unified definition for 'Horizontal Federated Learning' is proposed:

**Horizontal Federated Learning:** A federated learning technique without exchanging/sharing local data set, wherein the local data set in different clients for local model training have the same feature space for different samples.

The following unified definition for 'Vertical Federated Learning' is proposed:

**Vertical Federated Learning:** A federated learning technique without exchanging/sharing local data set, wherein the local data set in different clients for local model training have different feature spaces for the same samples.

\*\*\*\*\* NEXT CHANGE \*\*\*\*\*

# 8 Conclusions

Interim conclusions:

The term "output" is proposed as unified term for e.g. decision or prediction or statistic or recommendation.

The following definitions are proposed for adoption by WGs, and will be documented in a CR to 3GPP TR 21.905:

**- ML model:** A mathematical algorithm that applies AI/ML techniques to generate a set of outputs based on a set of inputs. It may include metadata which consists of, e.g. information related to the model and applicable runtime context.

**- ML model training:** A process to train an ML Model by learning the input/output relationship in a data driven manner and obtain the trained ML Model for e.g. inference.

**- ML model inference:** A process of running a set of inputs through a trained AI/ML model to produce a set of outputs.

**- ML model lifecycle management:** The management capabilities allowing a producer or consumer to manage different phases of the ML model lifecycle as defined in clause 6.2.1.7.

**- Functionality-based lifecycle management:** Signalling procedure where network indicates activation/deactivation/fallback/switching of AI/ML functionality via 3GPP signalling (e.g. RRC, MAC-CE, DCI); operates based on, at least, one configuration of AI/ML-enabled Feature / Feature Group or specific configurations of an AI/ML-enabled Feature/FG.

**- Federated Learning:** A distributed machine learning approach where the AI/ML model(s) are collaboratively trained by multiple participants, including one acting as an FL server and multiple acting as FL clients, iteratively without exchanging data samples.

**- Horizontal Federated Learning:** A federated learning technique without exchanging/sharing local data set, wherein the local data set in different clients for local model training have the same feature space for different samples.

**- Vertical Federated Learning:** A federated learning technique without exchanging/sharing local data, wherein the local data set in different clients for local model training have different feature spaces for the same samples.

**- Transfer Learning:** A machine learning technique where the knowledge acquired from training one or more ML models is leveraged to enhance the performance or accelerate the training of another ML model.

\*\*\*\*\* END OF CHANGES \*\*\*\*\*