Chapter 8
A New Approach for Federated, Shared, and Collaborative Learning via a SAN Storage Network

Saad Mahmoudi
https://orcid.org/0009-0007-3873-7197
Computer Science Research Laboratory, Ibn Tofail University, Kenitra, Morocco

Mohamed Amnai
Computer Science Research Laboratory, Ibn Tofail University, Kenitra, Morocco

Tarik Elmouden
https://orcid.org/0000-0002-6963-6686
Computer Science Research Laboratory, Ibn Tofail University, Kenitra, Morocco

ABSTRACT

The exponential emergence of IoT devices in a smart city generates significant data traffic on the network. This traffic can be affected by changes in the values exchanged between IoT devices and the aggregation server, which further guarantees the lack of parameter integrity, leading to unreliable learning. For this reason, we propose a new approach to protecting the private and confidential data of IoT devices required for federated learning of an AI model. Our approach aims to improve accuracy of learning model predictive values based on Fiber Channel technology, which adjusts

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the sharing and storage of learning parameters over the network, ensuring a reliable connection between IoT devices and storage arrays. This technology accelerates the AI model training phase while reducing latency.

1 INTRODUCTION

Given that the IoT network is overwhelmed by data from many IoT devices, the importance of security is considered a critical key in the process of creating a learning model. Learning time is also essential for the reliability and affinity of AI models. In this context, we have designed an architecture that aims to secure, improve the accuracy rate of the model, as well as reduce the learning time which depends on the case, it can be very long, taking the example of the distribution and collection of categorically different data, which generates a problem of data heterogeneity. Our architecture allows in the first place to achieve shared, distributed, and collaborative learning between the different connected objects. The architecture aims to preserve the confidentiality of IoT data centrally on a high performance storage network by using network data transmission technologies such as Fiber Channel over IP and iSCSI commands encapsulated in Fiber Channel transfer protocol to ensure reliable and certifiable writing and reading of both learning parameters and data collected from a smart city ecosystem environment.

In this article, we analyzed different architectures with a sharp focus on the security of learning parameters, which are iteratively transmitted between IoT devices and the aggregation server so that the model is well-refined, adjusted, and reliable. The accuracy of the learning model depends on the distribution rate and the distribution of data among the different connected objects (Liu et al., 2020). For better convergence of local models, the IoT objects participating in the learning phase must have almost identical data classes. Then the training results will be sent to the cloud server for the aggregation process of the training parameters. For this reason, the distribution management of the training parameters in accordance with the situation of non-independent identical distribution (non-IID) is mandatory in the infrastructure of the ecosystem of a smart city (Zhao et al., 2018). To address all the previously identified challenges including data privacy, limited computational resources, secure communication, and efficient data storage, we propose the implementation of a federated learning model deployment architecture that is integrated with a Storage Area Network (SAN). This architecture leverages the high speed and secure capabilities of SAN to optimize both the storage and retrieval of training data and model parameters across the distributed network.

Key enabling technologies within this architecture include the Fiber Channel protocol, which facilitates high bandwidth, low latency data transmission within the

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