Improving Air Traffic Management through machine learning collaboration on private data sets

AICHAIN

Project # 894162 in the SESAR 2020 Exploratory Research
Topic SESAR-ER4-2019 - Digital Information Management (DIM)
Full project title: ***A platform for privacy-preserving Federated Machine Learning using Blockchain to enable Operational Improvements in ATM***

Motivation and Goals

Air traffic management (ATM) can greatly benefit from **cyber-secured exploitation of large private data sets** belonging to different stakeholders.

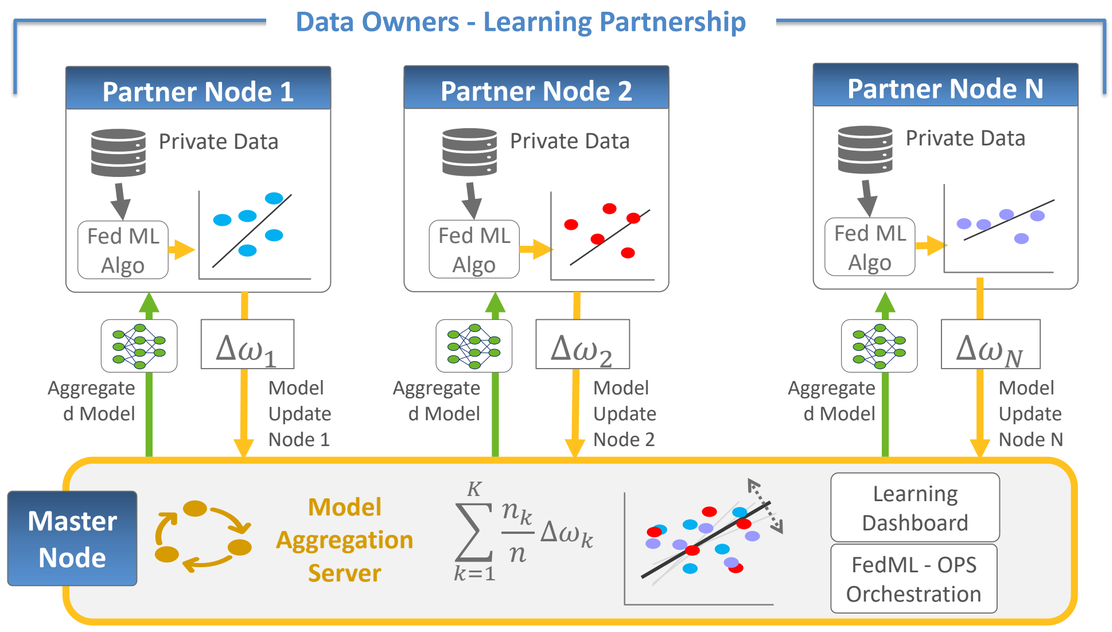
The **AICHAIN project** is proposing **an innovative digital information management (DIM) concept** that will help exploit those valuable private datasets through machine learning collaboration on private data sets with no exchange of sensitive data.

Concept proposed

AICHAIN Technological Solution = **Federated Machine Learning** + **Blockchain network** + **Governance and Incentives**

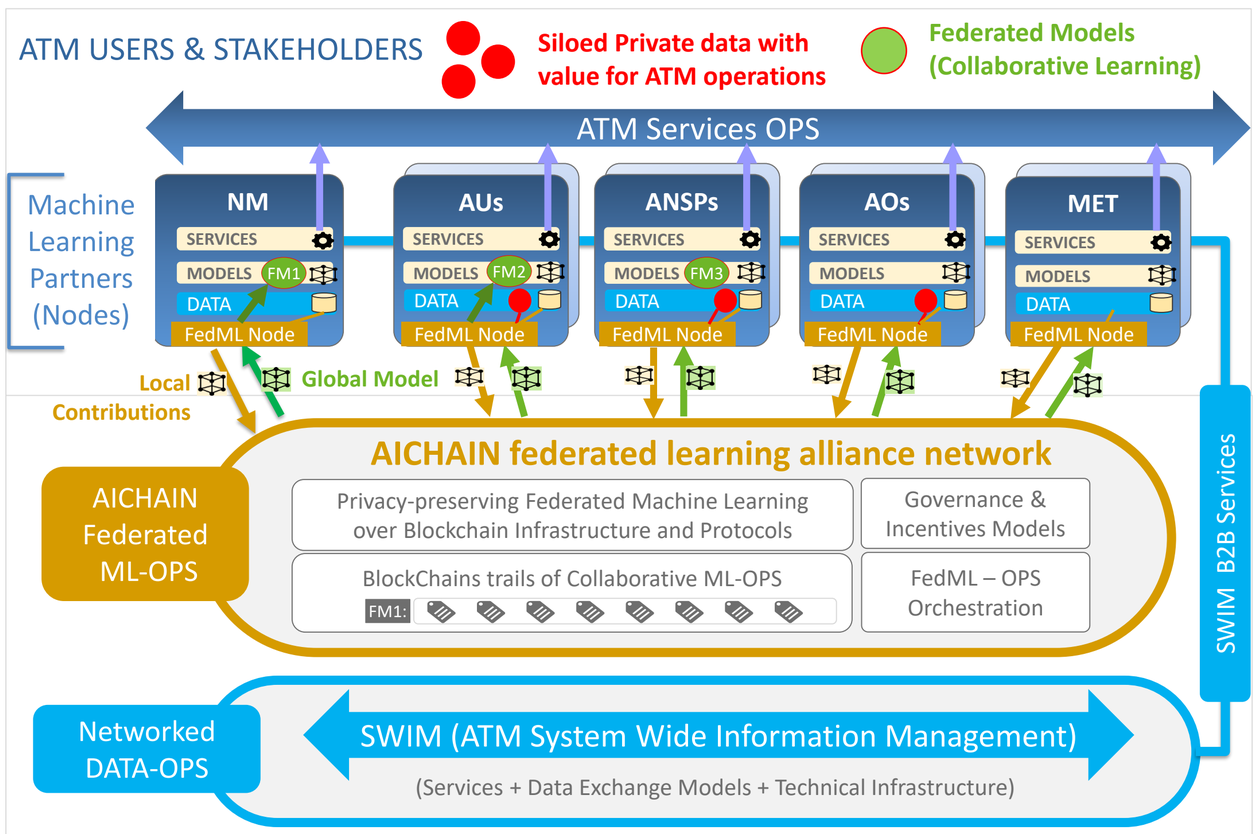
Federated Machine Learning

FedML concept consist in sharing the ML models instead of the data, and training them in a federated way (i.e., distributed and collaborative). **Only the ML parameters locally trained are shared** and then merged into an aggregated model in the master node. **Blockchain** is added to grant **strong cyber-security** and **trust** among parties.



Technical Solution in ATM context

AICHAIN Technological Solution aims to become a new **SESAR technology enabler** as a part of ATM Data and Information Management infrastructures.



Research Areas and Methodology

Research Question | Topics researched | Research Answers

Tech. Area — AICHAIN Technology Solution Architecture and Experimental Prototype

1 **Is the AICHAIN enabler feasible?**
(i.e., is it possible to exploit information in a federated way while preserving trust, cyber-security and scalability?

Target Architecture | Experimental Prototype

→ Experimental Evidence Of Cyber Security, Trust, Privacy protection

ATM Ops Area — Operational Value experiments and analysis with an ATM Use Case

2 **Does the solution bring operational value to ATM?**
(i.e. can AICHAIN help to improve the ATM performance e.g. capacity, cost-efficiency, predictability, etc.?
Use cases selected within the Demand Capacity Balancing (DCB) Operational Focus Area of ATM.

Data Sets for FedML Experiments | ATM Operations Predictability → ETOT Prediction, Impact of DCB, Airspace Users reaction to DCB measures

→ Experimental Evidence Of Operational Improvements (in a DCB use case)

Gov. Area — Governance and incentives Models

3 **Will data owners be motivated to share data value?**
(i.e., which potential incentive mechanism could be implemented in future research?)

Rules for participants | Participant benefits | Incentive instruments | Equity & Access | Regulation compliance

→ Expert Panel Qualitative Validation Workshops

Expected Outcomes of the Project

1. **AICHAIN Architecture proposal** (as a potential future SESAR Enabler for multiple Operational Improvements and ATM use cases)
2. **A functional prototype** (to proof the benefits of federated machine learning in ATM operations while ensuring data privacy and trust)
3. **Proof of AICHAIN potential operational benefits** (quantitative & qualitative evidence)
4. **Governance & incentive mechanisms** (towards the smooth integration and use of the AICHAIN enabler in operations)

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