

**ANESTIS DALGKITSIS
ALEXANDROS KOUFAKIS**

JORRIT STUTTERHEIM, ALEANDRO MIFSUD, PRIYANKA ATWANI, LEON GOMMANS, CEES DE LAAT, CHRYSA PAPAGIANNI, ANA OPRESCU

MICROSERVICE-BASED FABRIC COLLABORATIVE MODEL TRAINING



INTRODUCTION

- ▶ **Collaborative Model Training with Federated Learning**
- ▶ An approach that enables multiple organizations to train machine learning models on decentralized data, while maintaining data privacy and sovereignty.
- ▶ **Key Benefits**
- ▶ Enhanced privacy and security compared to traditional approaches, making it valuable in sectors with sensitive data (e.g. healthcare, building retrofitting financing).

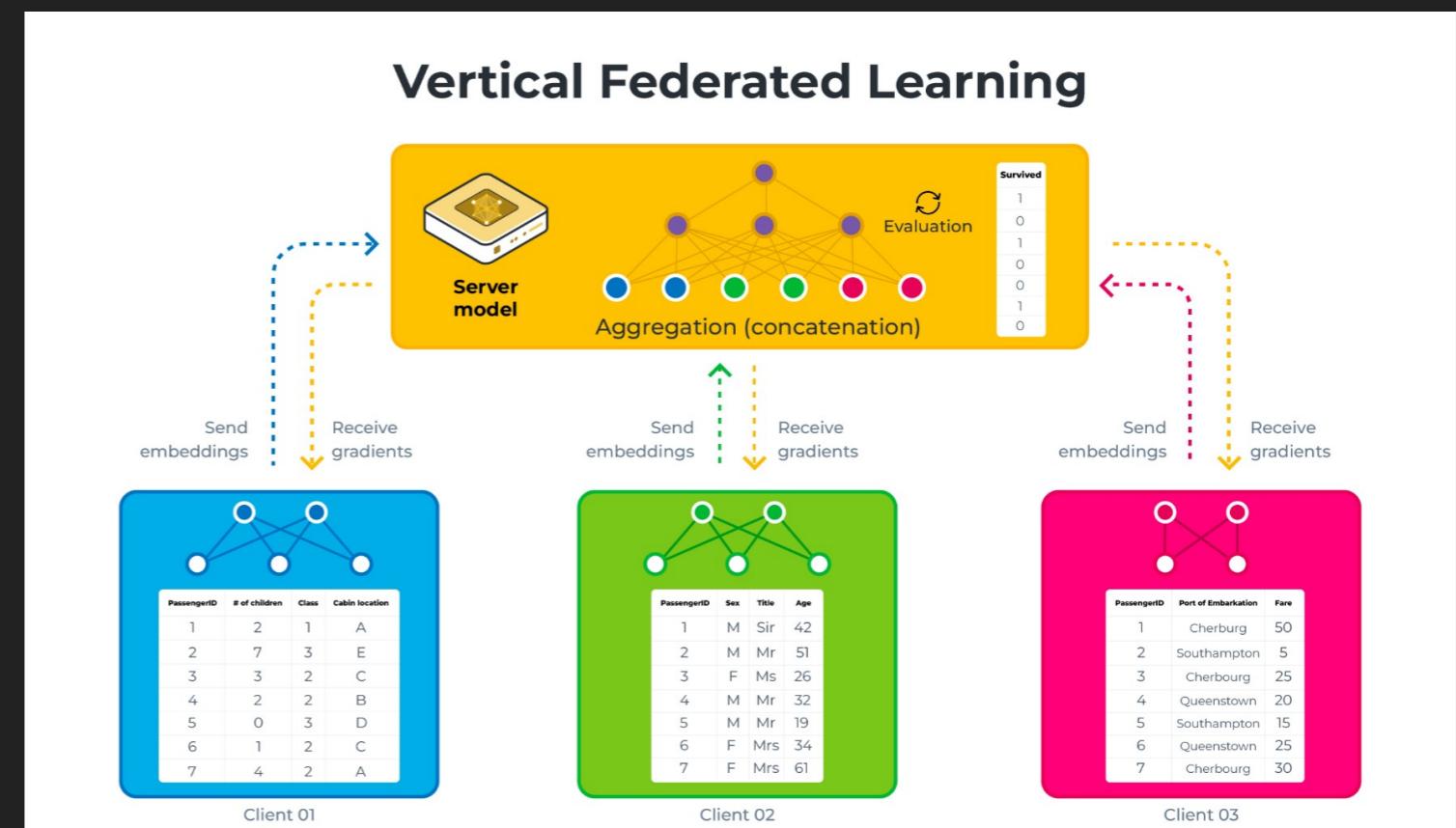
CONTRIBUTIONS

- ▶ Demonstrate **Secure Collaborative Model Training** with **Vertical Federated Learning** for the building energy consumption prediction use case.
- ▶ Use **Microservices Architecture** to allow for digital data exchange while ensuring privacy and contractual agreements.
- ▶ Use **FABRIC** to create a *realistic, multi-site networking slice and evaluate the implementation.*

MICROSERVICES-BASED FABRIC VFL COLLABORATIVE MODEL TRAINING

BACKGROUND

- ▶ **DYNAMOS Microservices Orchestration**
 - ▶ Flexibility, scalability, and resilience by enabling independent deployment, management, and scaling of individual components
- ▶ **Vertical Federated Learning**
 - ▶ Distributed Model
 - ▶ Clients have heterogeneous features
 - ▶ Common set of samples among the clients



USE CASE

- ▶ Vertical Federated Learning for **building energy consumption prediction** based on data from different sources.
- ▶ EU Client 1: Building registry (area, floors, windows)
- ▶ EU Client 2: Weather data (temperature, humidity)
- ▶ US Client 1: Energy Provider (energy consumption)

CONSUMPTION IS THE
TARGET VARIABLE

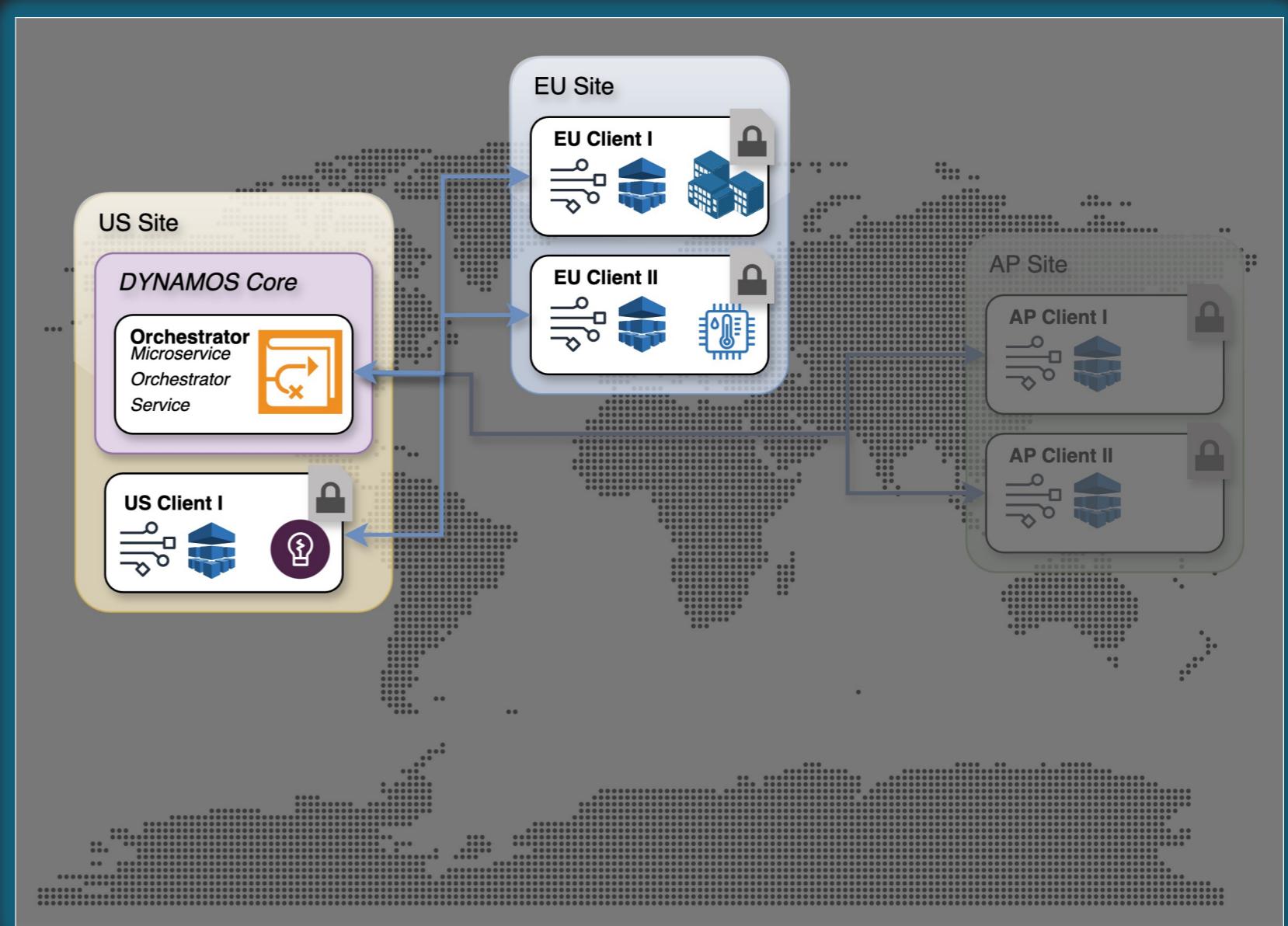
ID	Area	Floors	Windows
1	130	1	10
4	50	1	3
5	75	2	4

ID	Temp	Humidity	Date
1	20	80	2024-01-01
4	24	90	2024-01-01
5	16	90	2024-01-01

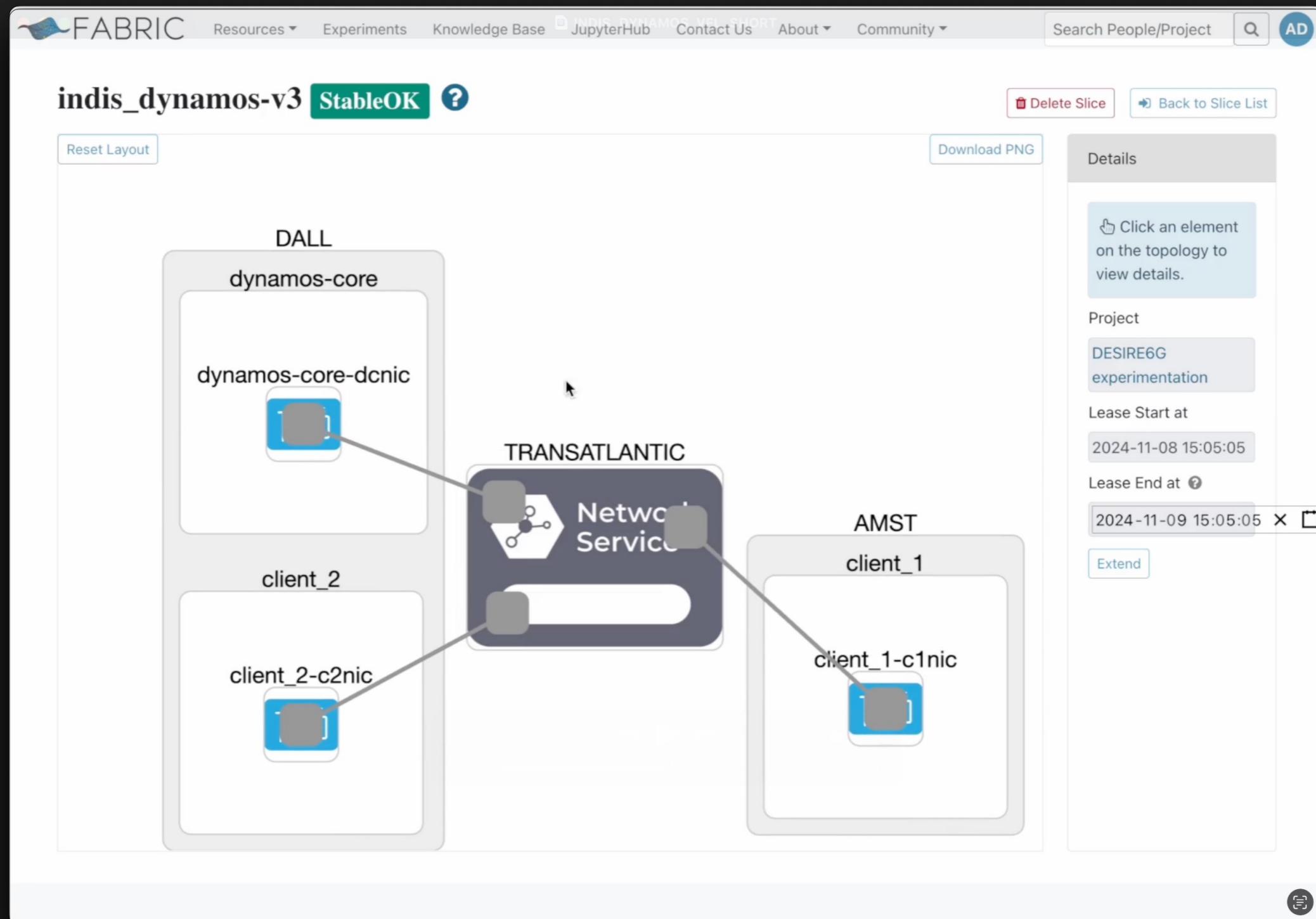
ID	Consumption	Date
1	200	2024-01-08
4	260	2024-01-08
5	180	2024-01-08

FABRIC SLICE

- ▶ Demo focused on two international sites.
- ▶ Emulating a scenario with 3 inter-site clients:
 - ▶ 2 clients in EU AMST
 - ▶ 1 client in US CIEN
- ▶ VFL Aggregator is deployed at the US site.
- ▶ L2STS Networking, Transatlantic data transfers between sites.



SLICE DEPLOYMENT



MICROSERVICES-BASED FABRIC VFL COLLABORATIVE MODEL TRAINING

DEMO

The diagram illustrates a microservices-based fabric VFL collaborative model training architecture. At the center is a black rectangular box labeled "Utility Company". Three dashed lines connect it to three green circular icons representing data providers: "Building Registry", "Weather Station", and "DYNAMOS".

The "DYNAMOS" provider is highlighted with a blue border. To its left is a screenshot of a web browser window titled "DYNAMOS" with the URL "localhost:5173". The browser shows a form with fields:

- Request type: VFL-demo
- Username: research@uva.nl
- Password: (redacted)
- Aggregation node: Utility Company
- Data providers: Building Registry, Weather Station
- More options: Bedroom windows, Build year

A large blue button at the bottom of the form says "Send". Below the browser is a small blue circular icon with a white "i" and the text "Getting gradients...".

To the right of the "DYNAMOS" node is a terminal window titled "k9s" showing Docker stats for containers "k8s_flwr-clientapp-3_prets-8d48658d4-ffbp4_prets_635629a9-73b0-4a77-9e29-364f1176f4a9_0", "k8s_flwr-clientapp-2_prets-8d48658d4-ffbp4_prets_635629a9-73b0-4a77-9e29-364f1176f4a9_0", and "k8s_superexec_prets-8d48658d4-ffbp4_prets_635629a9-73b0-4a77-9e29-364f1176f4a9_0".

At the bottom of the screen are four terminal windows labeled "client-1", "client-2", "client-3", and "client-3 aggregator". Each window displays the command "ls --color=auto prets-8d48658d4-ffbp4:" followed by a timestamp and a file name (e.g., "checkpoint_1731679384.9665449.pth").

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FIND US: CIENA BOOTH 1940

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INFORMATION

