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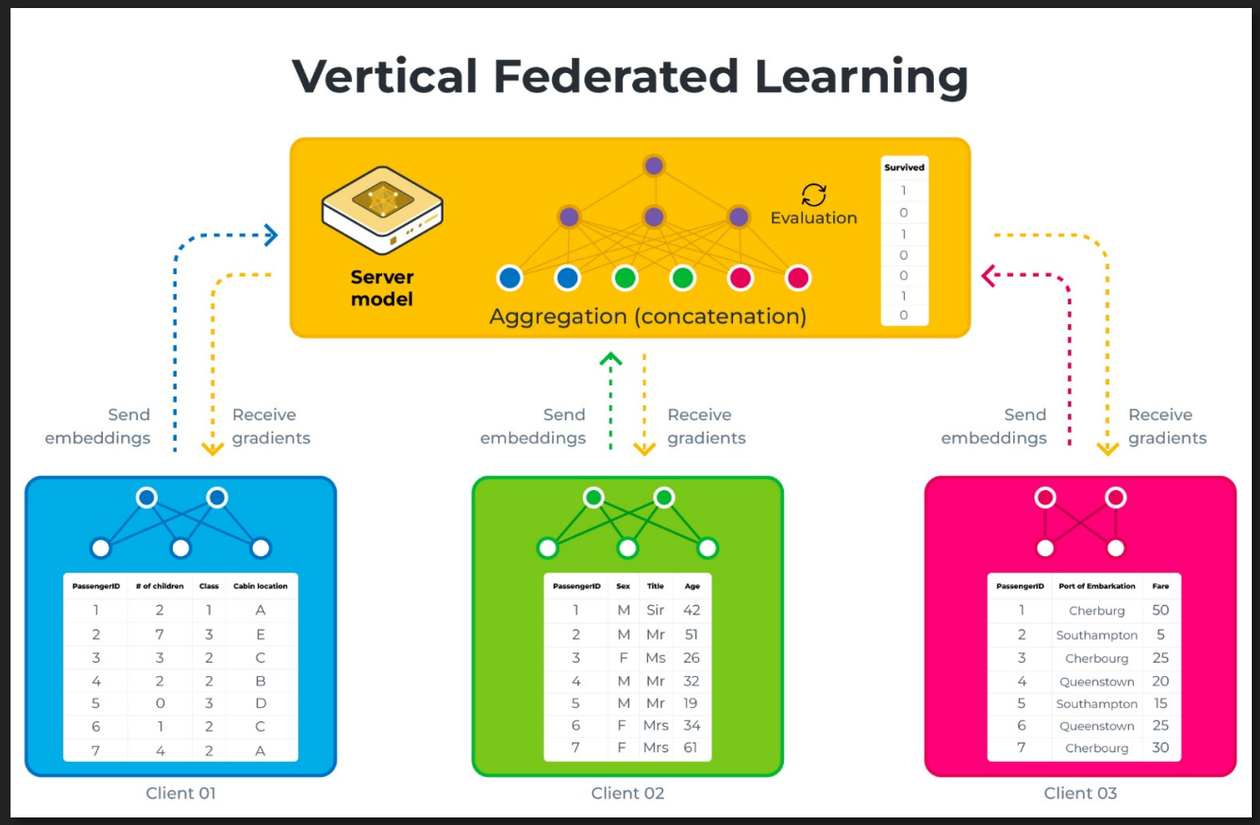
SECURE COLLABORATIVE MODEL TRAINING WITH VFL IN MULTI-DOMAIN ENVIRONMENTS

INTRODUCTION

- Collaborative Model Training
  - 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).

BACKGROUND

- **Federated Learning**
  - Collaborative model training with decentralized data.
  - Ensures privacy, governance, and controlled data access.
- **Vertical Federated Learning**
  - Utilizes distributed models for collaboration.
  - Handles heterogeneous features across clients.
  - Operates on a shared sample set among participants.



Flower Framework

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 the FABRIC FAB Testbed to create a realistic, multi-site networking slice and evaluate the implementation.*

DYNAMOS – DYNAMICALLY ADAPTIVE MICROSERVICE-BASED OS

- Microservice-based: flexibility, scalability, and resilience by enabling independent deployment, management, and scaling of individual components
- DYNAMOS Core
  - Dynamically creating and adapting the microservice chains according to policies and agreements
- DYNAMOS Agents
  - The heterogeneous clients participating into the collaborative training

ICSA Paper

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USE CASE

- Vertical Federated Learning for **Building Energy Consumption Prediction**
  - Harnessing data from diverse sources to predict energy usage.
- **Global Context:**

- Buildings contribute **20–40%** of energy consumption in developed countries, surpassing industrial and transportation sectors.
- **HVAC systems** are significant, accounting for:
  - **50%** of building energy consumption.
  - **20%** of total energy consumption in the USA.
- *(Source: "A Review on Buildings Energy Consumption Information")*

USE CASE

Opportunities:

- **Demand Forecasting:** Predicts peak times to optimize usage and reduce waste.
- **Retrofitting Advice:** Identifies inefficiencies and suggests targeted energy-saving upgrades.
- **Renewable Integration:** Aligns energy consumption with sources like solar or wind.
- **IoT and Smart Devices:** Enables real-time adjustments for efficient energy use.

USE CASE

- Data providers:
  - EU Client 1: Building registry (area, floors, windows)
  - EU Client 2: Weather data (temperature, humidity)
  - US Client 1: Energy Provider (energy consumption)

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

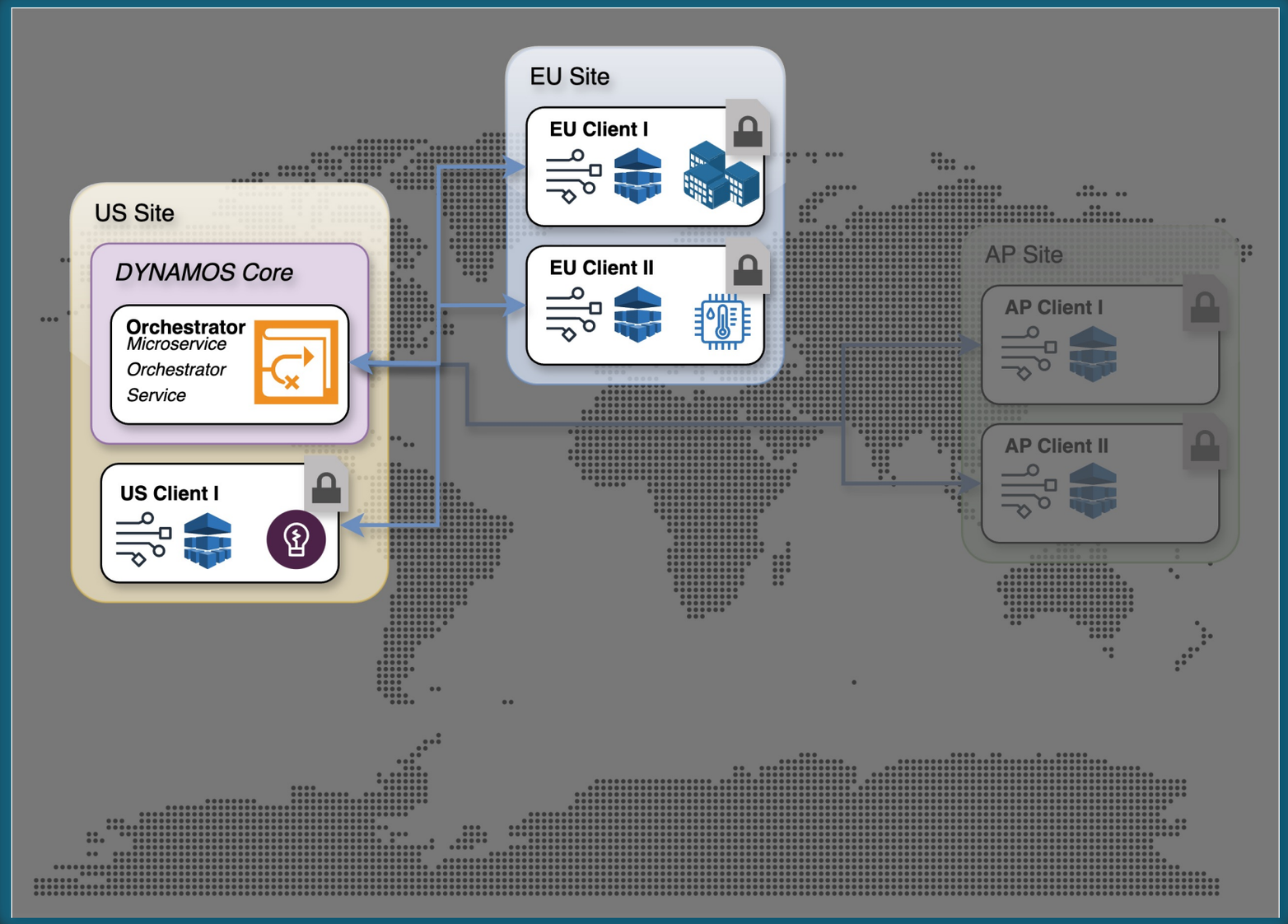
ID	Temp	Humidity	Date
1	20	80	2024-01-01
4	24	90	2024-01-01
5	16	90	2024-01-01

CONSUMPTION IS THE TARGET VARIABLE

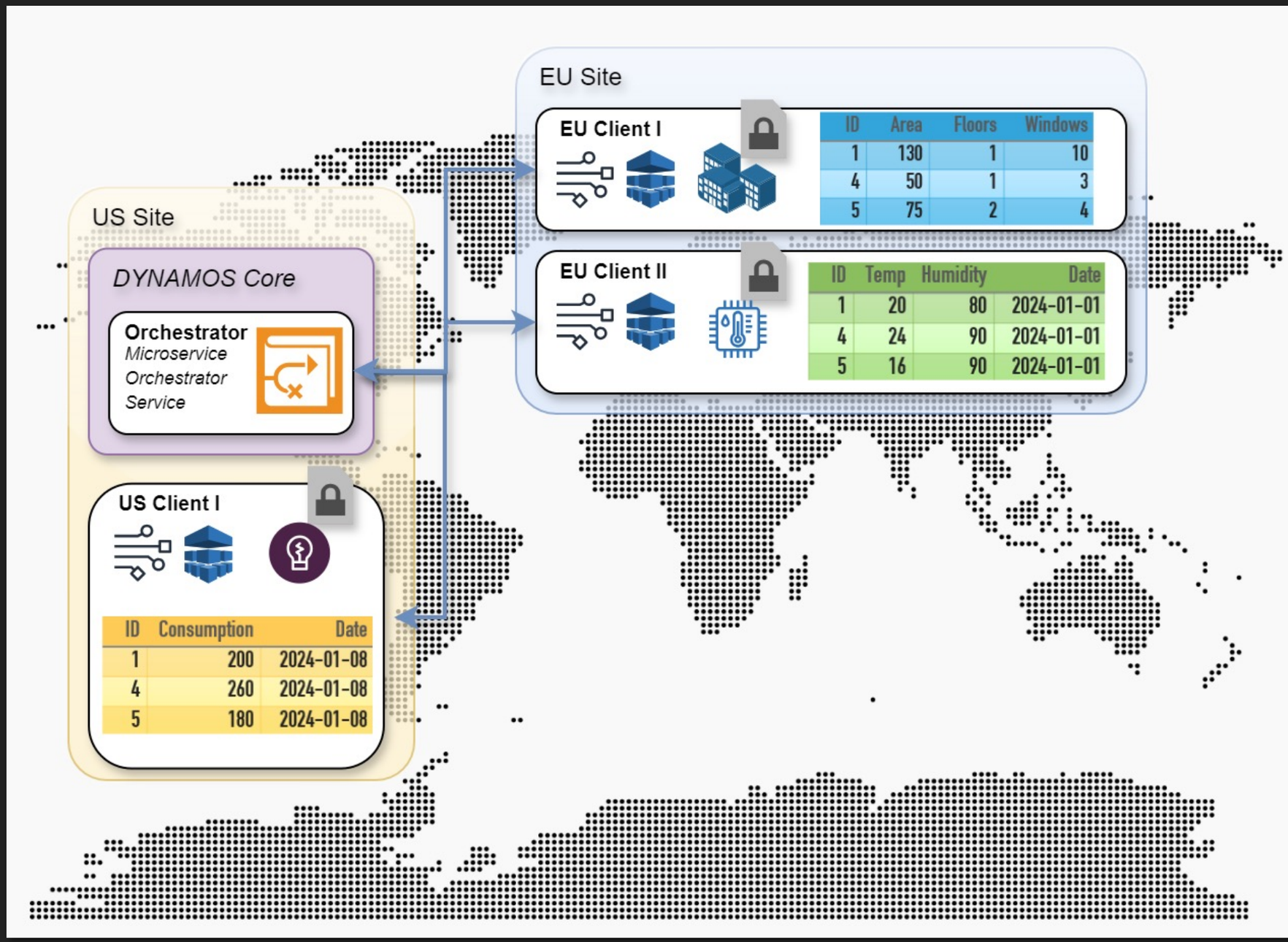
ID	Consumption	Date
1	200	2024-01-08
4	260	2024-01-08
5	180	2024-01-08

MULTI-SITE FABRIC SLICE DEMO

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



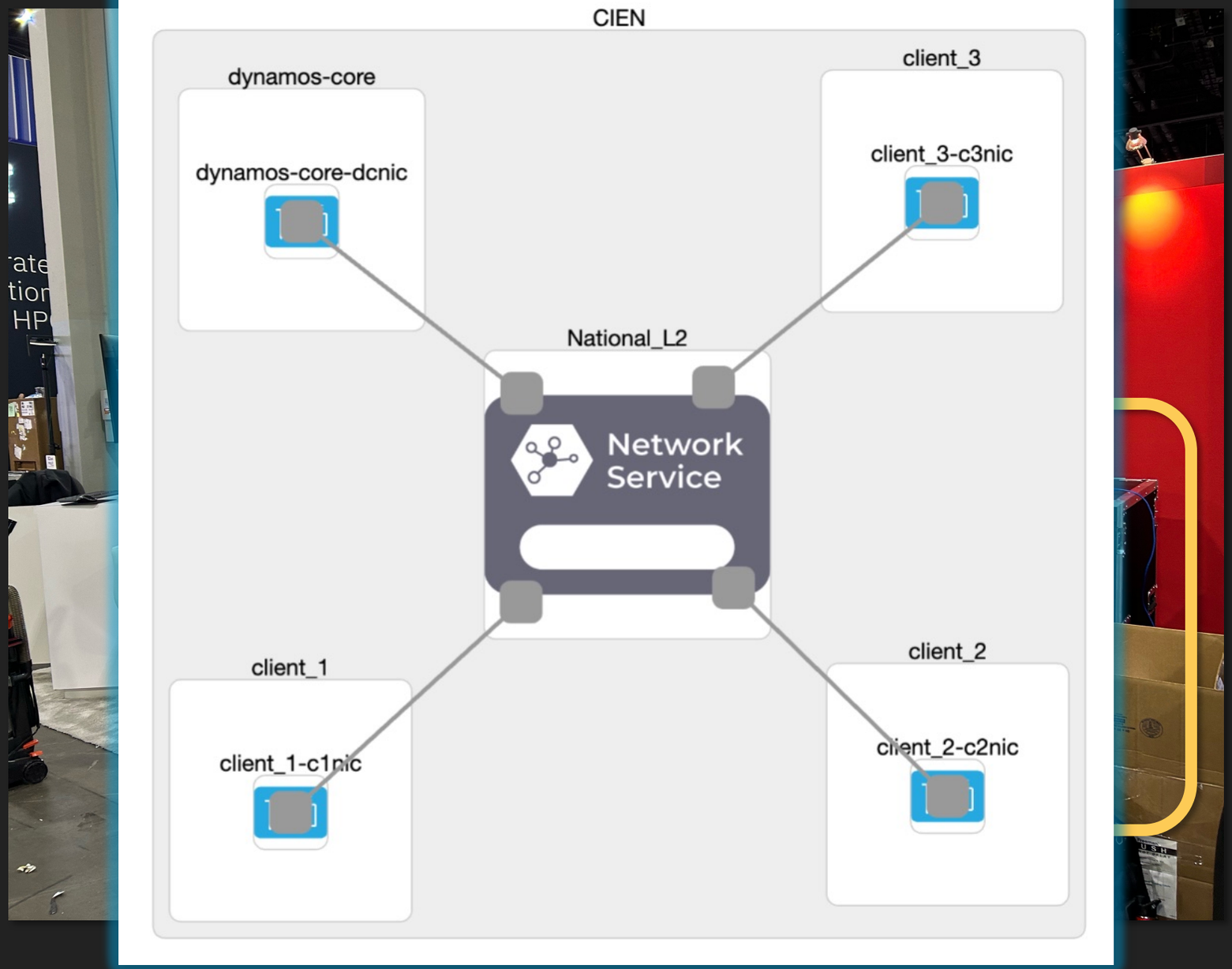
DEMO: VFL FOR BUILDING ENERGY CONSUMPTION PREDICTION



CIENA TRAVELLING FABRIC NODE SC24 DEMO

- US site-only nodes hosted at the CIENA travelling FABRIC node, here at SC24!
- You can find us at the CIENA Booth 1940.

⬅ This way!



EU Site

Building Registry

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

Weather Station

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

US Site

DYNAMOS Core

Orchestrator
Microservice Orchestrator Service

Utility Company

Aggregation (concatenation)

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

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DISCUSSION

FIND US: CIENA BOOTH 1940

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INFORMATION