



**eSAAM 2023**

**on Cloud to Edge Continuum**

# AI and Edge Computing: Driving Competitive Advantage for Businesses

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Oct. 17, 2023

Ludwigsburg, Germany

# Intro: What's IKERLAN

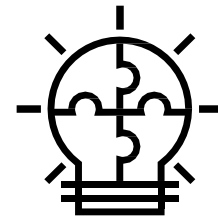
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We are a  
**technology center.**

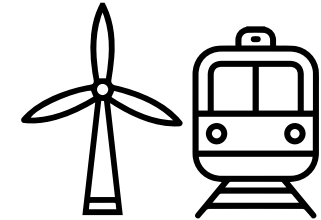
We focus on the  
**transfer of knowledge to Industry.**

# ikerlan

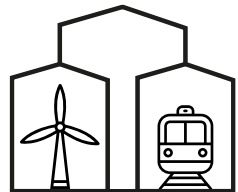
MEMBER OF BASQUE RESEARCH  
& TECHNOLOGY ALLIANCE



SOLUTIONS



COMPANIES



## Sectors



OVER  
**407**  
PEOPLE

- 43 % Transport and mobility
- 19 % Manufacturing
- 14 % Energy
- 5 % Services and other industries
- 7 % Automotive
- 2 % Health
- 1 % Aeronautics



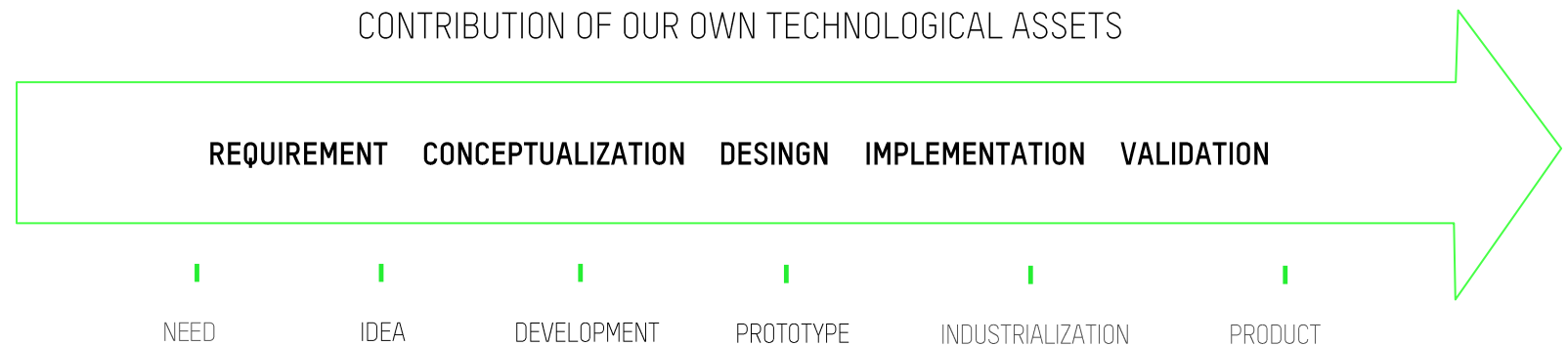
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# Intro: What's IKERLAN

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**We develop industrial prototypes** through the application for our technological knowledge.

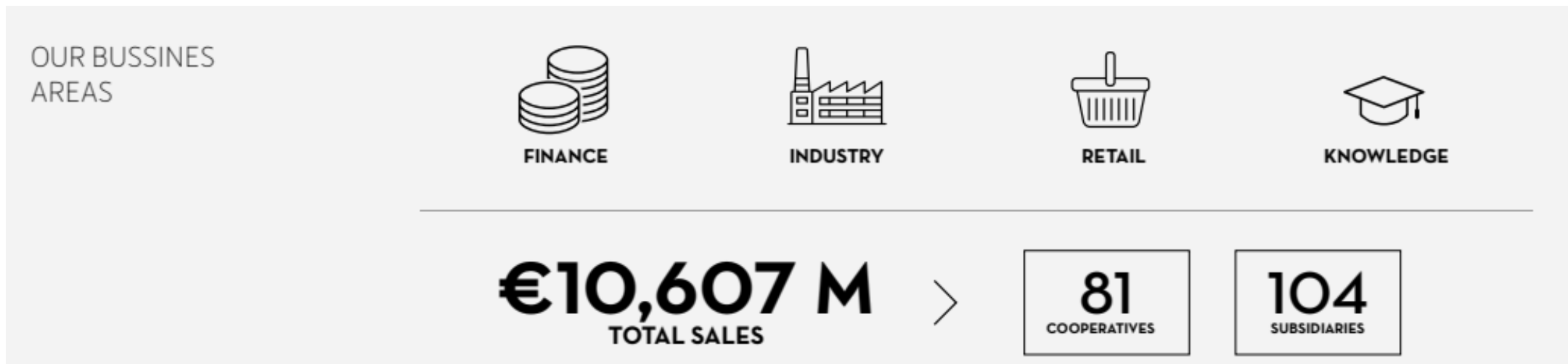
OUR PARTICIPATION  
IN PROJECTS



# Intro: What's MONDRAGON

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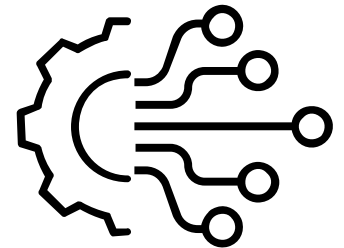
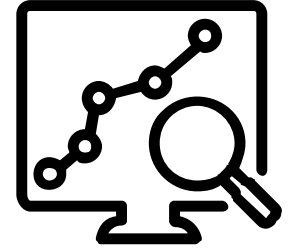
- Top 10 Industrial Group of Spain, #1 in Basque Country region
- Corporation of Cooperative Companies
- Workforce of >70.000 people
- 174M€ in R&D&i in 2022



# AI & Industry & Open-Source

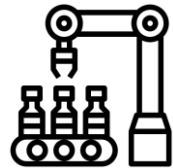
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- AI in the Edge-Cloud Continuum for Industry:
  - MLOps
  - Collaborative AI
  - AI optimization
  - Data Spaces
- Integrating Open-Source Technologies:
  - Interoperability
  - Vendor neutrality
- Open-Source as *Building Blocks*
- Customization as *Glue*



# Use Cases

*Manufacturing Use Case*  
Mondragon Assembly  
Federated Learning and AI in  
production



*Industrial Use Case*  
Multiple Clients  
AI in the Edge and IoT



*Research*

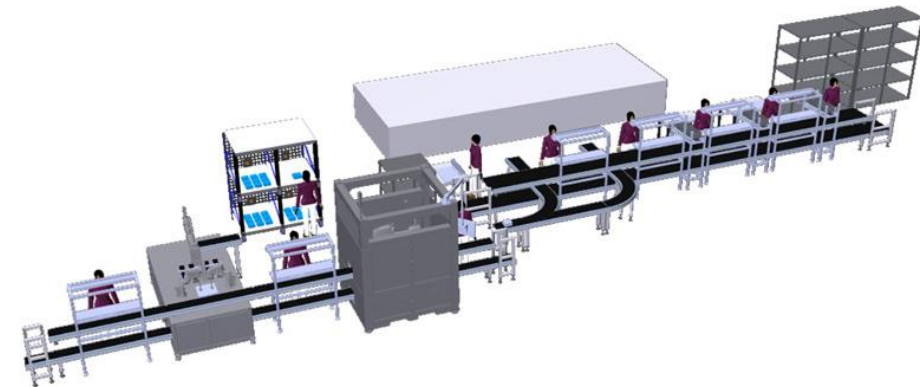
FaaS Framework  
IoT & Edge to Cloud Continuum



# Mondragon Assembly Use Case

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- International reference in automation and assembly solutions
- International presence
- 3 Business Units:
  - Automation
  - Turnkey lines for PV modules manufacturing
  - Turnkey lines for battery pack technologies

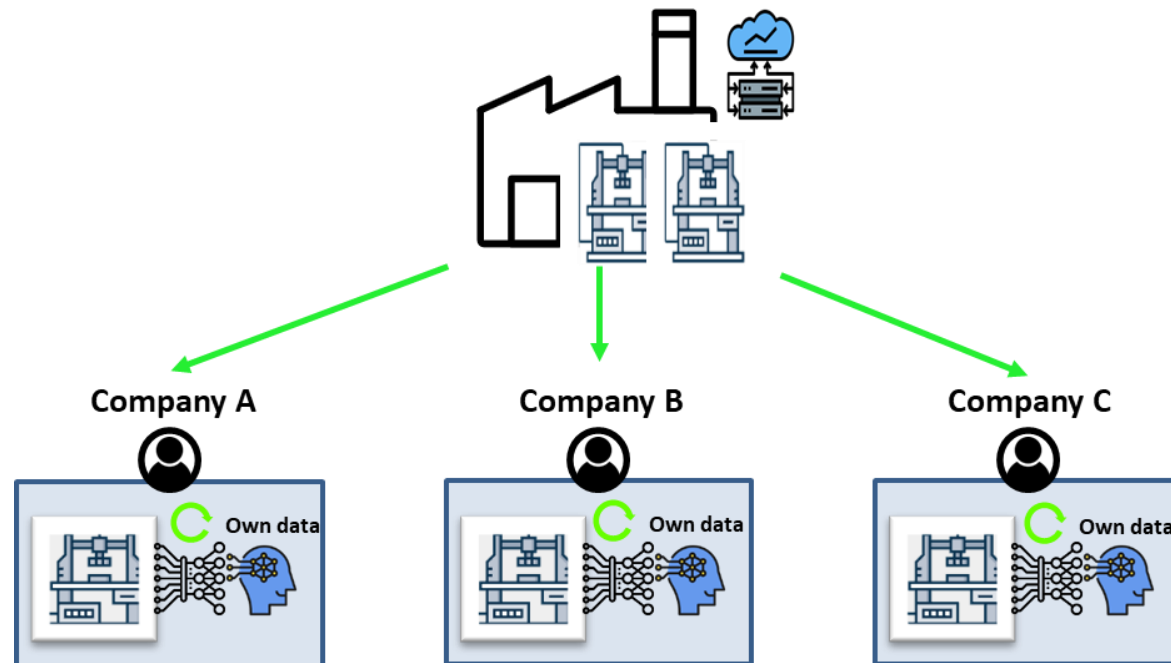


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# Mondragon Assembly Use Case

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- Use Case with various AI models for predictive maintenance, defect detection, etc.
- Each automation line is deployed in different plants/clients



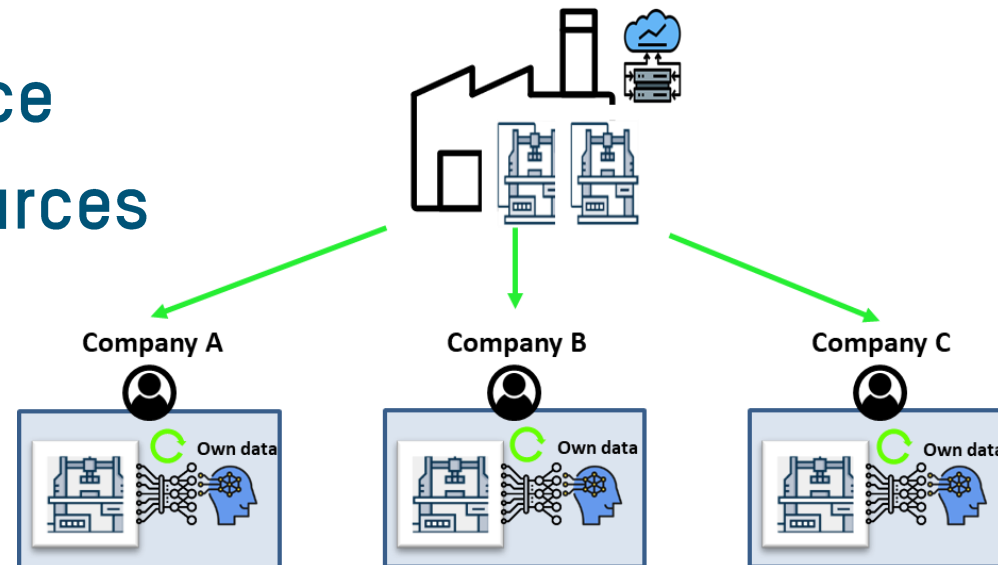
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# Mondragon Assembly Use Case

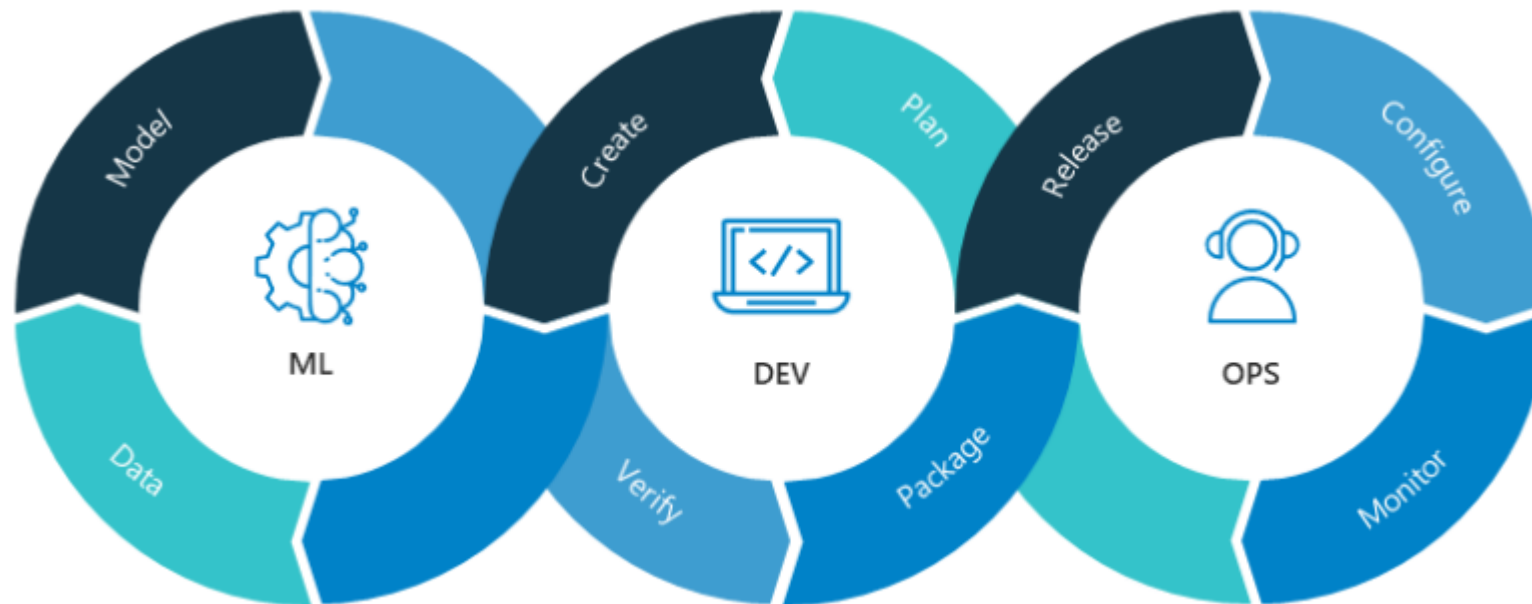
- How to train a common model without sending data to the Cloud?
  - *Federated Learning*: decentralized ML approach where models are trained locally on distributed edge devices without sharing raw data
- Using Open-Source
- Using Edge Resources



# Mondragon Assembly Use Case

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- How to take the AI models from PoC stage to production?
  - **MLOps**: manage the full life-cycle of the models, from taking the data, training, deploying, detecting drift, retraining, etc.



 Flower

 mlflow™

 Apache  
Airflow

 EVIDENTLY AI

# Mondragon Assembly Use Case

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## MLOps plataform with Federated Learning and Distributed AI

The screenshot displays the FL-ops MLOps platform interface. At the top, it features the Mondragon Assembly logo, the FL-ops logo, and the ikerlan logo (Member of Basque Research & Technology Alliance). The navigation bar includes 'Home', 'General', and 'Diagram' tabs.

System metrics are shown at the top of the main content area:

- Number of registered clients: 3
- Number of clients requiring training: 0
- Minimum number of clients to train: 3
- Number of models in IDS space: 8

Two diagrams illustrate the system architecture and workflow:

- Architecture Diagram:** Shows a 'Data Space' connected via 'IDS Connectors' to a 'Server Node' and three 'Client' nodes (Cliente\_1, Cliente\_2, Cliente\_3). Each client is labeled 'Collecting\_data'.
- Workflow Diagram:** A linear process starting with 'Initialize', followed by 'Collecting data & Monitoring' (highlighted in green), then a 'Training Process' block containing 'Waiting for Clients', 'Training', and 'Aggregate & Evaluate'. The final step is 'Deploy models'.

The 'Models' section at the bottom contains a table with the following data:

Name	Latest Version	Staging	Production	Last Modified	Tags
Cliente_1-axis_failures_federated	Version 6	-	Version 3	30/5/2023, 0:00:48	-
Cliente_2-axis_failures_federated	Version 12	-	Version 9	30/5/2023, 8:30:47	-
Cliente_3-axis_failures_federated	Version 12	-	Version 9	30/5/2023, 8:31:02	-



# Mondragon Assembly Use Case

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## MLOps plataform with Federated Learning and Distributed AI

The screenshot displays the MLFlow MLOps platform interface. At the top, there are navigation tabs for 'Home', 'General', and 'Cliente\_1'. A 'Diagram' button is visible in the top right corner.

The main interface is divided into two panels. The left panel, titled 'Data Space', shows a central 'Server Node' connected to three 'Cliente' nodes (Cliente\_1, Cliente\_2, and Cliente\_3). Each client node is labeled 'Collecting\_data'. The 'Server Node' contains an 'IDS Connector' icon. A dashed red line connects the 'Server Node' to a 'Data Space' icon on the left.

The right panel, titled 'Cliente\_1 information:', provides details for the selected client:

- IP Address: 172.16.56.28
- Register timestamp: 2023-05-24T09:43:45.197Z
- Client status: Collecting\_data

Below the main panels, there is a navigation bar with tabs for 'Model life cycle', 'Time series', 'Model monitoring', and 'Model history'. The 'Model life cycle' tab is selected.

The main content area shows a workflow titled 'ConceptDrift\_evaluation\_process'. The workflow is displayed as a directed graph with the following steps:

```
graph LR; create_table[create_table] --> check_unprocessed[check_unprocessed]; create_table --> wait_for_simulations[wait_for_simulations]; check_unprocessed --> skip_generate_simulations[skip_generate_simulations]; check_unprocessed --> generate_simulations[generate_simulations]; skip_generate_simulations --> evaluate_p_value[evaluate_p_value]; generate_simulations --> evaluate_p_value; evaluate_p_value --> determine_conceptdrift[determine_conceptdrift]; determine_conceptdrift --> fl_train[fl_train]; determine_conceptdrift --> skip_training[skip_training];
```

The 'evaluate\_p\_value' step is highlighted in red and labeled 'failed'. The 'Next Run' is scheduled for 26/9/2023, 7:55:00. A legend on the left side of the workflow area indicates the status of each step: Queued, Running, Success, Failed, and Up For Retry.



# Mondragon Assembly Use Case

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## MLOps plataform with Federated Learning and Distributed AI

The screenshot displays the Dataspace Connector interface. At the top, there are navigation tabs for Home, General, and IDS Connector. The main header shows 'Dataspace Connector' with a sub-label 'Dataspace Connector'. Below this, there are five summary cards: 'Data Sources' (9), 'Data Offerings' (8, 848 bytes), 'File Types' (application/zip), 'Active Incoming Contracts' (0), and 'Policy Templates' (0). Each card has a corresponding action button: 'Register new', 'Share data', 'View agreements', and 'Define policy'. Below the summary cards is a 'Data Offerings' section with a search bar, a filter dropdown set to 'Show all resources', and a 'Register new' button. A table lists the offerings with columns for Creation date, Title, Keywords, and Agreements.

Creation date	Title	Keywords	Agreement
24/5/2023, 11:52:52	axis_failures_federated	AE,ML	0
25/5/2023, 0:00:35	axis_failures_federated	AE,ML	0
28/5/2023, 0:00:39	axis_failures_federated	AE,ML	0
29/5/2023, 0:00:37	axis_failures_federated	AE,ML	0

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# Industrial Use Case

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- How to use AI models in production in constrained devices?
  - Very common use case in lots of **industrial clients**
  - Use **current devices** in production to run AI workloads
  - Improve current processes with AI on the **Edge**
  - **Reduce cost**
  - Use **dynamic/elastic architectures** that can be updated to adapt fast



# Industrial Use Case

- How to use AI models in production in constrained devices?
  - AI optimization / **TinyML**
  - Deployment (**ML0ps-Edge0ps**) + Software Architecture
- Which kind of devices?
  - **Edge devices**: Microprocessors (x64, ARM Cortex-A, etc.) with capability to run containers and GNU Linux
  - **IoT devices**: Microcontrollers (ARM Cortex-M, Espressif, etc.) with baremetal Firmware or RTOS
- With what constraints?
  - **Availability** (continue running while offline) and **security**
  - **Run** with current applications



# Industrial Use Case

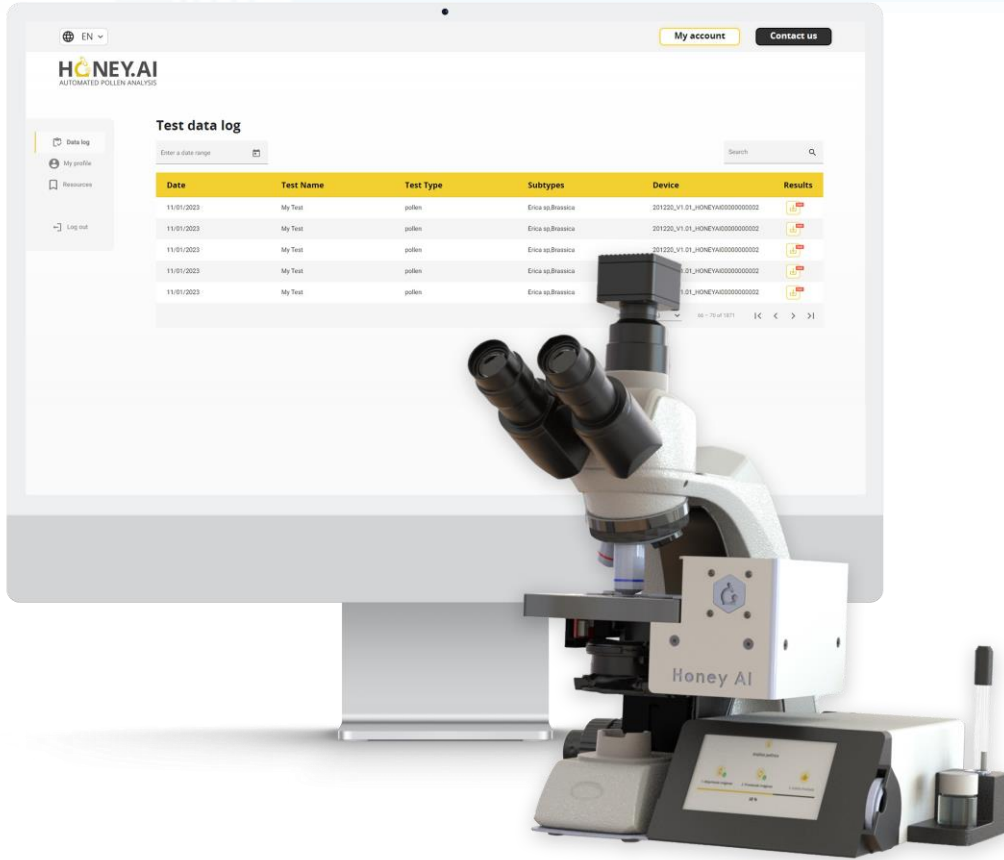
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- **AI optimization / TinyML**
  - **Frameworks:** TF Lite, TensorRT, PyTorch Mobile, ONNX, GLOW, Apache TVM, ARM NN, etc.
  - **Small and Efficient** networks (model architecture)
  - **Edge-Cloud Continuum:** Wide variety of hardware with different capabilities
  - Integration with **ML0ps-Edge0ps** to auto-optimize model for HW
- **Deployment & Architecture**
  - **Edge devices:** K8S, K3S, AWS Greengrass, Custom microservices deployment IKERLAN KonnektBox, etc.
  - **IoT devices:** Custom integration with baremetal, FreeRTOS, etc.

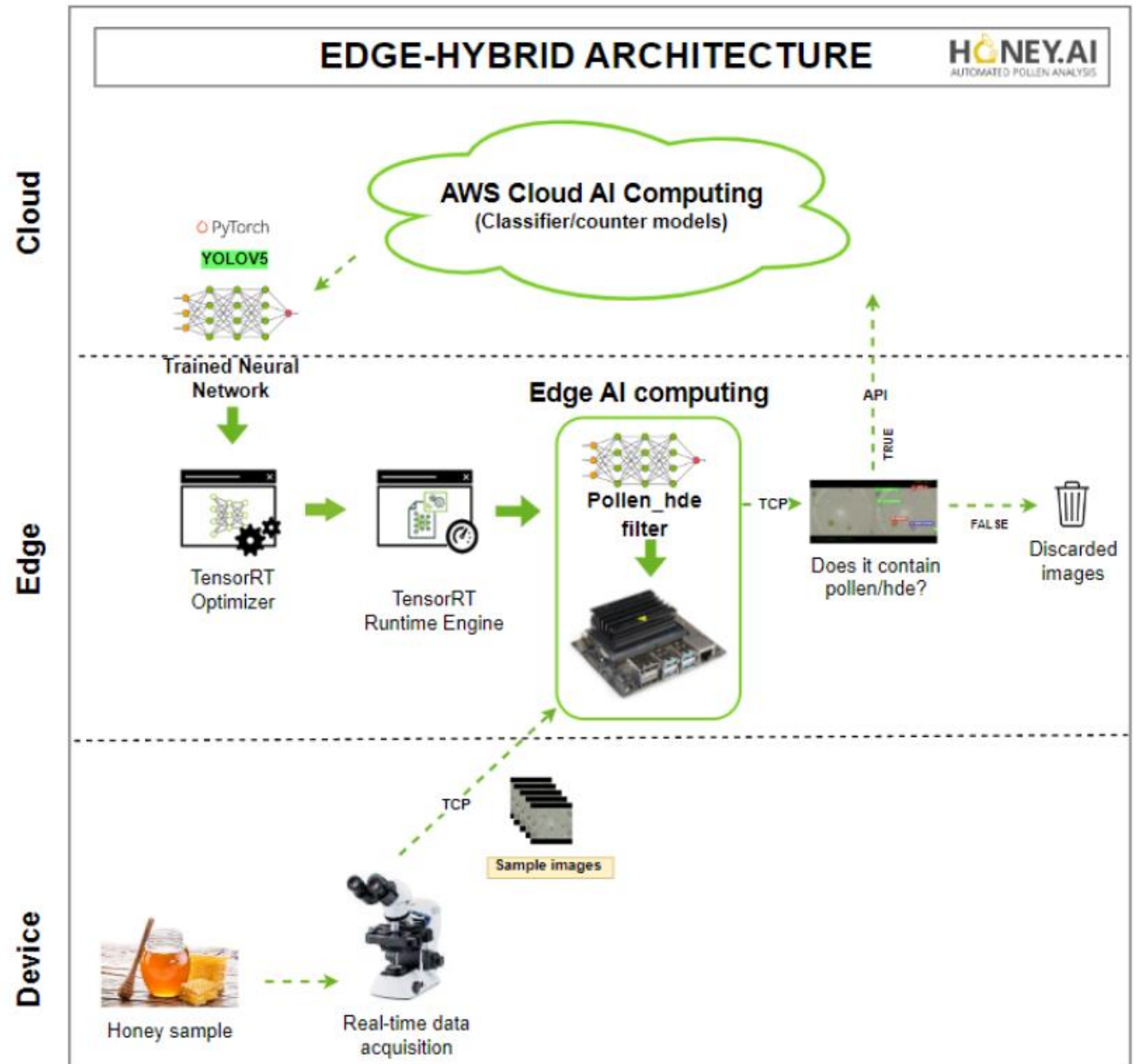




# Honey.AI



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Sovereign**EDGE**.EU

**COGNIT**

# A **Cognitive** Serverless Framework for the **Cloud-Edge Continuum**

**COGNIT.SovereignEdge.EU**

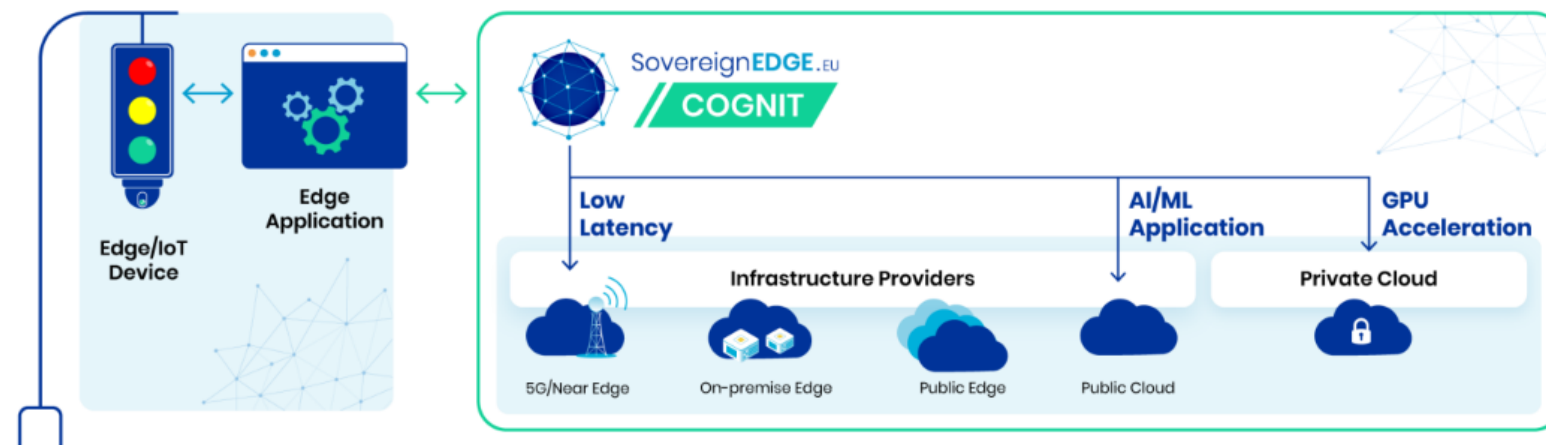


A project coordinated by **OpenNebula Systems** and funded by the European Union's **Horizon Europe** Research and Innovation programme, under Grant Agreement 101092711 – SovereignEdge.Cognit (2023-2025)

# Shaping the future in Cognit

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- Building an European Open Source FAAS *Function-as-a-Service* Framework
- Task offloading:
  - From IoT -> To the Edge-Cloud Continuum
  - The device decides **WHAT** and **WHEN** to offload
  - The framework decides **WHERE** to offload it in the continuum



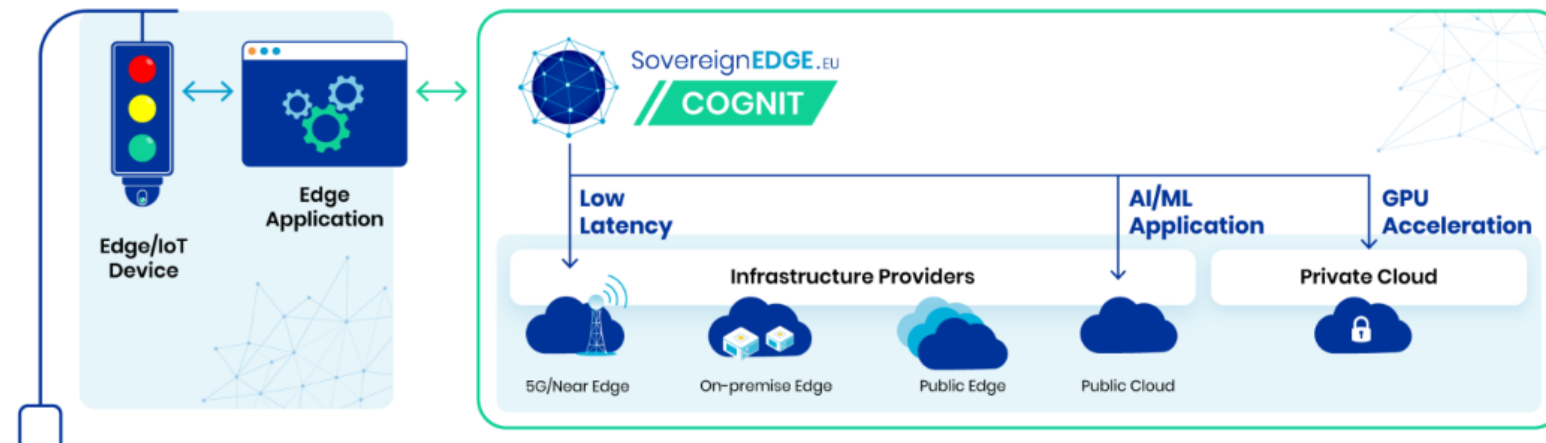
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# Shaping the future in Cognit

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- Define application and non-functional requirements to orchestrate the task offloading
  - **Low Latency** -> MEC 5G
  - **ML/AI based** -> Continuum resources with GPU
  - **Best effort** -> Cloud based
  - **Etc.**



Prometheus



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# Shaping the future in Cognit

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- Four validation use cases in different sectors

<b>1</b>  <b>Smart Cities</b> Coordinated by ACISA	<b>2</b>  <b>Wildfire Detection</b> Coordinated by Nature 4.0
<b>3</b>  <b>Energy</b> Coordinated by Phoenix Systems & Atende Industries	<b>4</b>  <b>Cybersecurity</b> Coordinated by CETIC and SUSE



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