ICOS

Towards a functional continuum operating system

Meta Operating Systems: Innovating the CEI landscape

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ICOS: Towards a functional continuum operating system

https://www.icos-project.eu/

Project Objective:

1. The ICOS project aims to design, develop, and validate a **meta-operating system** for a computing continuum.
2. This continuum integrates resources from the **Internet of Things**, edge computing, and cloud computing.

Challenges Addressed:

1. **Device Volatility and Heterogeneity**: Managing diverse devices with varying capabilities.
2. **Continuum Infrastructure Virtualization**: Creating a seamless infrastructure across edge and cloud.
3. **Optimized Service Execution and Performance**: Ensuring efficient and scalable service delivery.
4. **Resource Consumption**: Efficiently utilizing computing resources.

Project Information

ICOS

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EC signature date

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1 September 2022

End date

31 August 2025

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Digital, Industry and Space

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€ 10 997 675,00

EU contribution

€ 10 997 675,00

Coordinated by

ATOS SPAIN SA

Spain

ICOS ecosystem

Cloud Provider

Private oneCloud

On-Prem Data Lakes

Multi-Cloud Public Cloud

Storage & Analysis

aws

Azure

HPC center

Connect and extend computational capabilities to new and existing applications in the data center and/or cloud.

Near Edge Provider

This could be seen as a Cloud Provider extension where Cloud Providers (AWS, Azule, etc.) deploy and manage regional / local computation nodes following the same "cloud business models".

High-end AI and machine learning capability, powered by the world's highest performing Edge Computing server.

Far Edge Provider

Ad-hoc computatation node intalled and/or operatated by both an Vertical Service Provider and an Indipendent Vendor

Pre-configured µEdge Swarm (inteligent group) allows connection to any analog or digital device with embedded OT security and local processing

IoT/Edge devices Providers

Edge / Micro Controllers

Sensors / Actuators

Driver

Driver

Driver

Driver

Driver

IoT Gateway

Cameras

Drones

PLC

Motors

Sensors

Push Button

RFID Readers

Contactors

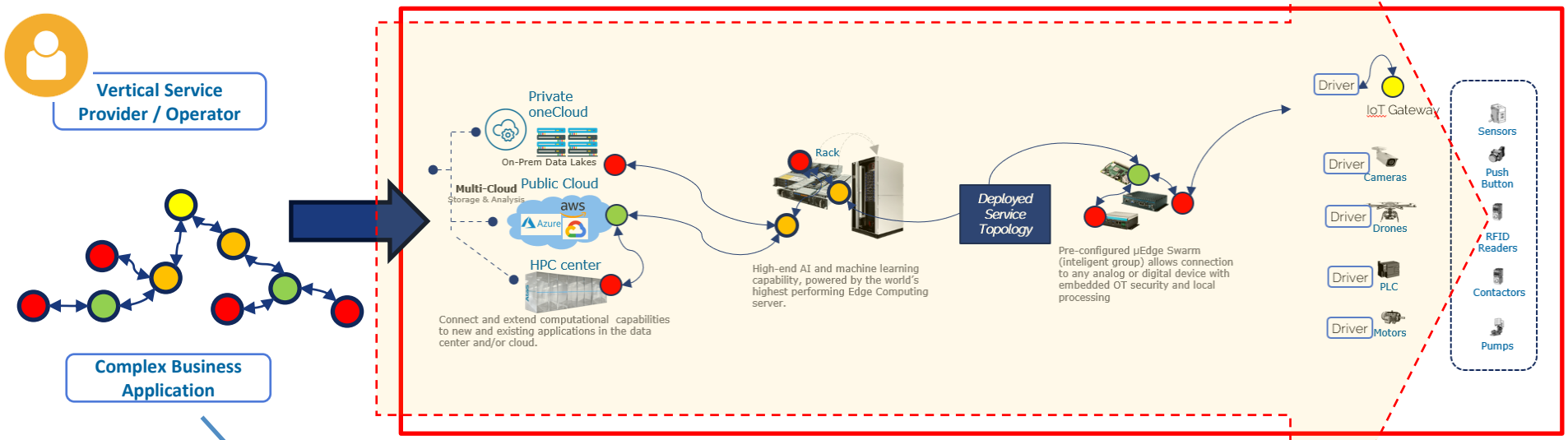
Pumps

Continuous infrastructure virtualisation: Create a seamless infrastructure across edge and cloud with awareness of connected IoT devices.

Device Volatility and Heterogeneity: Managing diverse devices with varying capabilities.

ICOS tools

a) Requirements-Aware
b) Optimization
c) Secure / Privacy
d) Abstracted Infrastructure
e) Proactive Governance
f) Distributed Data Management



Heterogeneous Software/Technology, diverse needs (Location, Privacy/Security, Performance, Eco-Efficiency, IoT)

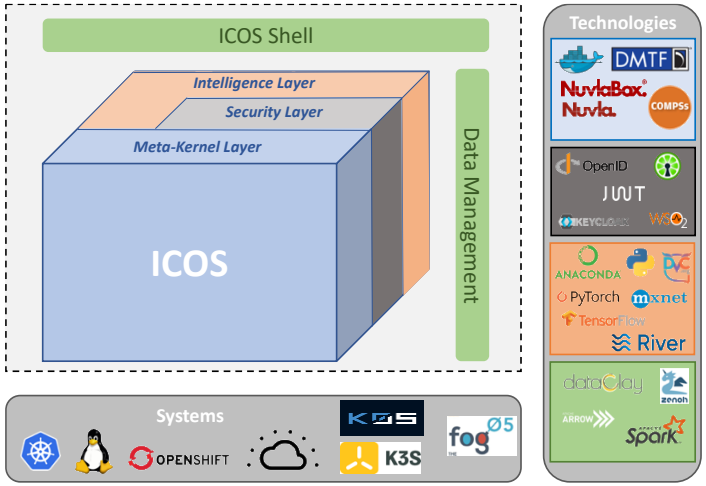
ICOS Challenges

1. Modeling strategy for *proactive continuum management* (dynamic deployment, configuration, migration, anomalies detection, SLA deviations, etc.)

2. *Decentralized AI-assisted approach* (online training under changing conditions, FL for privacy, etc.)

Key Innovation

6. Layered architecture managing the whole continuum (IoT to cloud)



3. *Dynamic and flexible data federation* between devices

5. Transparent deployment on top of native OSs

4. Open and unified programming model

Cloud Continuum Engineered by ICOS

Technical Impact

Design of an innovative, beyond SOTA ICOS ecosystem, providing a secure (common standards), smart (AI-assisted), efficient (green) and integrated (modular) platform for managing applications lifecycle across the continuum

Economic Impact

Feasibility demonstrated through the ICOS micro analysis, according to UCs KPIs and open call winners' specifications

EU Competitiveness

The ICOS ecosystem to contribute to the creation of a globally attractive, secure and dynamic data-agile economy, supporting the market to move beyond a simple send-data-to-the-cloud, offering new opportunities to European actors to establish market and services increasing EU's autonomy and performance in the data economy

https://www.icos-project.eu/deliverables

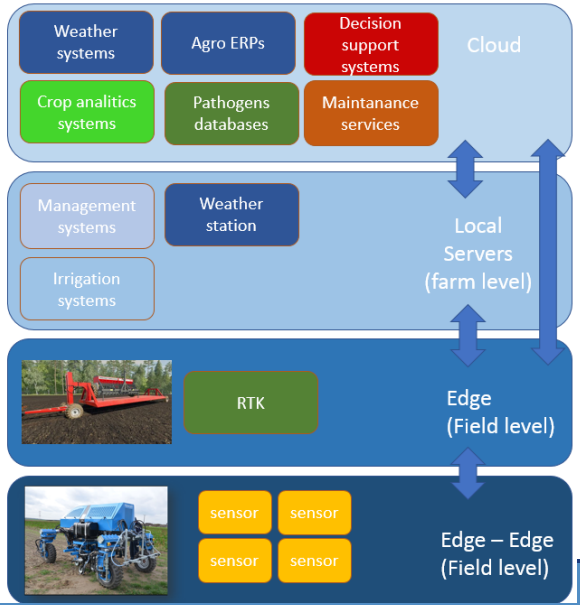
Agriculture Operational Robotic Platform

INSTYTUT CHEMII BIOORGANICZNEJ POLSKIEJ AKADEMII NAUK	PSNC	PL
SIEC BADAWCZA LUKASIEWICZ - POZNANSKI INSTYTUT TECHNOLOGICZNY	L-PIT	PL

Challenges

- Need of innovative system solutions to support the decision-making reliability by field robots with the participation of distributed data/services
- Delays in access to data affecting the limitation of field robots operating speed
- Challenges in connectivity in real conditions and continuous monitoring of device operation

A solution based on a robotic platform(s) combined with transport platform with RTK system and interaction with external systems.



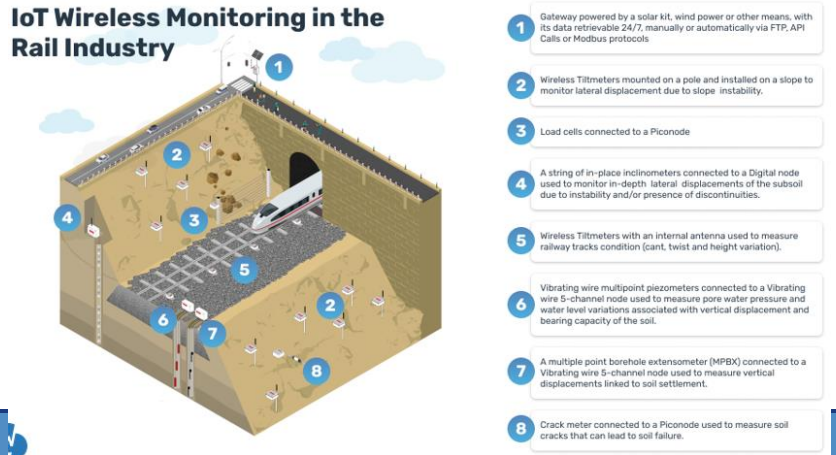
Railway Structural Alert Monitoring System

FERROCARRILS DE LA GENERALITAT DE CATALUNYA	FGC	SP

Challenges

- Energy efficacy solutions for low-power IoT devices to guarantee safety operation in real time without jeopardizing the lifetime of the deployed technology.
- Deterministic wireless networking protocols to achieve reliable system in remote location with multiple wireless communication system involved.
- Edge and cloud orchestration to offer several different applications with the same technology portfolio deployed: coexistence of real-time processing and coordination with cloud services.

Optimize the decision-making process and to exploit all the available resources, the ICOS architecture will be integrated in this service.



In-car Advanced Infotainment & Multimedia Mng system

STELLANTIS	STE	IT
ATOS	ATOS	SP

Challenges

- Provide a Multiuser and Multi-sites Virtual Sharing Experience to interact in sync with high-definition media contents (3D models, immersive videos, pictures, etc.) with in-car passengers and other users far away.
- In-Car edge computational node to remote rendering 3D object close to the end user to minimize latency.
  - With a multiuser remote rendering solution, it is possible to bring high-quality 3D objects and interactive interfaces to smart glasses and holographic display.
- Implement a personalized productivity zone, a gaming station, a study center, creative studio, even a wellness arena.

In-Car Edge Node: Rendering / Small Analytics / Data from IoT Devices

Cloud – Persistence Layer / Big Analytics

Edge Node: Rendering / Small Analytics / Data from IoT Devices

Energy Management and Decision Support system

SSE AIRTRICITY	SSEA	IR

Smart Homes

Data from 5 smart homes will be used to test ICOS infrastructure to implement an energy management system including use of Machine Learning models and edge computing.

- Smart technology: a) Micro-generation: PhotoVoltaics (PV) or wind turbines; b) Electric Vehicles (EV) and Heat pumps; c) Home energy storage and Smart meters

ICOS: Advantages

Understanding the usage and consumption of electricity becomes of fundamental importance to manage energy crisis. Deployment and use of ICOS continuum main advantages:

- New AI models with resource sharing to optimise energy management
- Cloud /edge for secure and sustainable solutions
- Large flexibility with solutions adapted to customer needs
- The customer can decide to: a) Buy/Sell energy from/to the grid; b) Sell/trade energy to peers; c) Store energy or Create dispatchable demand

Towards a functional continuum operating system

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