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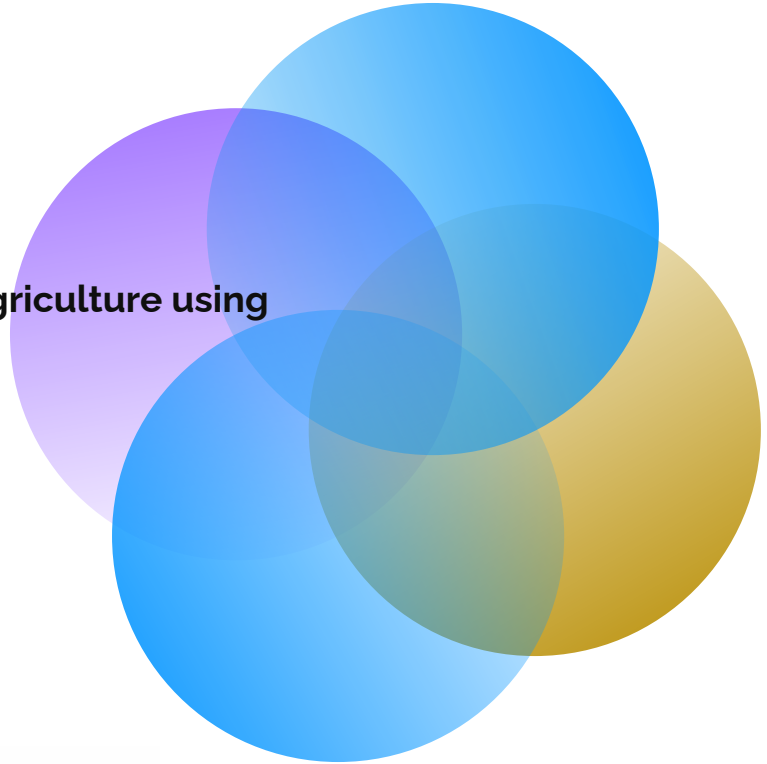
Potential of implementing operational metasystems in agriculture using the ICOS project as an example



Iman Esfandiyar, Łukasz Łowiński, Marcin Płóciennik, Michał Błaszczak

28 – 29 listopada 2023 r.

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ICOS
Funded by the European Union

Edge ecosystem

Extreme Edge / Far → Near Edge → Edge DC

IoT/Edge devices/Mobile

Devices

- Sensors
- HVAC
- Pumps
- Cameras
- Motors
- Drones
- Contactors
- Push Button
- PLC
- RFID Readers

µEdge

Pre-configured µEdge Swarm (inteligent group)

Flexible Wireless comms

Flexible connectivity

Edge micro DC

High-end AI and machine learning capability, Edge Computing server.

Cloud

applications in the data center and/or cloud.

Private oneCloud

On-Prem Data Lakes

Public Cloud

Multi-Cloud
Storage & Analysis

HPC center

Lighter virtualization
Diversity

Federation-Cloud
Hybrid

Continuum Management and Orchestration
(control plane and data plane)

Atos

The Extreme / Far Edge characteristics challenges

- High heterogeneity of devices.
- Uncontrolled and asynchronous environment.
- Volatile and random behaviour.
- Diversity of supporting hardware technologies.
- Massive in scale digital ecosystem.
- Small virtualisation footprint.

- … and security, network config., slicing, ad-hoc groups, etc
- … and battery / energy consumption.

TOWARDS A FUNCTIONAL CONTINUUM OPERATING SYSTEM

Objective: design, develop and validate a meta operating system for a continuum
Challenges:

- Volatility and heterogeneity, virtualization and diverse connectivity;
- Optimized and scalable, resources consumptions;
- Guaranteed trust, security and privacy;
- Reduction of integration costs and effective mitigation of cloud provider lock-in effects.

Score 14/15 (treshold 10)
Duration: 1.09.2022 – 31.08.2025
Overall budget: 10 997 675 EUR

https://www.icos-project.eu

ICOS ...THE BASICS

1. Modeling strategy for proactive continuum management

2. Decentralized AI-assisted approach

3. Dynamic and flexible data federation

4. Open and unified programming model

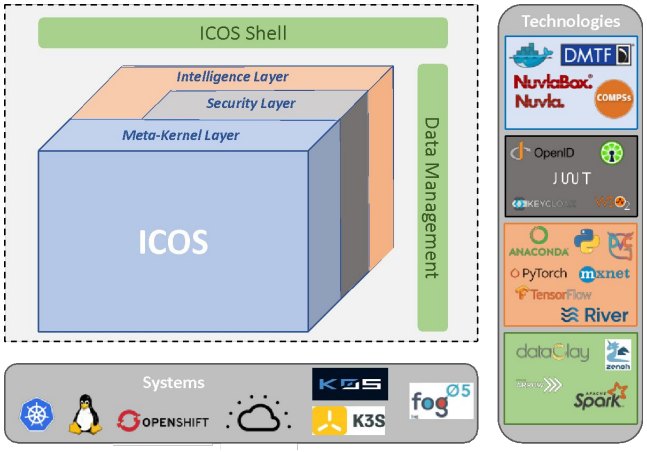
5. Transparent deployment on top of native OSs

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

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

Key Innovation



Cloud Continuum Engineered by ICOS

Economic Impact

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

EU Competitiveness

The ICOS ecosystem will 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.

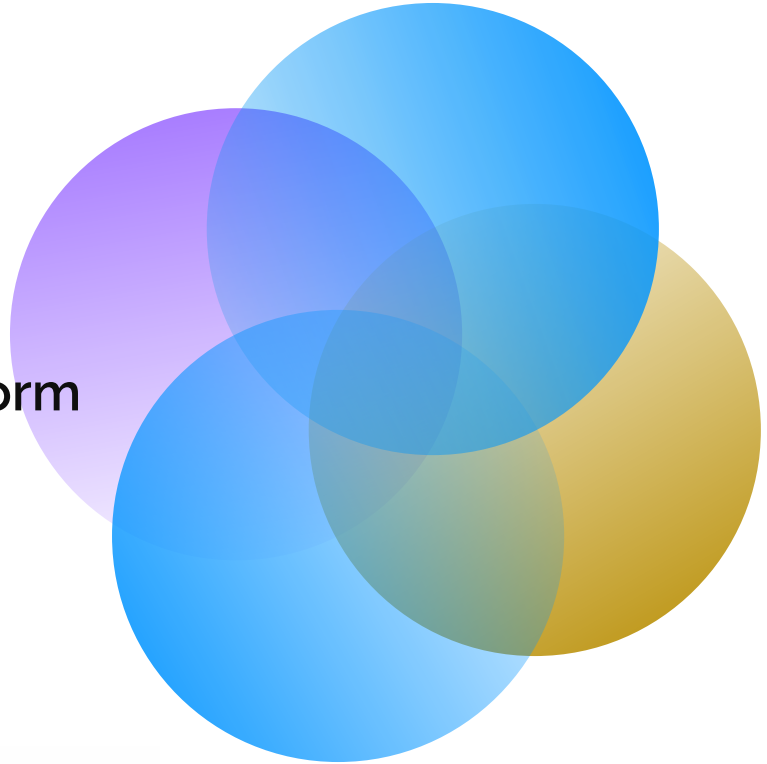
CONSORTIUM SO FAR

- 21 (18+1+2) organisation
- 11 countries
- 14 companies (some SMEs)
- 7 Univ. / Research
- 4 validation scenarios
- A new partner will be included to the consortium to replace AWS (discussion in place with the PO).

ICOS

TOWARDS A FUNCTIONAL CONTINUUM OPERATING SYSTEM

UC1:
Agriculture Operational Robotic Platform (AORP)



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Agriculture Operational Robotic Platform UC1 Idea

Environment:

- Usable space of modern agriculture
- Real time communication
- field robots with various functionalities

Challenges:

- Decision-making system with the participation of distributed data/services
- Delays in access to data
- Connectivity in real conditions and continuous monitoring

Agriculture Operational Robotic Platform UC1 Idea

Robotic platform

Transport Platform

Monitoring

External systems

- Precision sowing module
- Precision care module
- Crop data
- Maintanance data

DATA COLLECTION

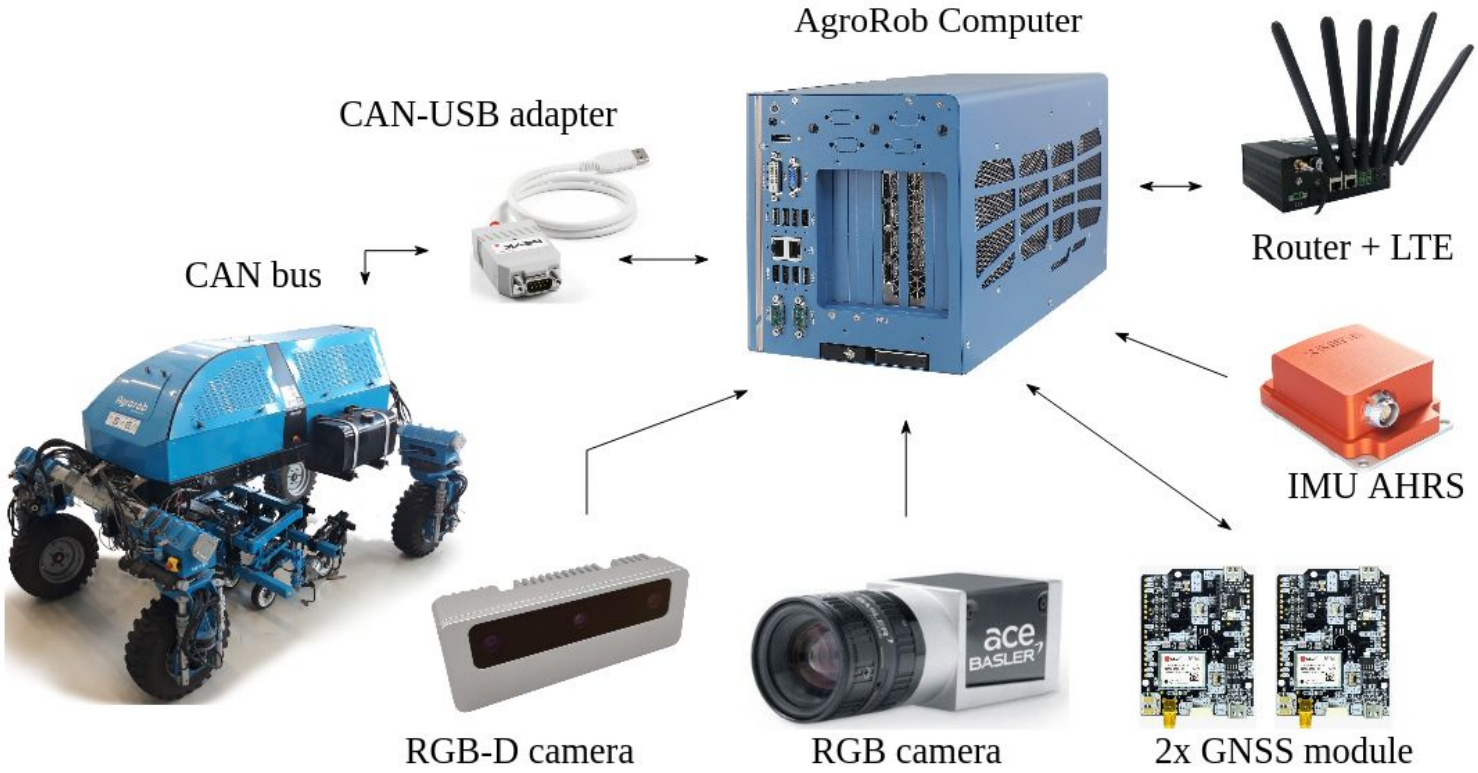
- Weather systems
- Irrigation systems
- Agro ERPs
- Crop analitics systems
- Pathogens databases
- Decision support systems

COMMUNICATION

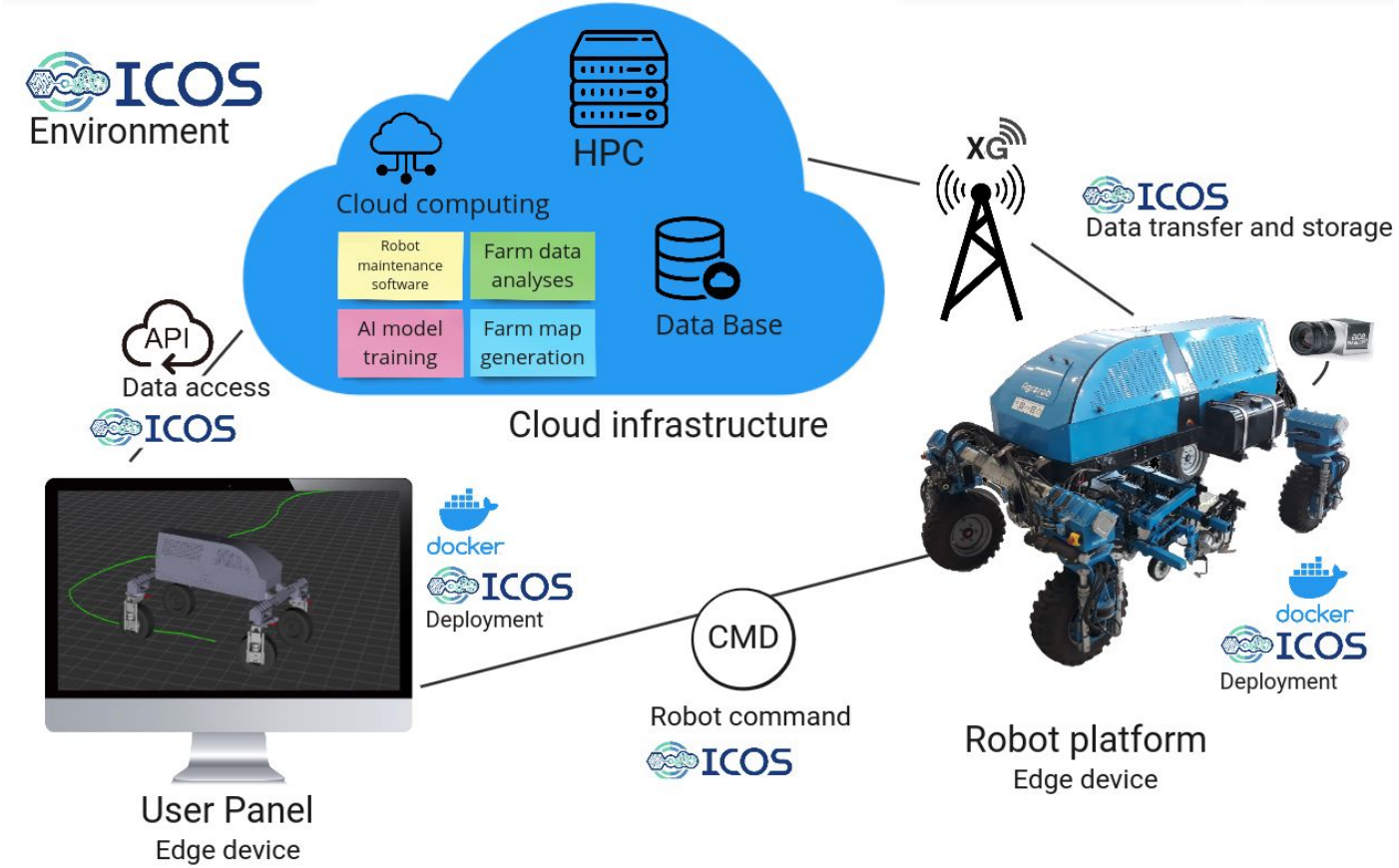
- Maintanance services
- Managemen t systems
- Agro ERPs

VISUALIZATION

Agriculture Operational Robotic Platform UC1 Idea



Agriculture Operational Robotic Platform UC1 Idea



Agriculture Operational Robotic Platform UC1 Idea

expected solution results:

- Easy field robot maintenance & control (real-time)
- Fast data exchange robot-external datasets/services
- Safe and stable communication
- Optimal mission planning

Benefits and KPIs

This Use Case aims to validate the solution in real-world heterogeneous use cases, deployed in public and private application domains, enabling open remote access to third party users for experimentation, benchmarking, and testing.

Project objective	KPI	Target
Validation and mapping of germinated plants (defining statistics on the numer of germinated plants and seed quality compared to producer's declaration, etc.)	Detection	90% plant detection
Effectiveness of weeds and diseases detection		60%
Reduction of the amount of liquid fertilizer used in selected plant cultivation (by predicting the need for preventive treatments for a selected crop, etc.)	Efficency	from 400 to 170 l/ha (-57,5%)
Reduction of amount of plant protection herbicide used (task optimization with liquid herbicide and mechanical care with protection zone preservation)		from 300 to 60 l/ha (-80%)

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ICOS

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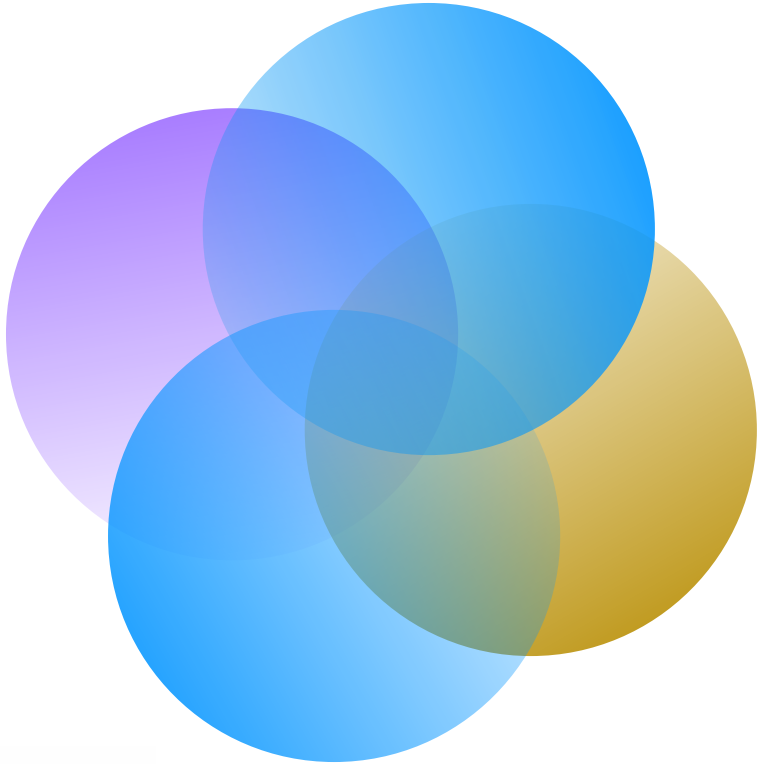

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