

INCODE

**INCODE - PROGRAMMING PLATFORM FOR INTELLIGENT COLLABORATIVE
DEPLOYMENTS OVER HETEROGENEOUS EDGE-IOT ENVIRONMENTS**

John Avramidis (*UNIS*)

Concertation and Consultation on Computing Continuum: From Cloud to Edge to IoT, 10.5.2023, Brussels

incode-project.eu

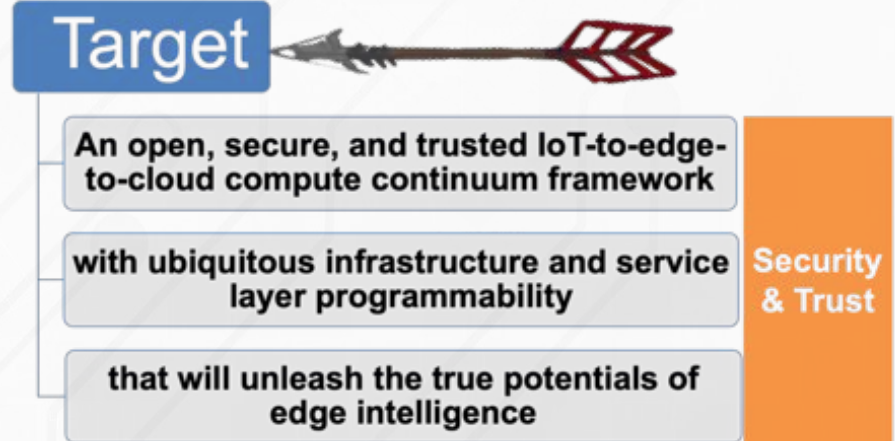


The entire continuum starting from IoT devices and going all the way to core cloud systems is not here yet!

How can we...

exploit IoT processing capabilities?

enable intelligent collaborative deployments?



Under the hood... The INCODE solution

- 1. Infrastructure management layer (IML)** -> performs resource allocation/release & process scheduling across the entire IoT-to-edge-to-cloud continuum including microservices like:
 - Infrastructure manager controllers (Cloud, network, mobile, o-RAN, IoT)
 - Infrastructure drivers (Cloud, networks, mobile, o-RAN, IoT)
 - Core components (resource manager, scheduler, file system)
 - Security & Trust (auth. through BC, attestation, data & app provenance through BC)
- 2. Applications and Business Programmability stratum (ABPS)** -> allow apps to run on the underlying HW in a HW-agnostic way including microservices like:
 - UI portal
 - RBAC
 - Runtime Orchestration
 - Telemetry
 - Software Lifecycle





INCODE
use case
Domains



Scientific & Technology:

- Easy interconnection of multiple IoT platforms
- Creation of a common development framework for IoT drivers & controllers
- Enhanced trust & security
- New & custom applications for smart IoT-edge cross-industrial environments

Business & Social:

- New business opportunities for infrastructure providers & systems integrators
- Verticals benefited from new types of applications
- Safety in working environment
- Work quality & satisfaction increase
- Goods quality through traceability
- Advance community crisis management services

Working with other projects and CSAs

- Avoid working in silos
- Establish relationships with stakeholders who can be benefited from INCODE
- Organization of joint events
- Participation in CSA workshops
- Share material & lesson learnt



The team





INCODE

◦ THANK YOU FOR YOUR ATTENTION ◦



incode-project.eu



Co-funded by the European Union

Objectives



Obj 1

- Design a decentralized, agile and secure architecture for collaborative smart nodes at the edge backed by the Decentralized Autonomous Organization (DAO) paradigm integration.

Obj 2

- Native device support by integrating Self Sovereign Identity (SSI) for a portable digital identity. OASEES Decentralized device identity will be a new class of identifier that fulfils all four requirements: persistence, global resolvability, cryptographic verifiability, and decentralization.

Obj 3

- Build rapid development kits (RDKs) for an open programmable framework across different smart edge nodes, while incorporating efficient cloud-to-edge continuum intelligence across heterogeneous target environments.

Obj 4

- Demonstrate the framework and programmability toolkit in a set of different vertical use cases and evaluate the benefits across different sectors.

Obj 5

- Maximize the impact of the OASEES results. Foster the creation of an open-source community around the OASEES solution, engaging a diverse set of stakeholders



OASEES Swarm Use cases

01

E-Health: Smart Nodes for Analysis of Voice, Articulation and Fluency disorders in Parkinson Disease

02

Mobility: EVs fleet coordinated recharging to support optimal operation of electricity grid

03

Security: Drone Swarm over 5G for High Mast Inspection

04

Buildings: Swarm powered intelligent Structural safety assessment for Buildings

05

Industrial: Robotic Swarm powered Smart Factory for I4.0

06

Renewable Energy: Smart Swarm Energy harvesting and Predictive Maintenance Wind turbines



OpenSwarm

Inria



mec



KU LEUVEN

SIEMENS



FALCO

www.openswarm.e

Ambition

Trigger the next revolution in truly **collaborative smart nodes**: devices augmented with **embedded intelligence** to interpret and understand the data they are generating, **communicate efficiently** even when moving around

Pillar 1

Orchestration of Collaborative Smart Nodes

- Communication: augment industrial IoT technology, add mobility, cool new “Zero-Wire” communication paradigm
- Security: standardize a true zero-touch solution
- Decentralized coordination: true peer-to-peer Coaty

Pillar 2

Collaborative Energy-Aware AI

- Cool new AI-capable low-power micro-controllers (e.g. MAX78000 includes a CNN!)
- Nodes themselves process the data
- Duality between central node for training and distributed nodes for executing model

Pillar 3

Energy-Aware Swarm Programming

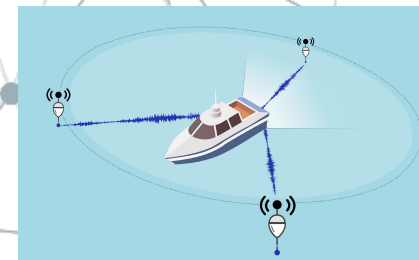
- Control the emergent behavior of the swarm rather than individual devices!
- how can we enable the operator to express this behavior?
- Towards a swarm compiler!





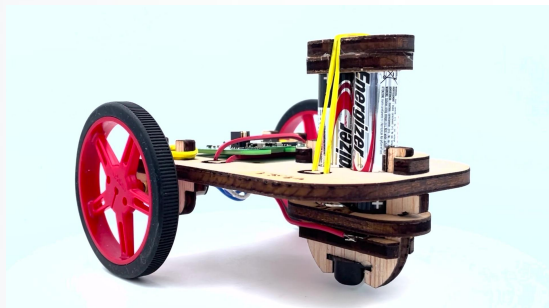
Ambition

Trigger the next revolution in truly **collaborative smart nodes**: devices augmented with **embedded intelligence** to interpret and understand the data they are generating, **communicate efficiently** even when moving around



PoC3. **Environmental**: Ocean Noise Pollution Monitoring

testbeds



On a 1,000 "DotBot" testbed...

real-world use cases



PoC1. **Cities & Community**: Renewable Energy



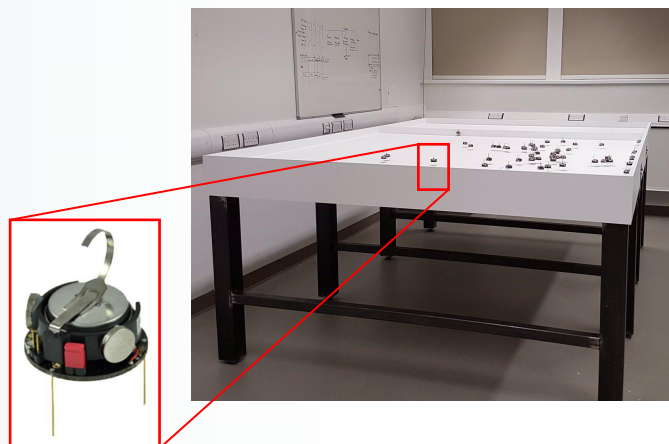
PoC4. **Industrial/Health**: EHS in industrial production sites



PoC2. **Environmental**: Supporting Human Workers in Harvesting Wild Food



PoC5. **Mobility**: Moving Network in Trains



... and a 1,000 "kilobot" testbed.

Inria

ANALOG DEVICES
AHEAD OF WHAT'S POSSIBLE™

mec



KU LEUVEN

SIEMENS

University of Sheffield

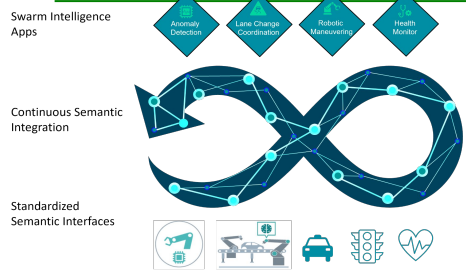
FALCO®

www.openswarm.e

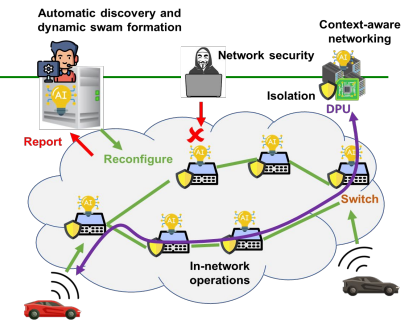
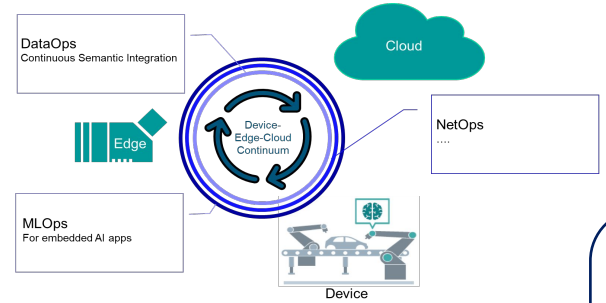
Thomas Watteyne



SmartEdge Solution

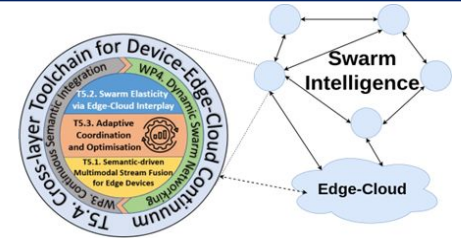


Semantic-driven X-Ops for Cloud-Edge Continuum

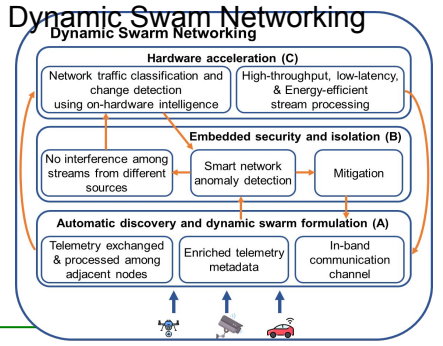
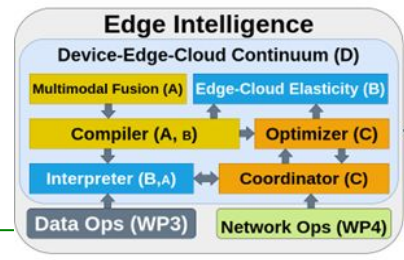
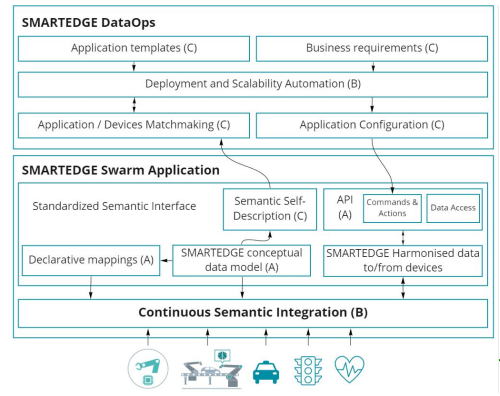


- Continuous Semantic Integration**
- A. Standardized Semantic Interfaces
 - B. DataOps tool for semantic management of things and embedded AI apps
 - C. Creation and Orchestration of Swarm Intelligence Apps

Low-code Programming Tools for Edge Intelligence



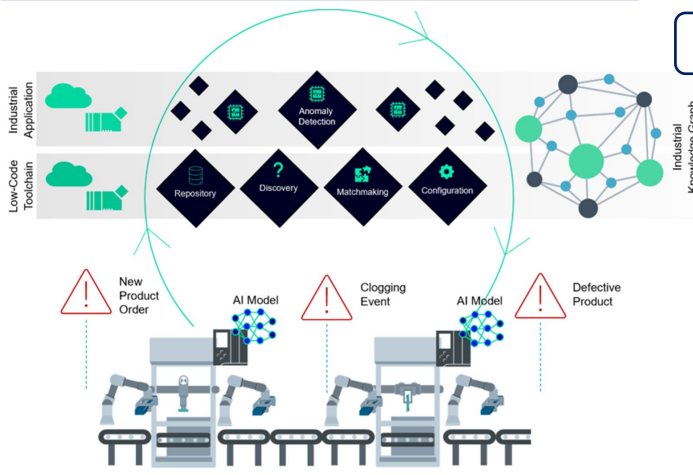
- Dynamic Swarm Networking**
- A. Automatic Discovery and Dynamic Network Swarm formation in near realtime
 - B. Embedded network security
 - C. Hardware-accelerated in-network operations for context-aware networking



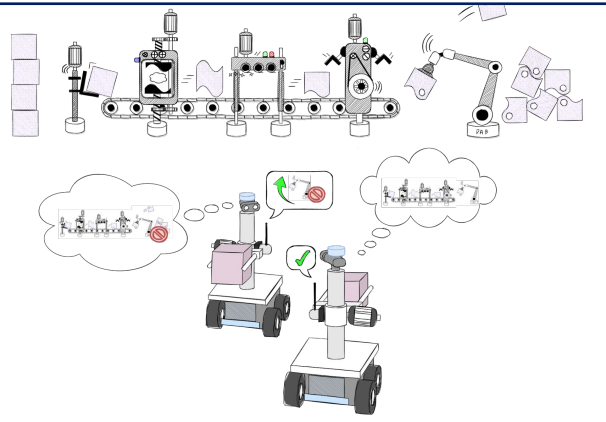


SmartEdge Use Cases

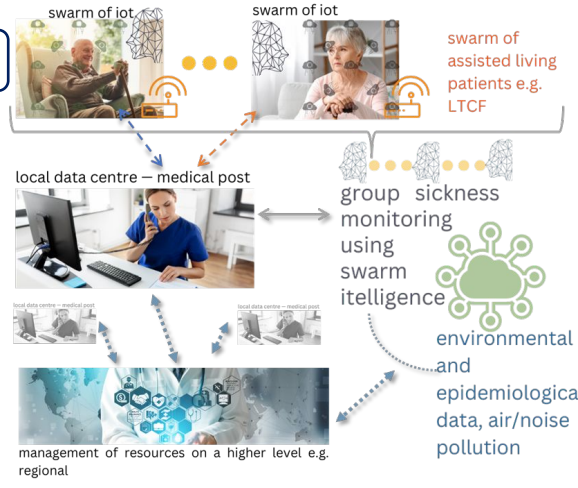
Smart Factory with Low-Code Edge Intelligence



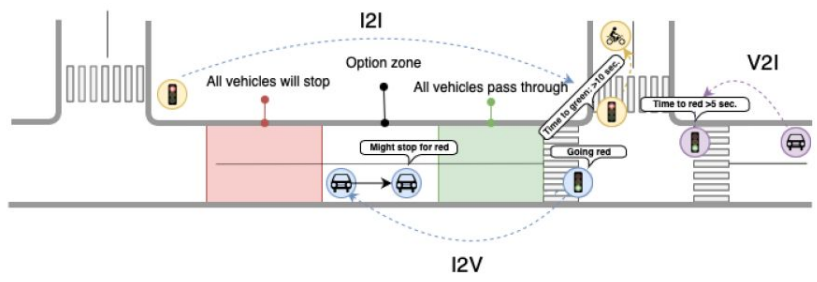
Smart Factories with Intelligent Mobile Robots



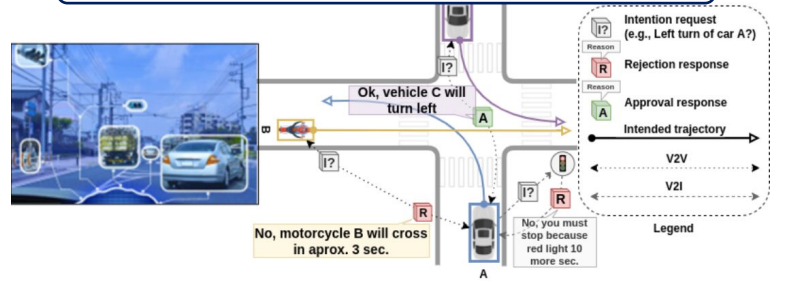
Edge/Swarm Intelligence in Health

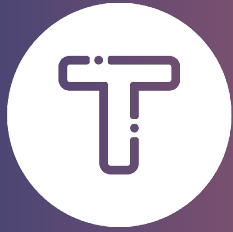


Active automotive option-zone Management



Cooperative Perception for Driving Assist



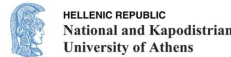


TaRDIS

Trustworthy and
Resilient Decentralised
Intelligence
for Edge Systems

Coordinator: Carla Ferreira
(NOVA University Lisbon)

Consortium



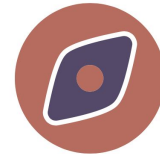
Use Cases



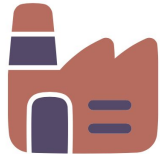
Energy
Communities



Intelligent
Homes



Satellite
Swarms

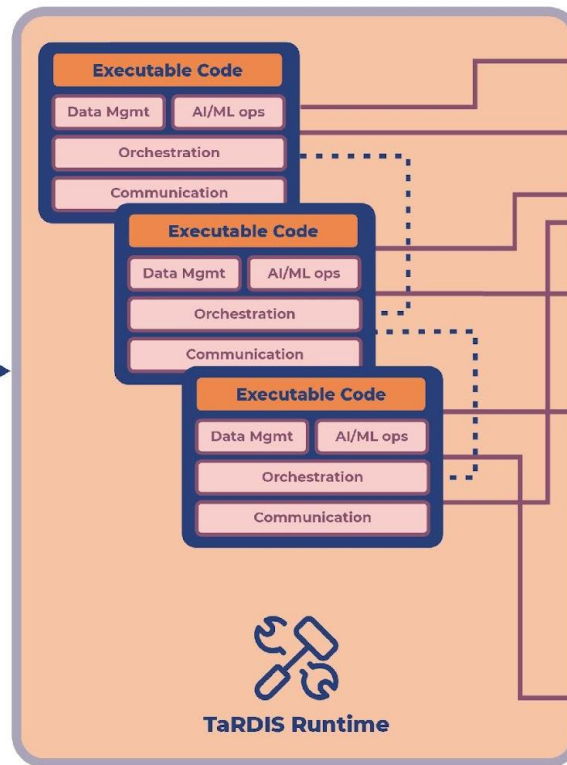
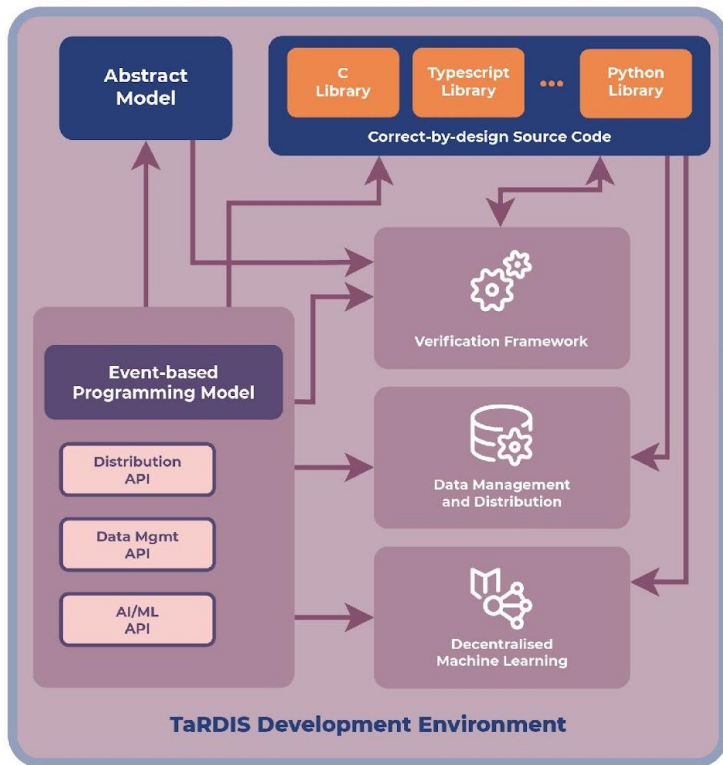


Smart
Factories

TaRDIS toolbox



Developer



Follow us



www.project-tardis.eu



@TARDIS_eu



@tardis-project