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DATA FJORDS: UNLOCKING AI FOR INDUSTRY & SOCIETY

5-6 May 2026 / Oslo

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From Data to Decisions: AI Lifecycle Management Across the Cognitive Computing Continuum

5 May 2026 | 11:30-13:00 | Room H3

A joint Horizon Europe project session

CoGNETs Continuums of Game Nets

swarmchestrate

INTEND

EMPYREAN

ENACT

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CoGNETs Continuums of Game Nets
EMPYREAN
ENACT
INTEND
swarmchestrate

From Data to Decisions: AI Lifecycle Management Across the Cognitive Computing Continuum

5 May / 11:30-13:00 CEST / Room H3

Georgios SPANOS
Centre for Research and Technology Hellas - ITI

Panagiotis KOKKINOS
National Technical University of Athens - ICCS

Alexandros NIZAMIS
Centre for Research and Technology Hellas - ITI

Valerio FRASCOLLA
Intel Corporation

Tamás KISS
University of Westminster

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AGENDA

Time	Session	Speaker(s)
11:30 – 11:35	**Welcome: Why Europe Needs an AI Computing Continuum** **Cluster & presenter introduction**	Georgios SPANOS
11:35 – 11:40	**CoGNETs Innovation Snapshot**	Georgios SPANOS
11:40 – 11:45	**EMPYREAN Innovation Snapshot**	Panagiotis KOKKINOS
11:45 – 11:50	**ENACT Innovation Snapshot**	Alexandros NIZAMIS
11:50 – 11:55	**Swarmchestrate Innovation Snapshot**	Tamas KISS
11:55 – 12:00	**INTEND Innovation Snapshot**	Valerio FRASCOLLA
12:00 – 12:02	**Moderator Synthesis**	Georgios SPANOS

12:02 – 12:05	**Dialogue introduction**	Georgios SPANOS
12:05 – 12:12	**Cross-Project Challenge Dialogue**	CoGNETs → EMPYREAN
12:12 – 12:19	**Cross-Project Dialogue**	EMPYREAN → ENACT
12:19 – 12:26	**Cross-Project Dialogue**	ENACT → INTEND
12:26 – 12:33	**Cross-Project Dialogue**	INTEND → Swarmchestrate
12:33 – 12:40	**Cross-Project Dialogue**	Swarmchestrate → CoGNETs
12:40 – 12:55	**Audience Exchange: Europe's Priorities for the AI Continuum**	All speakers + audience
12:55 – 13:00	**Closing Takeaways: Projects to Ecosystem Impact**	Georgios SPANOS

COGNITIVE COMPUTING CONTINUUM AND AI

PROJECT INNOVATION SNAPSHOTS

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CoGNETs
Continuums of Game Nets

CoGNETs: Orchestrating the Future of IoT-to-Cloud Swarm Intelligence

Presenter: Georgios Spanos

Affiliation: Centre for Research and Technology Hellas

Funded by the European Union

Project funded by

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of Economic Affairs, Education and Research EAER
State Secretariat for Education, Research and Innovation SERI

Grant Agreement No 101135930

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Vision

CoGNETs aims to develop a **Middleware Framework** that will empower **IoT**, **Edge**, and **Cloud** devices to autonomously organizing dynamic **IoT-to-Cloud swarm continuums** for optimal data processing and seamless service provisioning

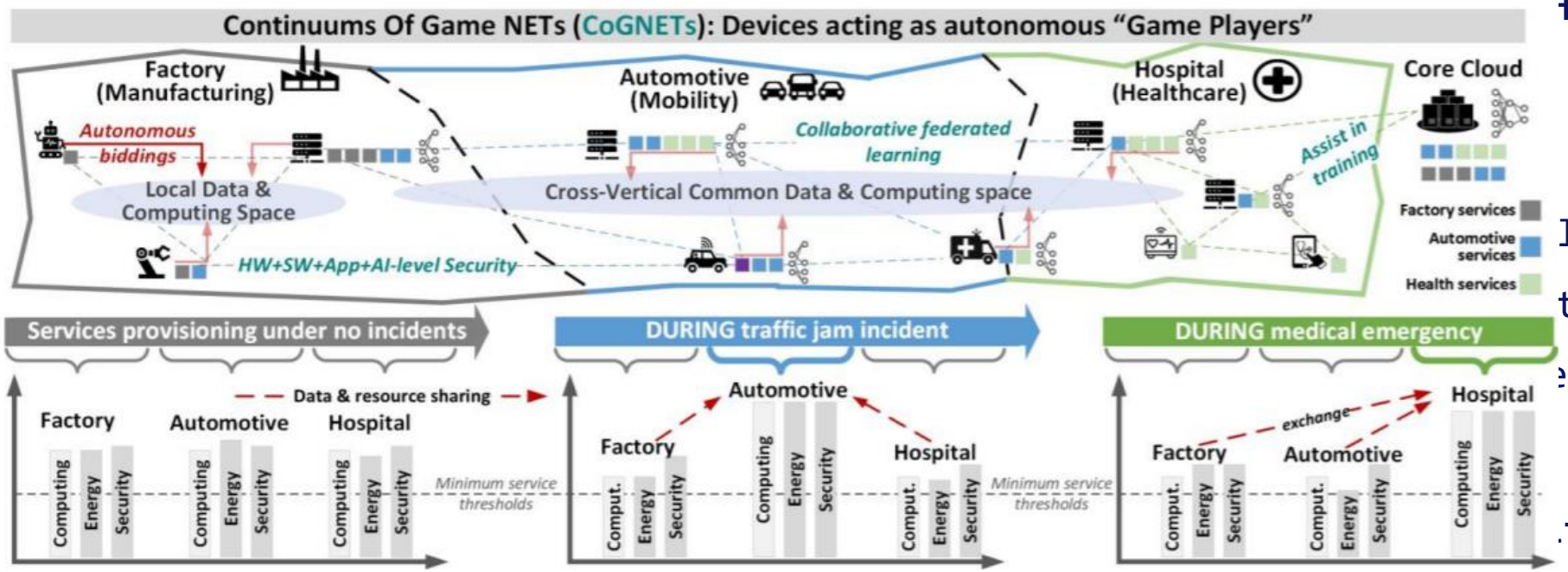
To enable operation of continuums with no fixed orientations shifting to an on-demand opportunistic approach targeting to **“dynamic swarm continuums”**

To promote **“self-organization”** and **“collaborative-learning”** of devices, **Asymmetric Multi-Player Competitive Games**, containing self-organizing “Pricing”, “Bidding”, and “Auctioning” properties, are introduced

Concept

To fuse such game logic within the individual device and turn it into a cognitive resource, capable [illegible] **f-organizing** (or [illegible] **spaces** (or *"Auctio*

Swarm [illegible] l be running as a d[illegible] thematically precise[illegible] maximized, while r[illegible]

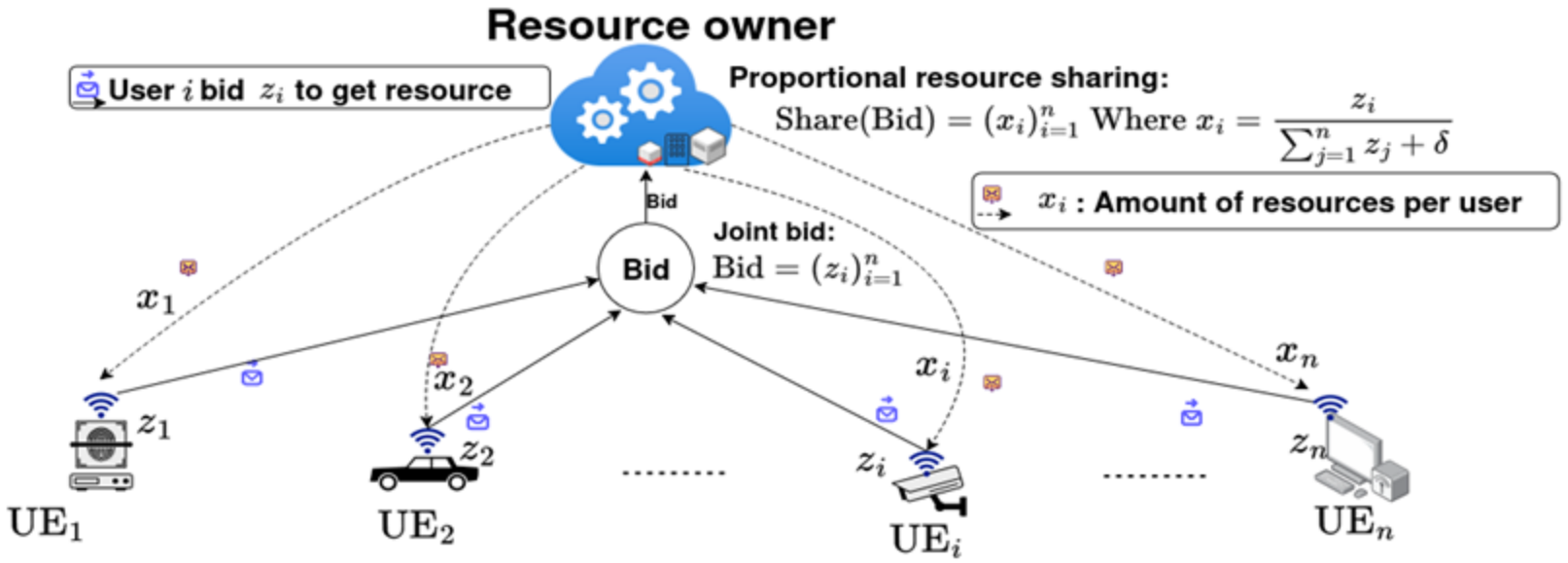


The ga[illegible] **ty dynamics** related to **cyber-risks**, **energy consumption**, **system faults**, offering more freedom with respect to the devices' cognition for safeguarding the overall continuum's cyber-resilience, digital-privacy, and energy-efficiency holistically

Math beneath game implementation

Repeated Kelly game for learning the **Nash equilibrium**

Sequential game: repeated **Kelly mechanism** operates negotiation rounds, agents learn over time and only aggregated bids are required for bid revision



Swarm architecture

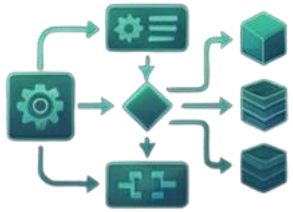
NODE FEDERATION &
SECURITY

HUMAN-IN-THE-LOOP &
RESOURCE VISIBILITY

DISTRIBUTED SERVICE MANAGER

EDGE
NODE

CLOUD
PLATFORM



DISTRIBUTED WORKLOAD MANAGER

SWARM GAME AGENT

DISTRIBUTED DATA MANAGER

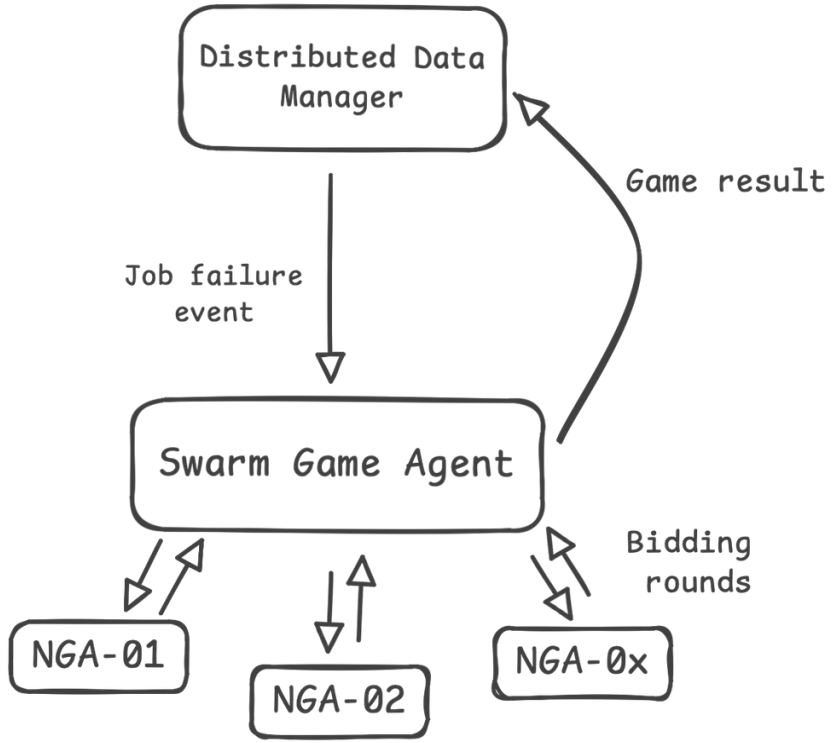
Game implementation in the middleware

Subscribes to Distributed Data Manager and monitors jobs

Takes action on (re)scheduled jobs immediately by bringing the responsible nodes into a new resource game using Node Game Agent.

Manages the negotiation rounds until game termination conditions are met.

Produces the final allocation result and forwards to DDM for further action.



CoGNETs
Continuums of Game Nets

Thank you!

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CoGNETs

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Optimising compute, cost, and energy across Europe's AI continuum infrastructures

Innovation Snapshot

Dr. Panagiotis Kokkinos
Institute of Communication and Computer Systems (ICCS)
& University of Peloponnese
EMPYREAN project

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Introduction

- In recent decades, computing & storage has been characterized by an ongoing tug-of-war between centralized and distributed approaches.

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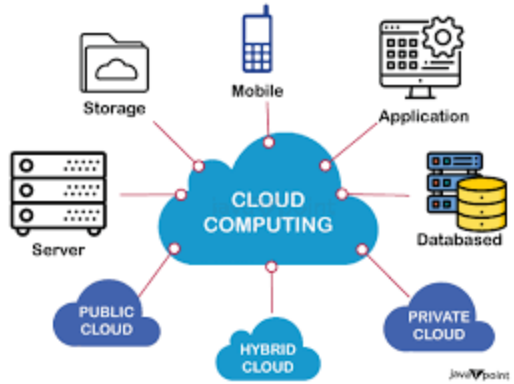
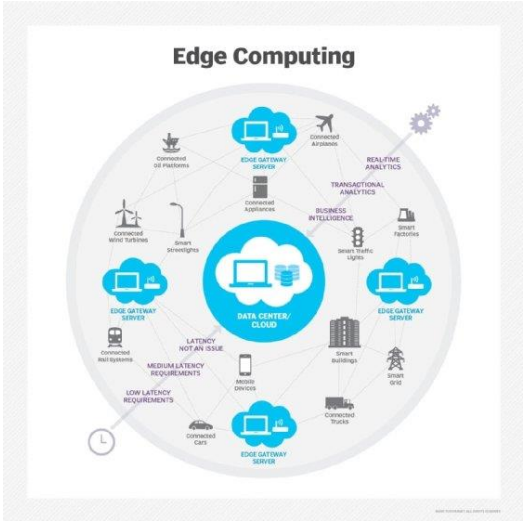
BOINC

eGee
Enabling Grids
for E-sciencE





Hybrid computing paradigm

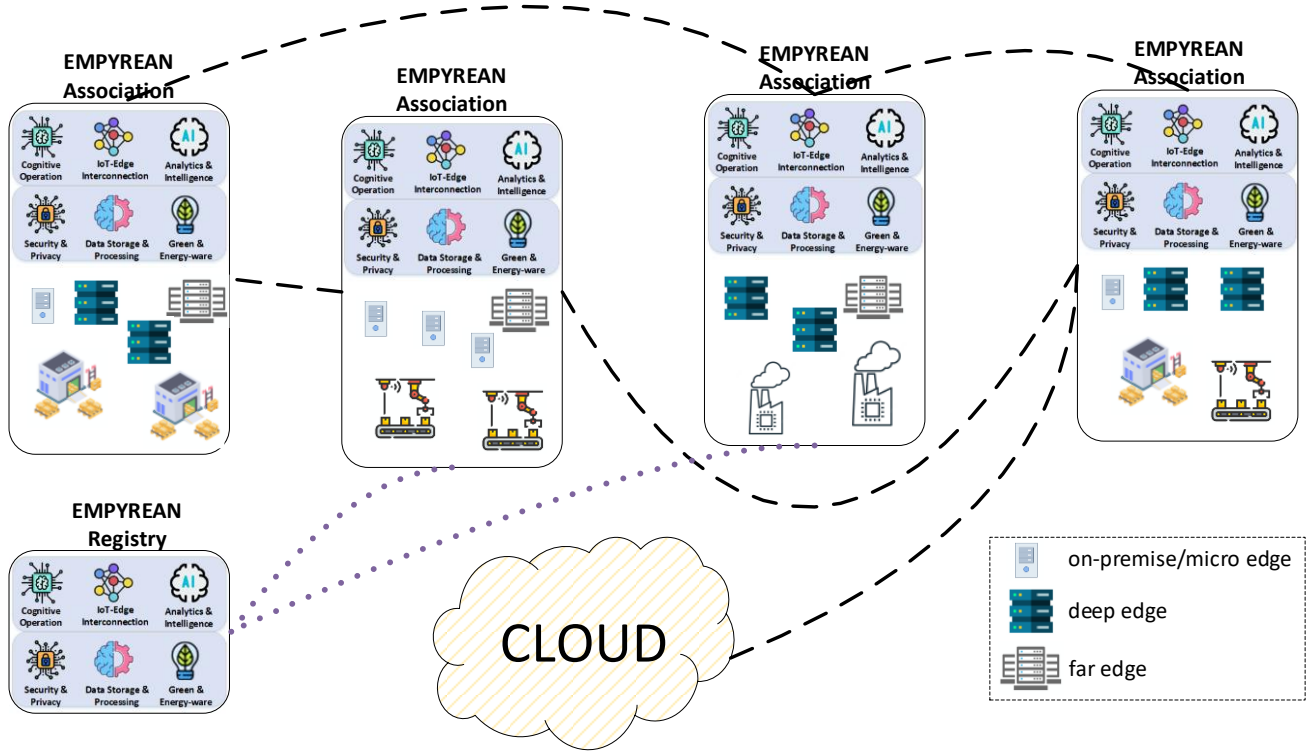
- Computing is evolving toward a hybrid paradigm
- Heavy workloads are typically executed in the cloud
- Latency-sensitive workloads are handled at the edge

Key Enablers

- Advanced networking technologies (optical networks, 5G/6G, satellite networks)
- High-performance and heterogeneous hardware (CPUs, GPUs, FPGAs, domain-specific AI accelerators)
- Softwarization, cloud-native paradigms (containers, unikernels, SDN)
- Open-source ecosystem
- Artificial Intelligence

EMPYREAN Vision and Concept

- **Associations and Associations-based continuum**
- A collaborative autonomous computing ecosystem over heterogeneous resources, different providers and connectivity types.
- A secure execution environment where the trust between data generating and data processing entities is continuously validated.
- Seamless interconnection, efficient data processing of ML-workloads and secure distributed edge storage.



EMPYREAN Platform

Cognitive Operation

- Collaborative Continuum's Management
- Multi-Agent Orchestration

Security and Privacy

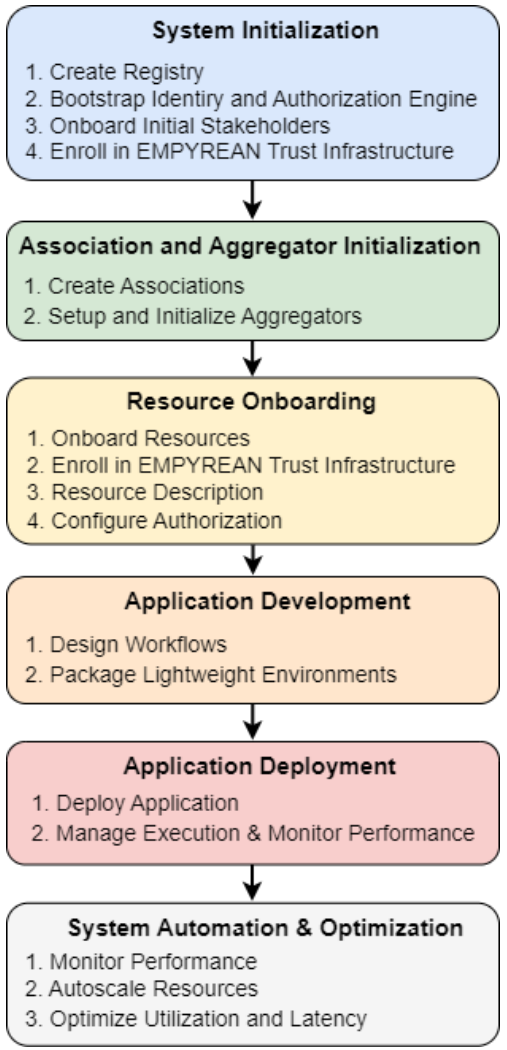
- Distributed Trust Management and Verification
- Cyber Threat Intelligence

AI-enabled Application Development & Deployment

- AI-based Workload Autoscaling
- Workflow-based Continuum-native Application Design
- Application Deployment Based on Unikernels

Data Storage, Processing, and IoT-Edge Interconnection

- Analytics-friendly IoT Erasure Coded Data Query
- RDMA for Edge Nodes Supporting IoT-based Sensor Data
- Cross-platform & Lightweight Container Packaging



Associations Implications

- Integrate intelligent edge devices
- Comply with data sovereignty and regulatory policies
- Provide resilience and fault tolerance
- Handle energy production and cost limitations
- Tackle geopolitical considerations

Thank you

Dr. Panagiotis Kokkinos, kokkinop@mail.ntua.gr

EMPYREAN project, https://empyrean-horizon.eu/

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ENACT

Efficient Edge-to-Cloud Workload Management

Alexandros Nizamis
CERTH
alnizami@iti.gr

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ENACT Project at Glance

ENACT -> Adaptive Scheduling and Deployments of Data Intensive Workloads on Energy Efficient Edge to Cloud Continuum

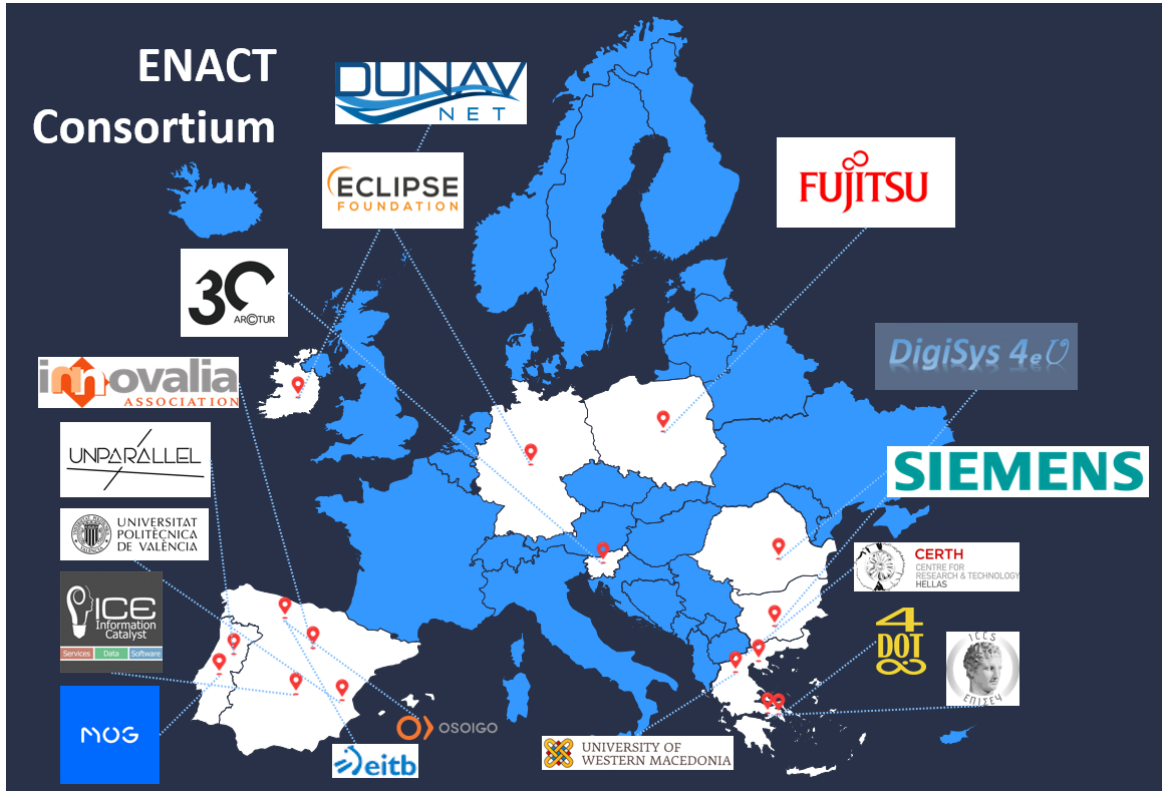
HORIZON-CL4-2023-DATA-01-04
GA number: 101135423
Type of action: RIA

Duration: 36 months
Starting date: 1 January 2024
Ending date: 31 December 2026

Budget: 5.055.074,00 €
EU funding: 5.055.074,00 €

17 partners

9 countries



M1 — M18 — M29 — M36

ENACT Approach

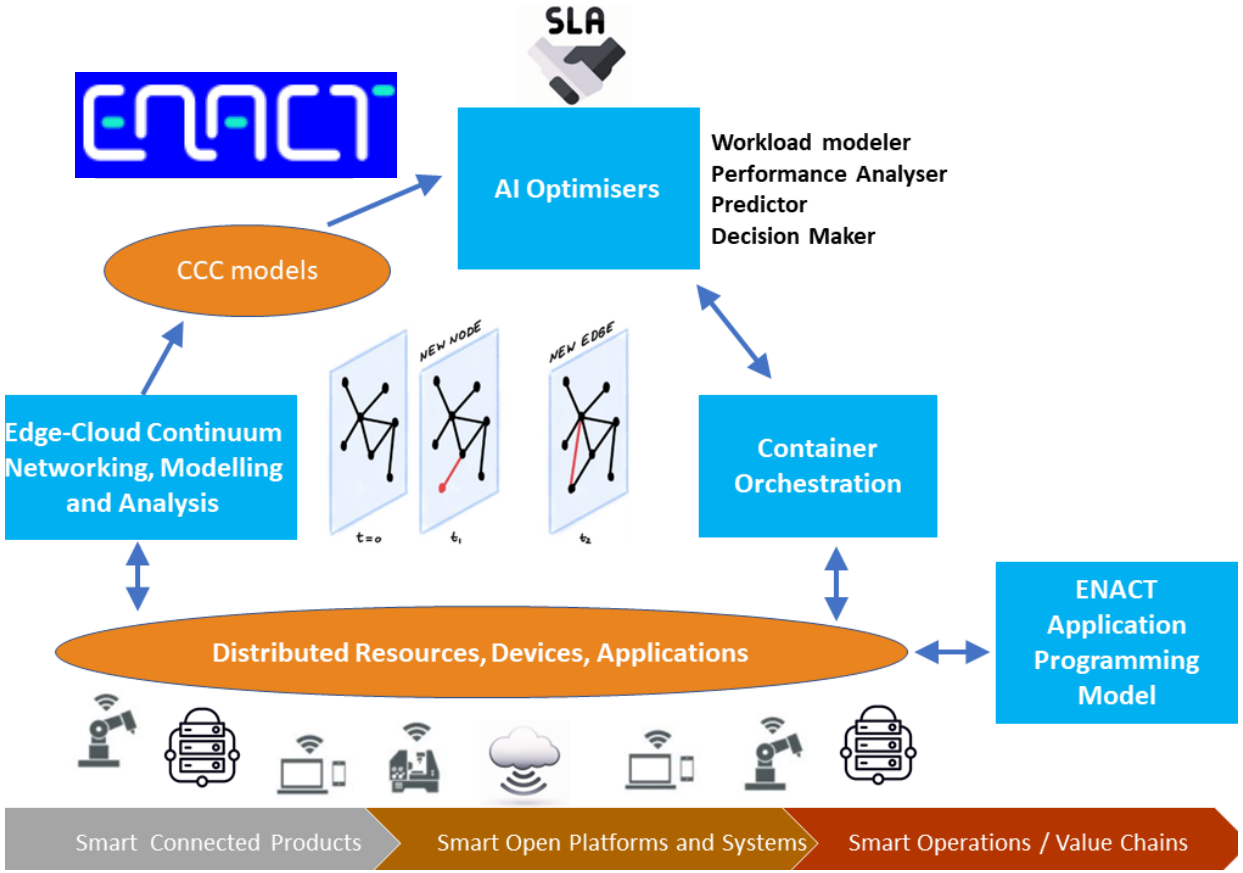
Application development toolkit for developing or adapting complex applications, making them distributed, responsive, robust and adaptive to changing environments

Tools to connect and discover distributed resources, devices and services across the compute continuum, characterize and model them to support complex application deployment needs

- Automatically interlinking and/or configuring distributed edge-cloud devices
- Bringing visibility to interconnected devices and changes in their characteristics

AI-powered orchestrator capable of deploying and managing applications across distributed (edge – cloud) nodes in an optimal way to support the energy efficiency and adaptations in applications

Open Source Project: https://gitlab.eclipse.org/eclipse-research-labs/enact-project



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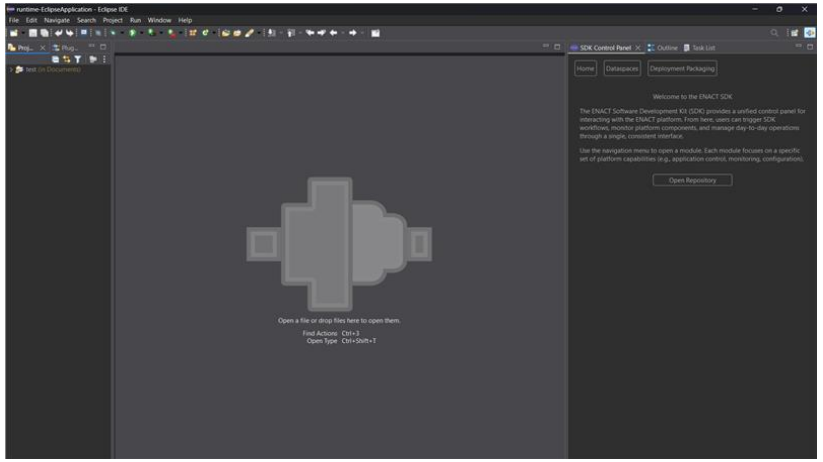
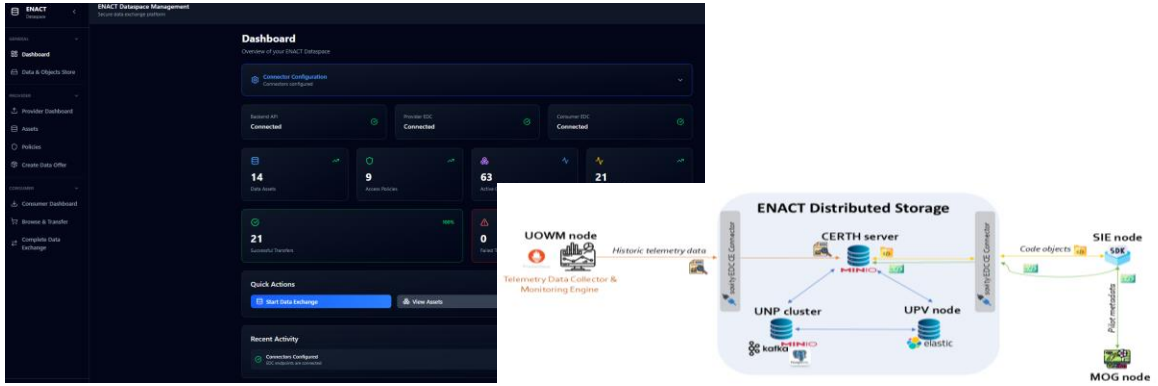
ENACT Main Outcomes

Software Development Kit & Application Programming Model

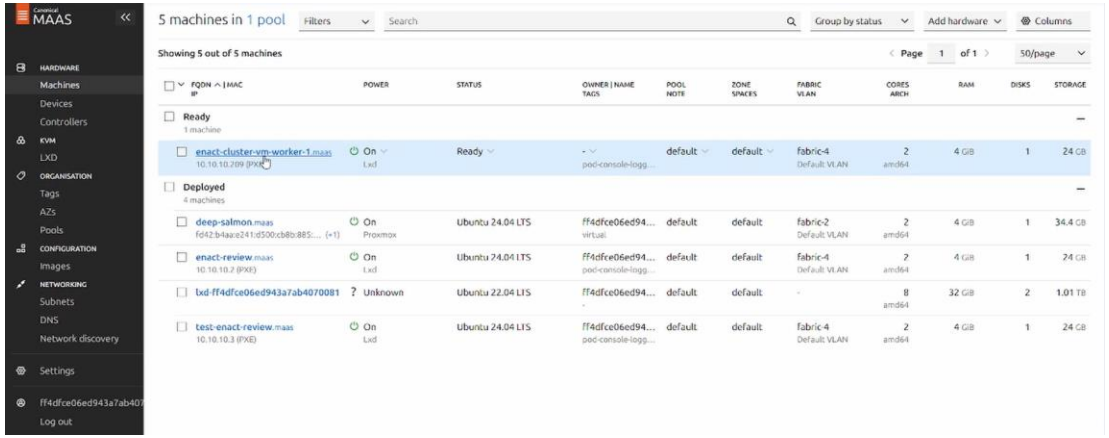


```java
import com.siemens.enact.apm.ztp_libs.ZTPComponent;

public class RunMe {

    private static ZTPComponent ztpService = new ZTPComponent();

    public static void main(String[] args) throws IOException, InterruptedException{

        //query all available machines
        List<ZTPComponent.MachineInformation> allMachines = ztpService.retriveAllMachines();

        //select random machine
        ZTPComponent.MachineInformation randomMachine = allMachines.get(new Random().nextInt(allMachines.size()));
        String randomMachineId = randomMachine.machineId;
        System.out.println("Random machine id: "+randomMachineId);

        System.out.println("Power state: "+randomMachine.powerState);

        //perform "powerOn" action on randomMachine
        ztpService.performAction("powerOn", randomMachineId);

        //update randomMachine information
        randomMachine = ztpService.retrieveMachine(randomMachineId);
        System.out.println("Power state: "+randomMachine.powerState);

        return;
    }

}
```

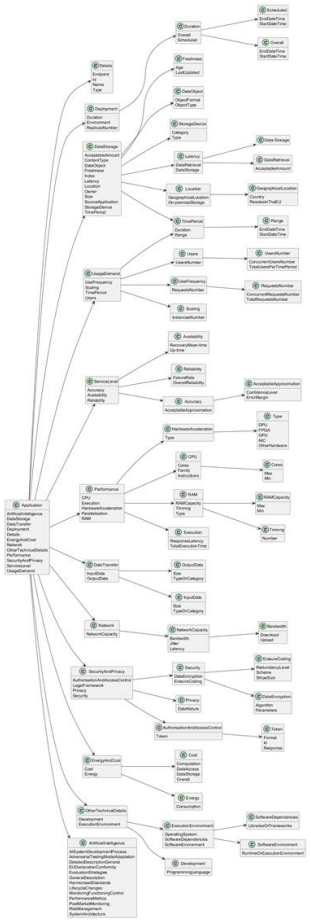
ENACT Data & Object Space

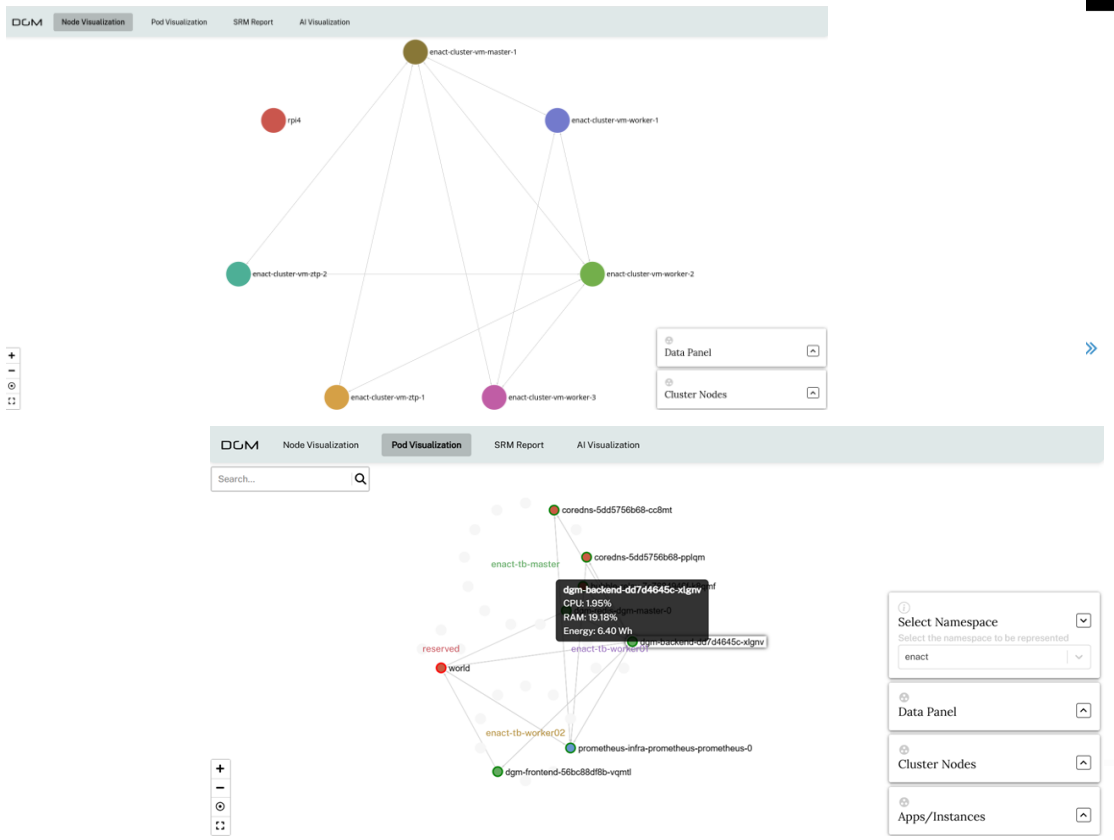


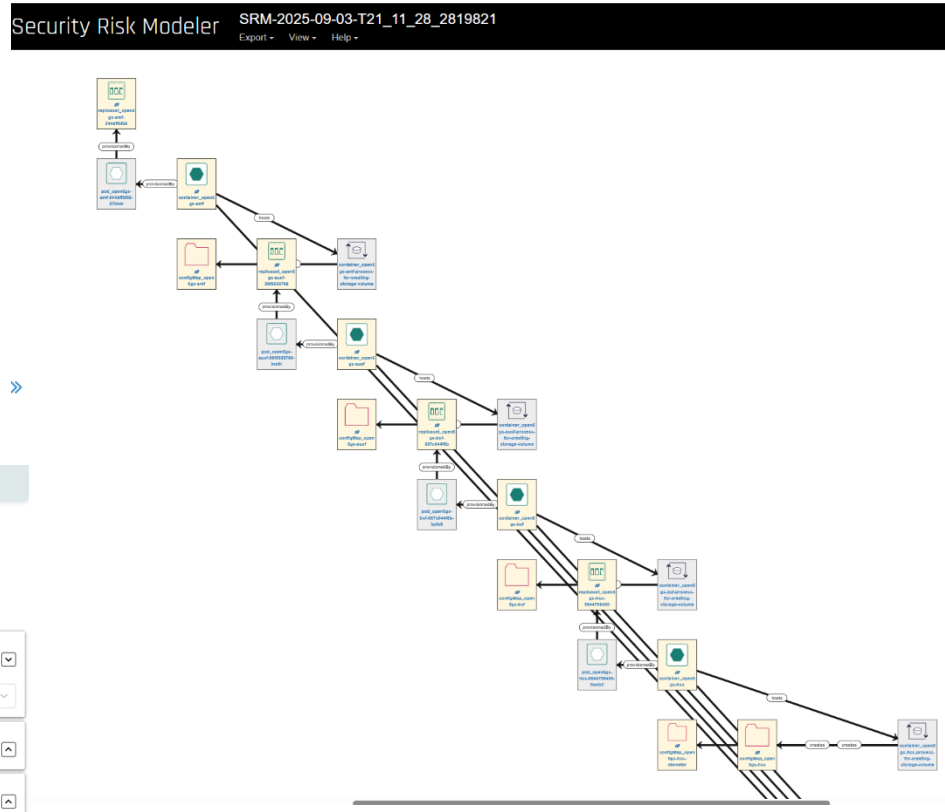
Zero Touch Provisioning Service



ENACT Main Outcomes







Security Risk Modeler

Dynamic Graph Modeler for Real Time CCC Visualisation

CCC Models (TOSCA-based) for Resources Representation

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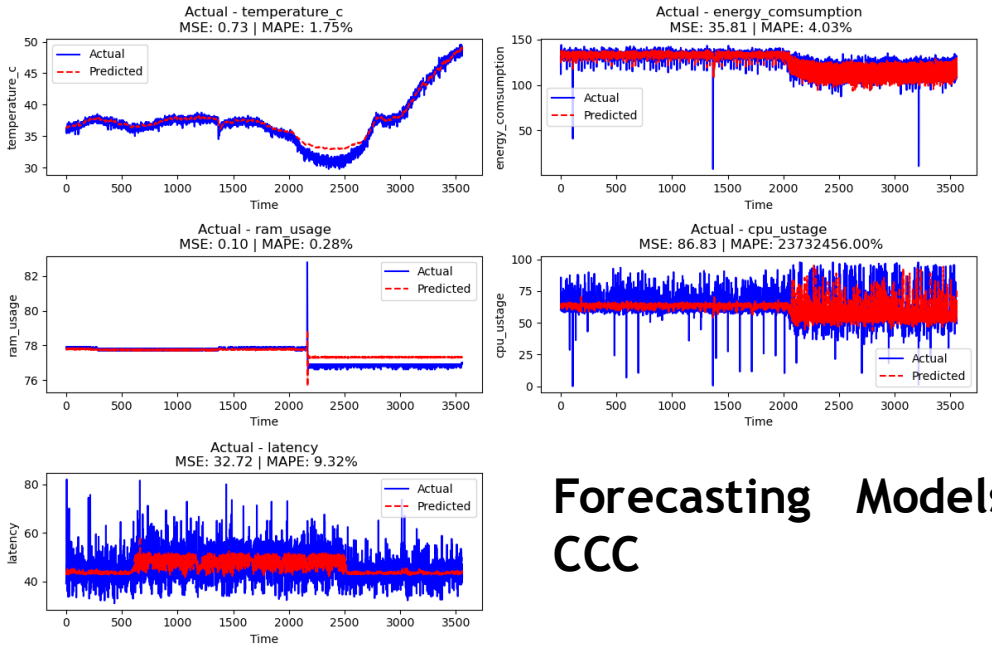
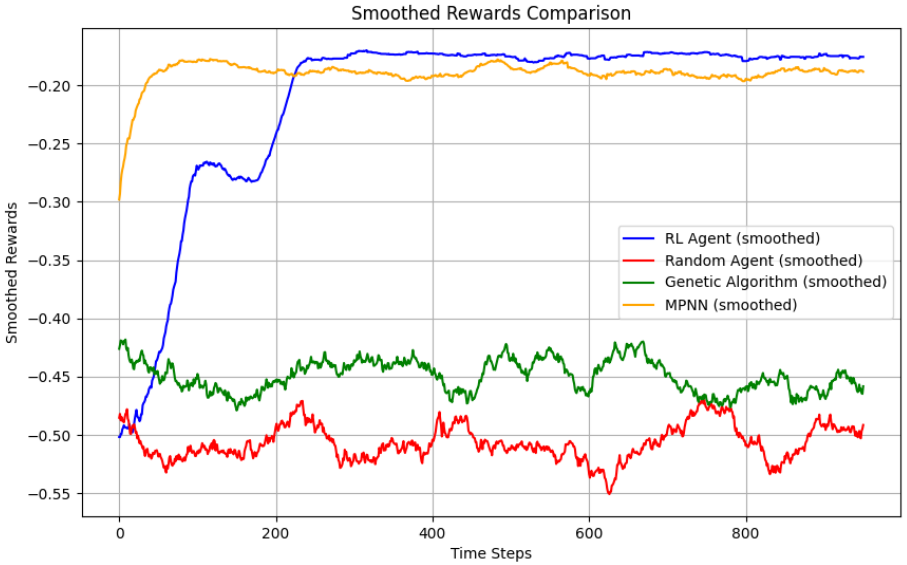
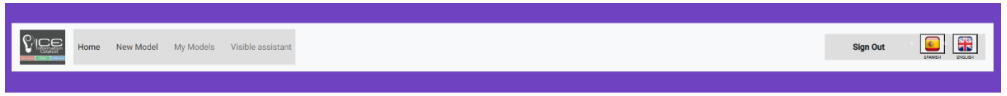


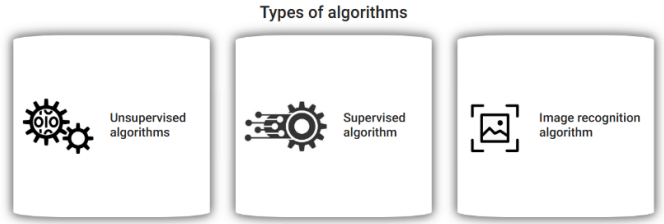
Forecasting Models for CCC

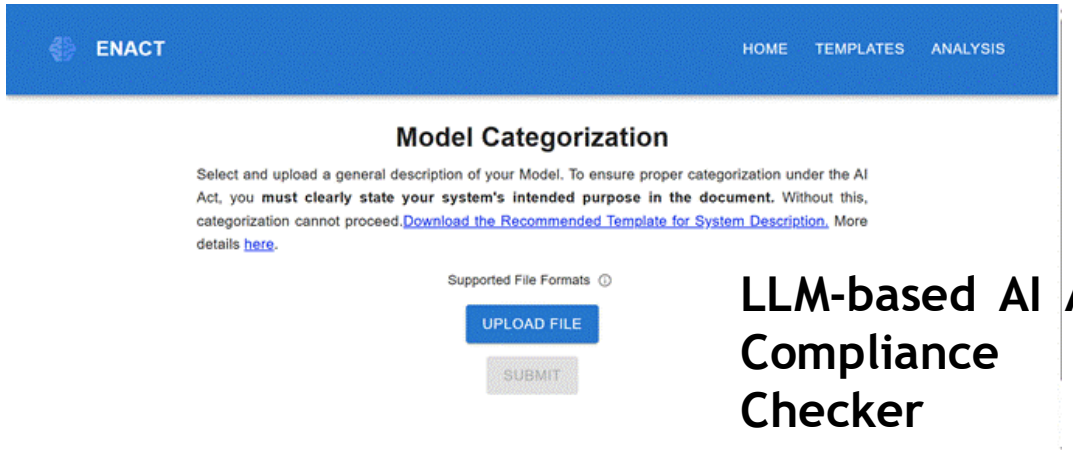


GNN-enabled DRL Orchestration Agent for CCC



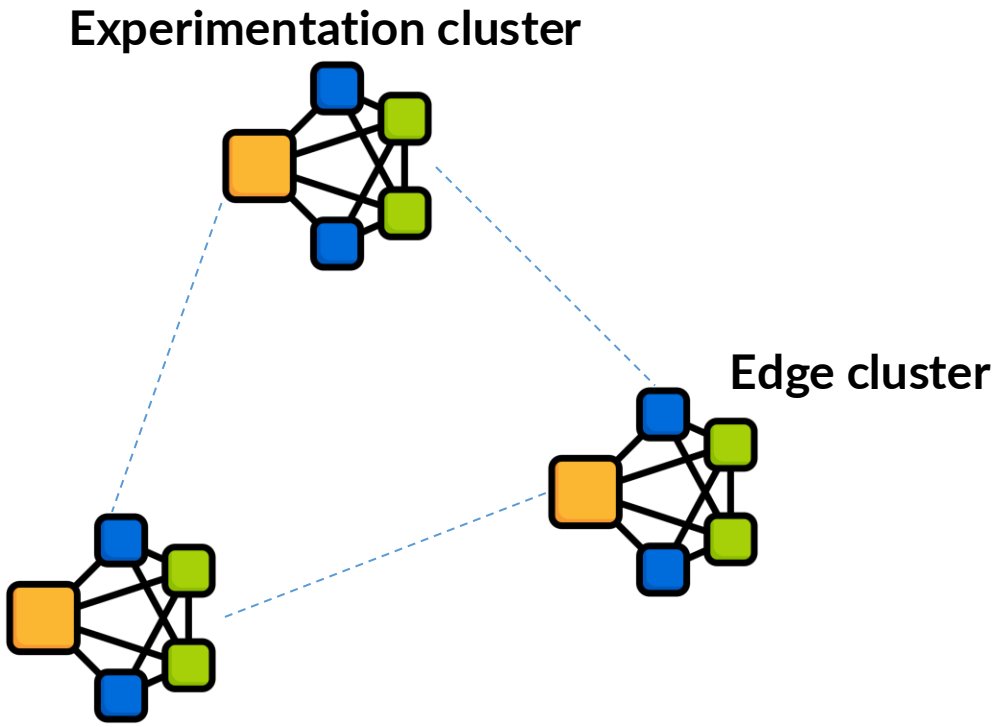
Virtual Training Environment





LLM-based AI Act Compliance Checker

ENACT CCC multi-cluster infrastructure



Cluster	Hosted by	Master Nodes			
		Nr	CPU	RAM	Storage
Experimentation	UNPARALLEL	1	4	8 GB	100 GB
Edge	SIEMENS	1	4	8 GB	64 GB
High-Performance	ARCTUR	1	2	4 GB	20 GB

Cluster	Worker Nodes					
	Nr	CPU	RAM	OS Storage	PV Storage	Throughput
Experimentation	3	8	32 GB	100 GB	200 GB	200/200 Mb/s
Edge	2	8	32 GB	30 GB	30 GB	90 Mb/s
High-Performance	2	28	256 GB	450 GB	150 GB	200/200 Mb/s

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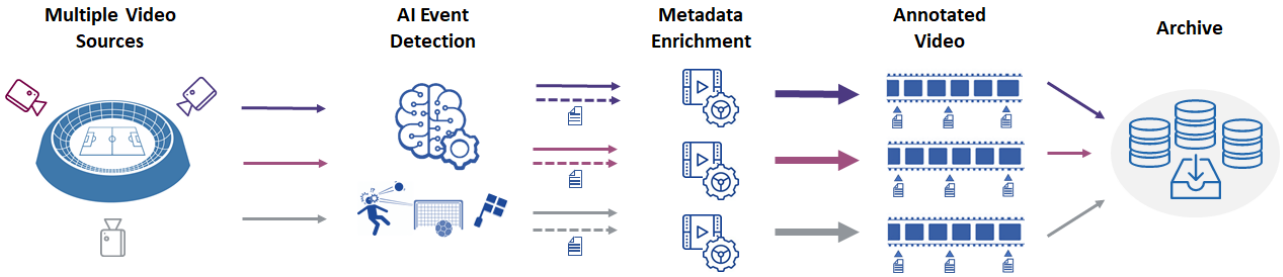
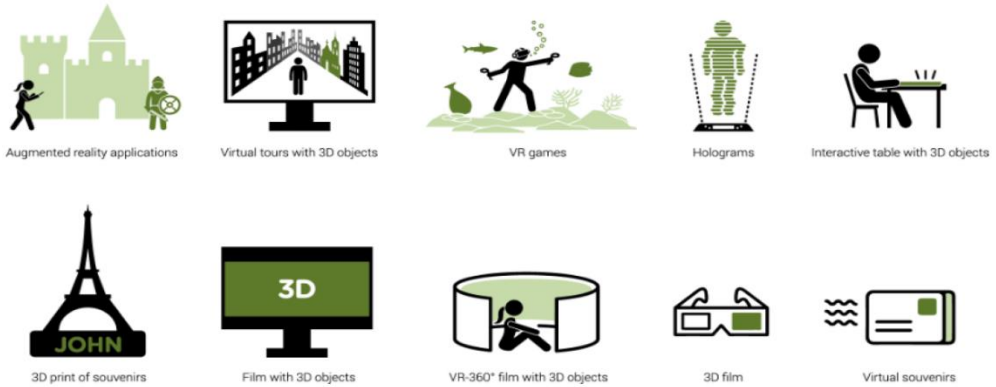
ENACT Validation: Use Cases

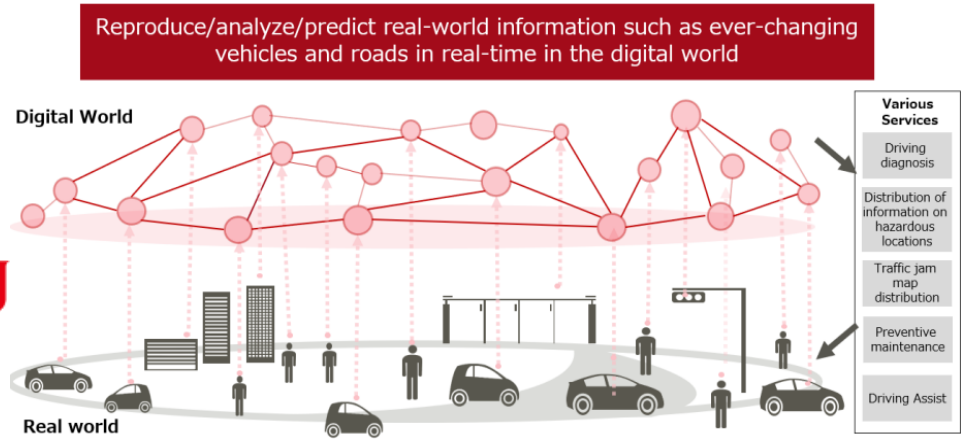
Pilot 1: Distributed Media and Entertainment Content Management



Pilot 2: Production and Distribution of Media Content for Cultural Heritage and Tourism Sectors



Pilot 3: Distributed Data Processing for Fujitsu's Mobility Digital Twin Initiative



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https://enact-horizon.eu/

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This project has received funding from the European Union's "Horizon Europe" Programme Under Grant Agreement No 101135423.

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DATA FJORDS: UNLOCKING AI FOR INDUSTRY & SOCIETY

5-6 May 2026 / Oslo

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Swarm Intelligence for Resilient and Scalable Distributed AI Services

ORGANISED BY BDV BIG DATA VALUE ASSOCIATION

SUPPORTED BY The Research Council of Norway

IN COLLABORATION WITH IFE NTNU SINTEF WESTERN NORWAY RESEARCH INSTITUTE VESTLANDSFORSKING

TEXT

Prof Tamas Kiss

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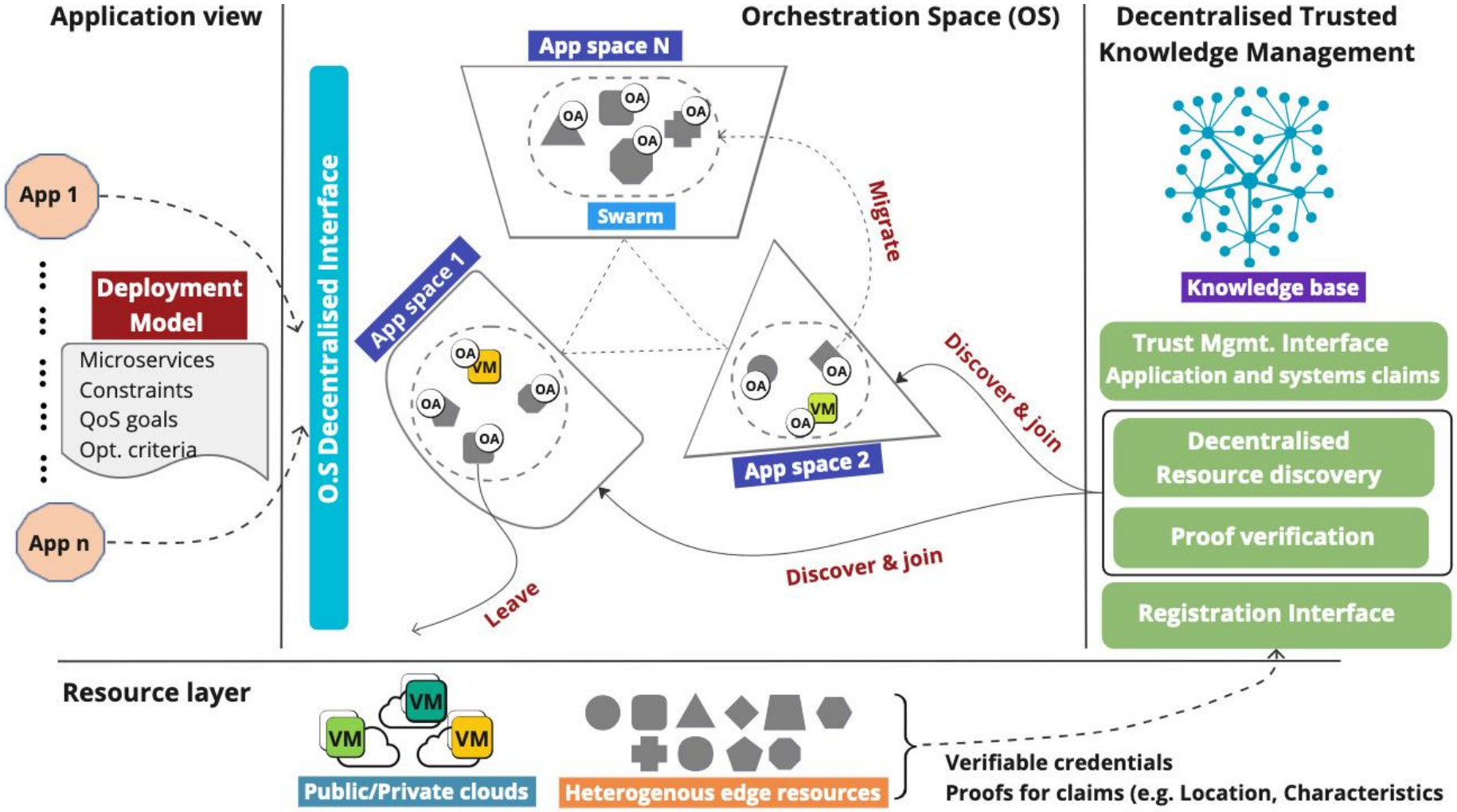
Scientific Coordinator of Swarmchestrate

swarmchestrate

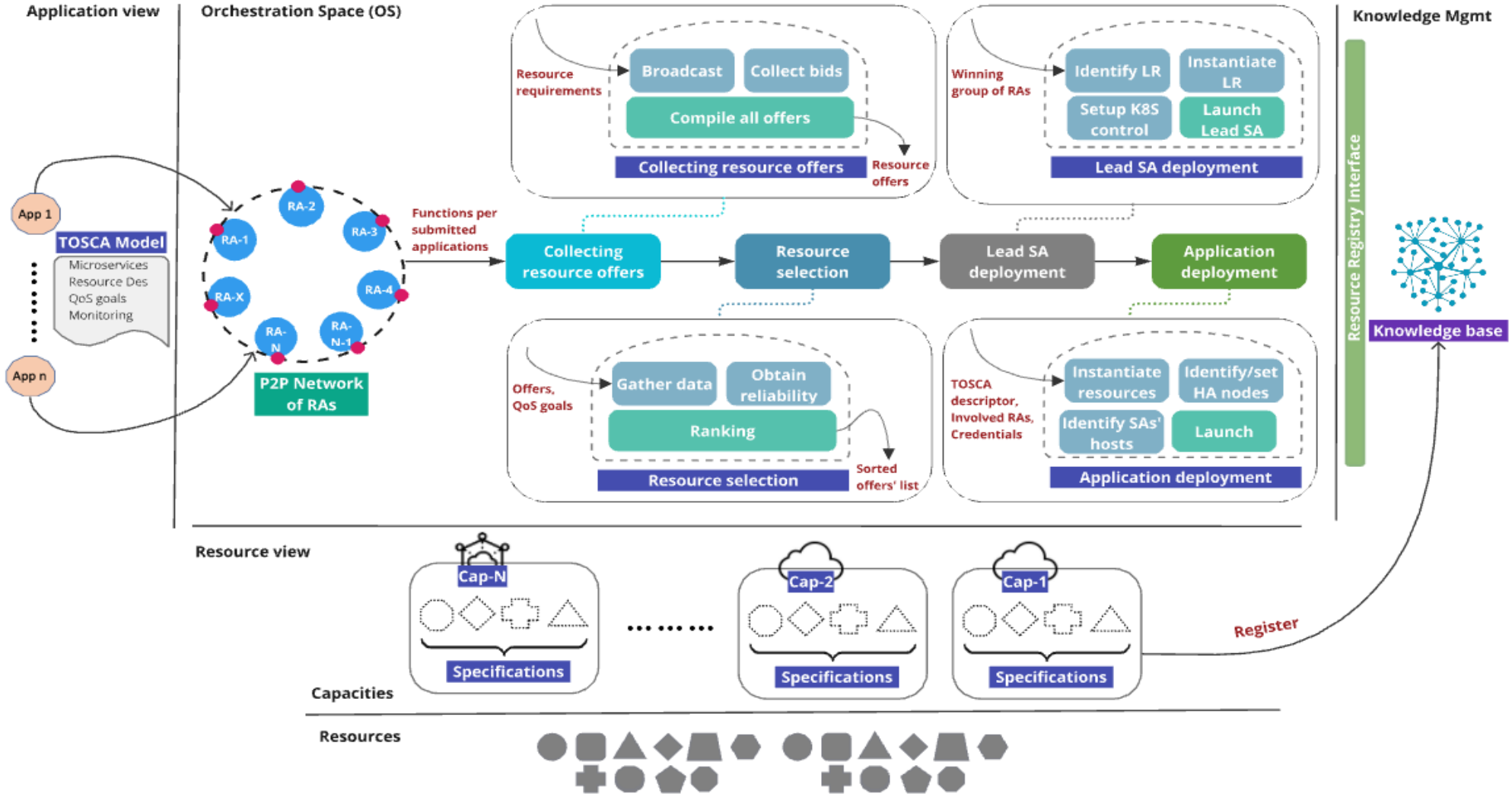
Swarmchestrate Project Objectives

- Develop an **application-level decentralised orchestration framework**, utilising Swarm-based distributed intelligence
- Develop **matchmaking algorithms using decentralised AI** methods to optimise energy efficiency and effectiveness
- Develop a **simulation and digital twin environment** based on the novel decentralized orchestration concept of the project
- Dynamically create and manage **a set of interconnected Swarms** across the distributed Cloud-to-Edge infrastructure
- Develop trusted, reliable, secure and transparent **knowledge management**
- Implement **real-life application demonstrators** utilising Swarmchestrate services in realistic scenarios

Swarmchestrate Concept



Swarmchestrate Application Deployment



RA: Resource Agent
SA: Swarms Agent
LR: Lead Resource
HA: High Availability
K8S: Kubernetes

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SWARMCHESTRATE OPTIMISES AI APPLICATION DEPLOYMENT AND RUN-TIME IN THE CLOUD-EDGE CONTINUUM

INTEND

Intent-based data operation in the cognitive computing continuum

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Motivation: Towards EU's sovereign data and AI infrastructures, built on the cloud-edge continuum

We need **AI agents** with advanced human-like intelligence to achieve **intent-based** automation

It is difficult for stakeholders to decide ***how*** to manage it, rather than to express ***what*** they **intend** it to perform

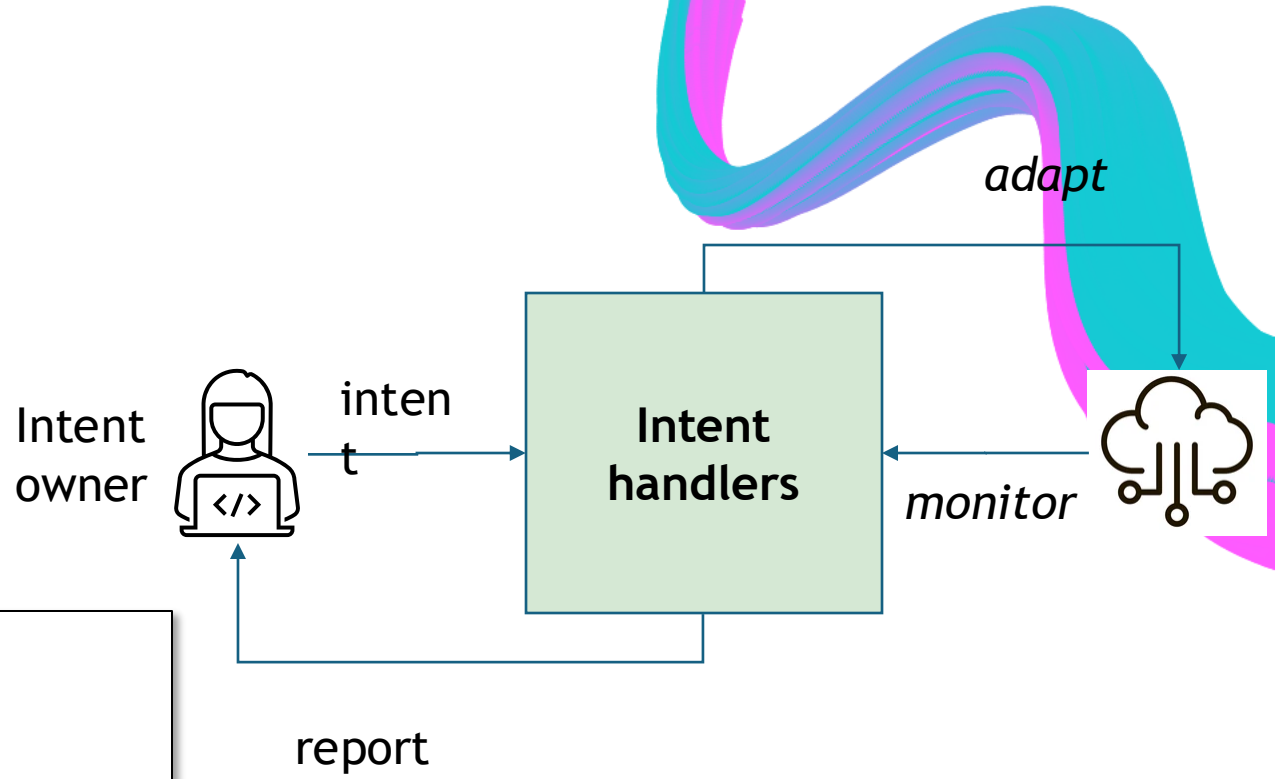
The **computing continuum** is getting ever more important but also more complex

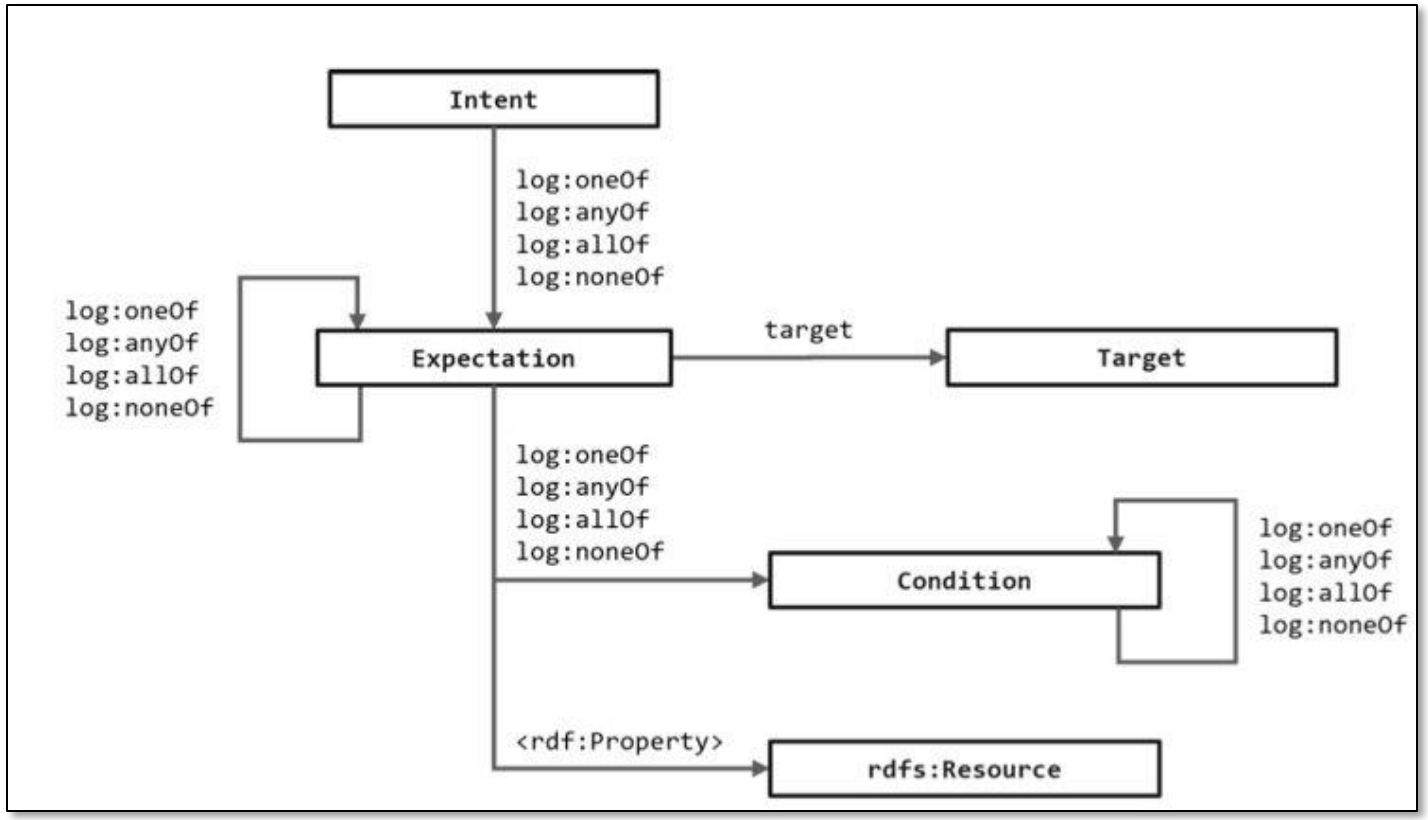
Intent-based management

Intents comprise the requirements, goals, and constraints in a simplified manner that is *abstract from complex technical definitions and dependencies*.
To put it even simpler, intents are the "**what**", not the "**how**".
The "how" is left to the "handler", which we call the "Intent Management Function". --**IG1253E, TM Forum**

- Inspired by intent-based networking (IBN), extending to the computing continuum
- An **intent** is the stakeholders' expression on *what* they want to achieve for the target system, without embedding on *how* to operate and manage the system to achieve these objectives
- The *three properties* of intents. *An intent must*:
  - be **operable:** have the potential to lead to some system actions
  - be **measurable:** we can tell if an intent is fulfilled or not
  - and have a **lifecycle:** we know when and for how long we need to fulfill it

Intent and intent handler





Intent handlers must be intelligent

- Build GenAI agents with **human-like intelligence** to manage data pipelines in the cloud-edge computing continuum, based on the stakeholder's intents

Adapt like human: continuously **learn** how to handle new situations and new types of resources

Think like human: make **strategic** decisions for the global continuum, with **decentralized** inputs

Talk like human: understand the **intents** of stakeholders and **explain** its own decisions, in a natural way

INTEND Use cases

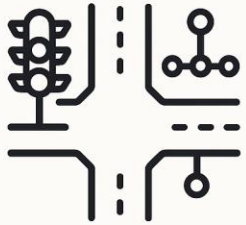
Green video streaming: Optimize energy consumption of contents and processing distributed in the cloud and private servers

Machine data analytics: End-user-friendly adaption of data analytics pipelines running on machine tools, edge servers, and cloud

Robotic systems: Adaptive localization pipelines on the distributed robotic systems (*a feasibility study*)

5G infra for data processing: Manage customer applications running on telecom infrastructure with edge datacenters

Urban data space: Adaptive edge-cloud platform for urban data space with real-time sensor data of the road and the traffic



Key Exploitable Results – the INTEND tools

- Stakeholder facing intent ***receiving*** and ***translation*** (WP4)
  - **inChat**: natural language interface for intent-based management
  - **inGraph**: knowledge graph management for intents and systems
  - **inSwitch**: context switching between intent domains
  - **iExplain**: intent-based observability and explanability
- Intent-based ***resource management*** (WP2)
  - **inOrch** (IDO): orchestration and computational resource management
  - **inNet**: a TMF921 implementation for network adaptation
  - **inStorage**: data placement and storage management
  - **inNeural**: smart model allocation and NPU configuration (early design)
- Decentralized intent ***coordination*** and ***aggregated observation*** (WP3)
  - **inCoord** (DICT): cross-domain intent coordination based on RL
  - **inSustain**: end-to-end assessment of energy consumption
  - **inTrust**: trustworthiness and compliance assessment of data pipelines
  - **inServ**: distributing workloads among datacenters and clusters (new after M24)

Summary of key scientific innovations

- **Intent**-based management
  - TMF standards (networking) → computing continuum → natural language
  - *As a novel way for human-AI collaboration: via **shared intentionality***
- **AI agents**
  - Early adopter and explorer of agentic AI
  - Combining Gen AI with continual and reinforcement learning
  - Following and evaluating new agentic techniques: RAG, MCP, Agent Skills
  - *A promising bridge between intent and system*
- **Knowledge** / Neuro-symbolic AI
  - Knowledge Graph (KG) for both system and intent, KG-enhance agent decisions
  - *Linking intent, agent and continuum*

Thanks!

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https://intendproject.eu

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