



# TRUSTWORTHY, COGNITIVE AND AI-DRIVEN COLLABORATIVE ASSOCIATIONS OF IOT DEVICES AND EDGE RESOURCES FOR DATA PROCESSING

## Project Presentation

**Call :** HORIZON-CL4-2023-DATA-01

**Topic :** HORIZON-CL4-2023-DATA-01-04 -  
Cloud Computing: towards a smart cloud  
computing continuum

**Type of Action:** RIA

**Grant Agreement no:** 101136024

**Project start:** 01/02/2024

**Duration:** 36 months

**Budget:** 4,673,541.7

**Site:** [empyrean-horizon.eu](http://empyrean-horizon.eu)

# Project Administrative Information

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- ❑ **Project Name:** Trustworthy, cognitive and AI-driven collaborative associations of IoT devices and edge resources for data processing
- ❑ **Call identifier:** HORIZON-CL4-2023-DATA-01-04: Cognitive Computing Continuum: Intelligence and automation for more efficient data processing
- ❑ **Project Type:** Research & Innovation Action (RIA)
- ❑ **Grant Agreement Number:** 101136024
- ❑ **Project Coordinator:** Institute of Communication and Computer Systems – ICCS
- ❑ **Duration:** 36 months (01/02/2024 – 31/01/2027)
- ❑ **Funding from the EC:** 4,673,541.7 €
- ❑ **Total Budget of the project:** 4,673,541.7 €

# Consortium (11 partners)



- INSTITUTE OF COMMUNICATION AND COMPUTER SYSTEMS – ICCS (Greece)



- NVIDIA MELLANOX TECHNOLOGIES LTD – NVIDIA (Israel)



- CHOCOLATE CLOUD APS – CC (Denmark)



- UNIVERSIDAD DE MURCIA – UMU (Spain)



- ZETTASCALE TECHNOLOGY SARL – ZSCALE (France)



- RYAX TECHNOLOGIES – RYAX (France)



- NUBIS IDIOTIKI KEFALAIOUCHIKI ETAIRIA – NUBIS (Greece)



- IDEKO S COOP – IDEKO (Spain)



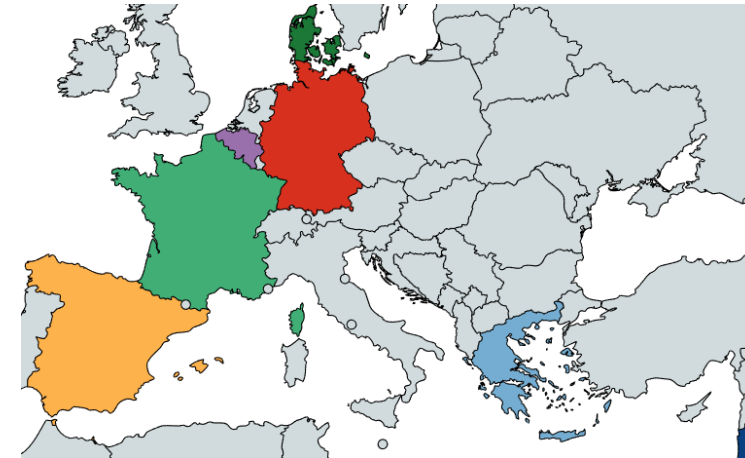
- NEC LABORATORIES EUROPE GMBH – NEC (Germany)



- INSTITUTE FOR AGRICULTURAL, FISHERIES AND FOOD RESEARCH – EV ILVO (Belgium)



- TRACTONOMY ROBOTICS BVBA – TRAC (Belgium)



# Motivation

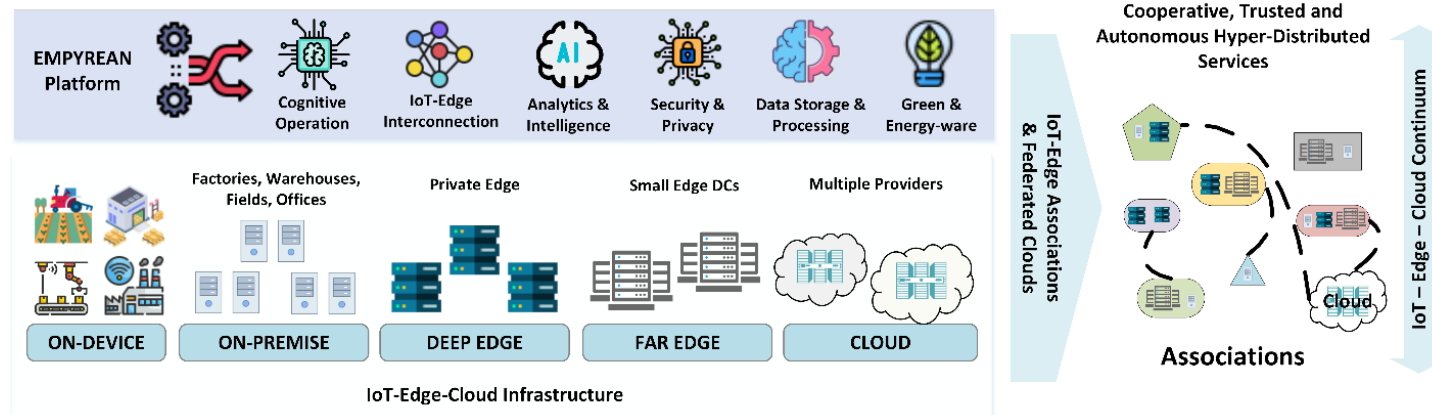
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- ❑ The conventional way of dealing with IoT data, is to push them to the cloud or utilize edge resources, forming an IoT-edge-cloud continuum.
- ❑ This continuum is implemented usually as a monolithic pipeline that cannot efficiently serve hyper-distributed and AI/ML-based applications.
- ❑ It is clear that more local decisions and a collective logic that leads to system-wide welfare optimality is needed.
- ❑ EMPYREAN proposes a new hyper-distributed computing paradigm, encompassing heterogeneous IoT devices and computing, storage and connectivity resources that may belong to different providers at different segments of the continuum.

# EMPYREAN Vision



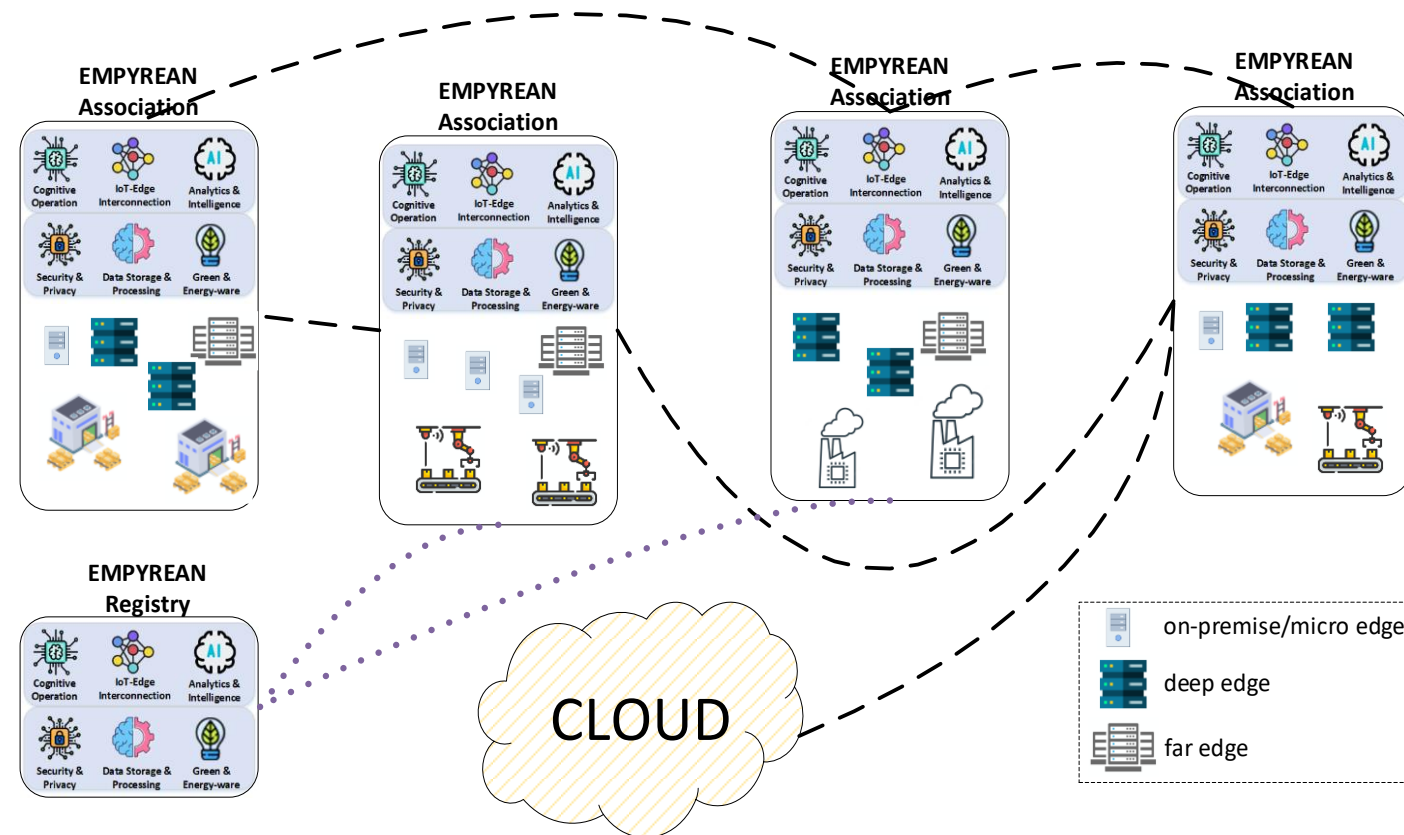
- ❑ EMPYREAN envisions a collaborative autonomous computing ecosystem over heterogeneous resources, different providers and connectivity types.
- ❑ EMPYREAN will build federations of collaborative resources, the IoT-Edge Associations.
- ❑ Association will provide a secure execution environment.
- ❑ Association-based continuum will balance computing tasks and data locally inside an Association as well as between federated Associations.
- ❑ EMPYREAN platform will provide interconnection, efficient data processing of ML-workloads and secure distributed edge storage.



# EMPYREAN Concept



- ❑ Transforming IoT-Edge-Cloud continuum into a collaborative autonomous computing ecosystem.
- ❑ Perception of a unified, adaptable, low latency, efficient, reliable and trustworthy virtual execution environment.
- ❑ Development activities:
  - Security, Trust and Seamless Data and Computing Management
  - Decentralized Intelligence, Application Development and Deployment
  - EMPYREAN Aggregator



# EMPYREAN Objectives

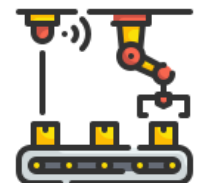
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- ❑ **Objective 1:** Enable collaborative autonomy in the IoT-edge-cloud continuum.
- ❑ **Objective 2:** Cognitive Associations, speculative resource orchestration and AI-driven adaptability.
- ❑ **Objective 3:** Ensure security, privacy and multi-party-trust in the IoT-edge-cloud continuum.
- ❑ **Objective 4:** Build mechanisms for efficient IoT data processing of ML-workloads and hyper-distributed applications.
- ❑ **Objective 5:** Workflow-based, AI-augmented application development and seamless control and deployment on the edge-cloud continuum.
- ❑ **Objective 6:** Demonstrate the capabilities of the EMPYREAN platform in supporting hyper-distributed, highly-demanding and dynamic applications.

# EMPYREAN (3+1) Use Cases

- ❑ High-demanding, safety-critical, dynamic, greatly impactful applications that pose heterogeneous demands.
- ❑ **Advanced manufacturing UC**
  - Developing a system able to perform process monitoring in robotic machining cells.
  - Demonstrate EMPYREAN platform as a key enabler for the ongoing industrial revolution.
- ❑ **Smart agriculture UC**
  - Developing a Soil Organic Carbon (SOC) process to assess the soil state in agriculture fields.
  - Demonstrate a revolutionary way to monitor and manage soil health, leading to more sustainable and efficient agricultural practices.
- ❑ **Warehouse automation UC**
  - Developing technologies to operate fleet of robots for order picking functions in warehouses.
  - Demonstrate secure and trusted interconnection of warehouses served by distributed Associations.
- ❑ A **South Korea based** UC in smart factories will further showcase the use of the EMPYREAN platform in international scenarios.



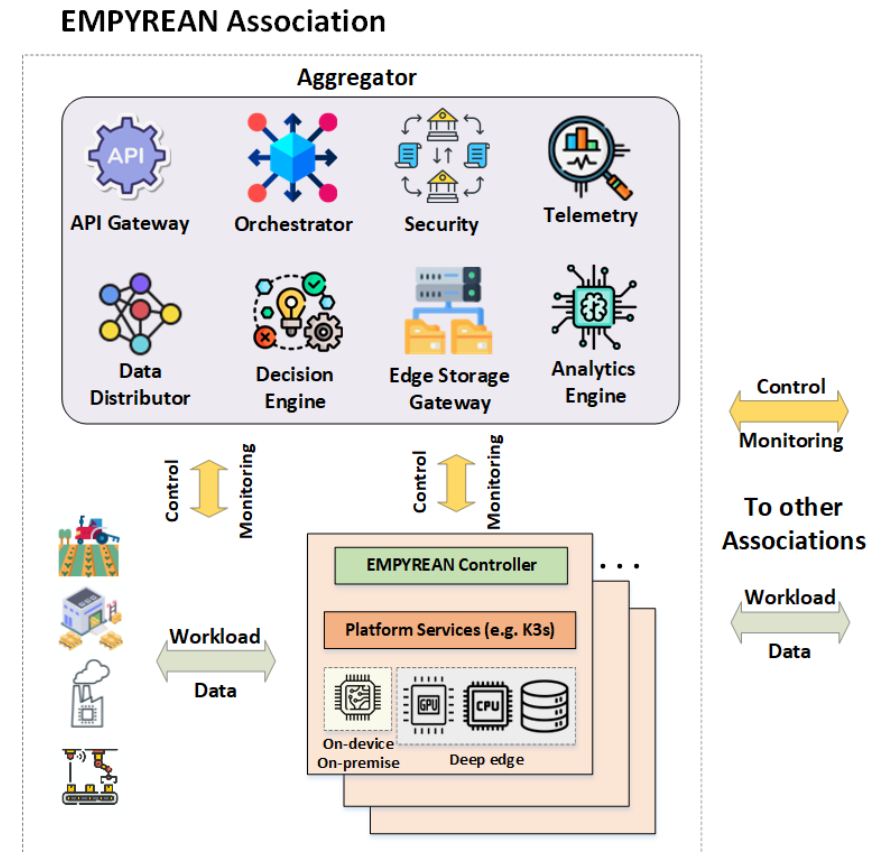


# EMPYREAN Ecosystem



- ❑ EMPYREAN Association is managed by an Aggregator.
- ❑ Multiple self-managed and interacting Aggregators form the management plane for the envisioned distributed and AI-enabled Associations-based continuum.
- ❑ EMPYREAN platform key building blocks:

- API Gateway
- EMPYREAN Orchestrator
- Decision Engine
- Edge Storage Gateway
- Data Distributor
- Security & Privacy
- Telemetry Engine
- CTI Engine
- Analytics Engine
- EMPYREAN Controller
- Service Development Kit

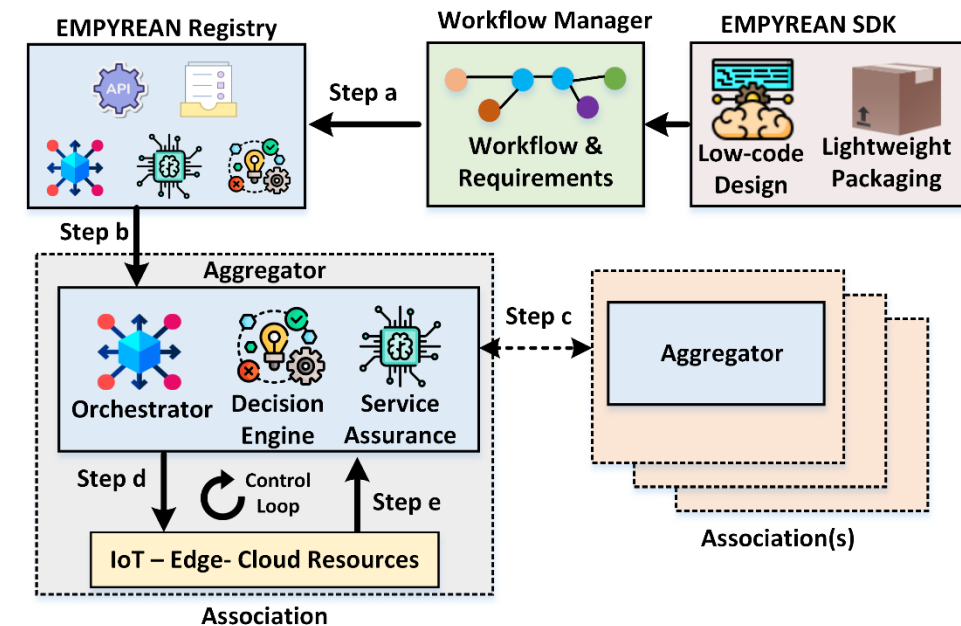


# EMPYREAN Lifecycle



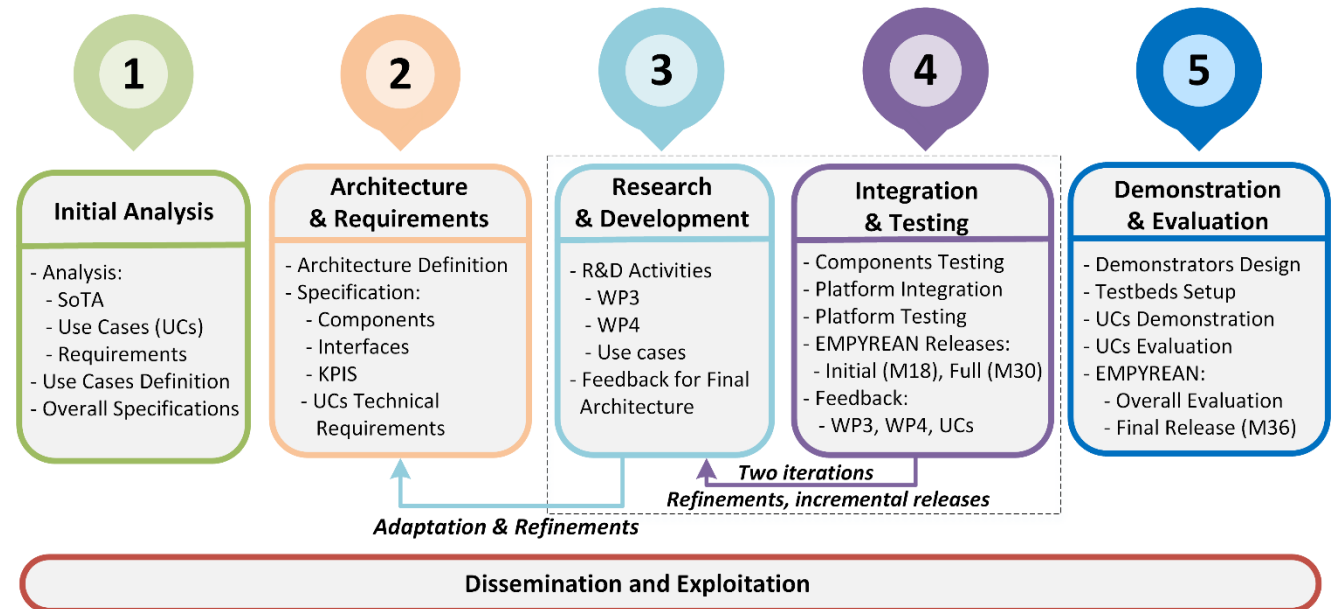
- ❑ EMPYREAN Associations and Hyper-Distributed Applications.
- ❑ Seamless deployment, cognitive orchestration and autonomous adaptability.
- ❑ Distributed closed-loop control system and self-driven continuous adaptations.
- ❑ Lifecycle:

- **Step a:** User provide application workflow-based description and high-level deployment requirements.
- **Step b:** EMPYREAN Aggregator decomposes high-level requirements into specific service goals.
- **Step c:** Assign application workload to resource in one or multiple Associations, involves cooperation among Aggregators in different Associations.
- **Step d:** Aggregator forwards low-level infrastructure-specific deployment objectives to Local Orchestrators.
- **Step e:** Distributed service assurance mechanisms, based on real-time telemetry, trigger re-optimizations.



# EMPYREAN Methodology

- **Phase 1** - Initiates technical work:
  - UCs detailed definition and analysis
- Incremental implementation and evaluation.
- **Phase 2:**
  - Detailed SERRANO architecture
  - Ensure integration and interoperability
- **Phase 3** - Implements innovations
- **Phase 4** - Integrates and verifies technological developments
- **Phase 5:**
  - Full functionality demonstration
  - High impact components identification



# EMPYREAN Impact



- EMPYREAN's modular-by-design approach supports the creation of a plethora of services.
- **Impact 1**: EMPYREAN will play a crucial role in EU's strategic autonomy and in its effort for the edge/cloud dominance.
- **Impact 2**: EMPYREAN unique technological advancements, their application in diverse key sectors (manufacturing, agriculture and warehousing) will substantially contribute toward the realization of Europe's Digital Decade targets by 2030, while benefiting EU industry roadmap.
- **Impact 3**: EMPYREAN is committed to promote interoperability and portability at every stage of the innovation process, towards an EMPYREAN-based open ecosystem.
- **Impact 4**: EMPYREAN partners will promote the strategic industrial cooperation in AI/ML-based data storage and processing that can benefit the EU industry roadmap.

# EMPYREAN Partner Roles



## Edge, acceleration and interconnection



## Security and Privacy



UNIVERSIDAD  
DE MURCIA

## Application packaging, resource orchestration



## Use cases





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## Contact

**Project Coordinator**

**Emmanouel (Manos) Varvarigos**

**Professor, ICCS/NTUA**

**vmanos@central.ntua.gr**



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