Federated Architectures for Distributed Intelligence

Way Forward

Concertation and Consultation on Computing Continuum
Concertation Meeting
Brussels
10th May 2023
Human-device interfaces
Hardware accelerators & low powered devices
Federated and distributed intelligence
VNFs and 5G edge processing
DLT enabled data management and cybersecurity

Parameter based pooling – Function as a Service
Abstraction layers for heterogeneous/mixed resources
Cognitive and automated orchestration platforms
Cloud based hardware/software acceleration & optimisation
Multicloud application development interfaces and tools
D2.6 Policy Guidance and Mapping
6 SRIAs + > 590 Topics

1. **SHARED DIGITAL FUTURES**
   - Impact of Data Act, AI Act, Cyber Resilience Act, Digital Services Package on NGIoT

2. **A FEDERATED FUTURE**
   - Highlights and trends across major SRIAs

3. **SRIA DATABASE**
   - >650 abstracted and categorised topics in csv on Zenodo

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Key themes and trends

Overall observations

- Federated and heterogeneous systems
- Trust and Performance
- Distributed intelligence and Federated Learning

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Key themes and trends

Overall observations

- Federated and heterogenous systems
- Trust and Performance
- Distributed intelligence and Federated Learning

Key themes

- Reliability: 75
- Trustworthy AI: 72
- Interoperability: 70
- Market: 49
- Energy/Power: 37
- Components: 35
- Foundational Tech: 34
- Contextual IoT: 30
WAY FORWARD
Federated Architecture for Distributed Intelligence

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EU-IoT

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Carlos Palau
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AerOS

Akis Kourtis
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OASEES
NGIoT 2020-2023
IoT architecture through software-defined networking as an uniform layer, based on advanced AI and federated learning
Agriculture, Energy, Health, Supply Chain

MetaOS 2022-2025
Platform-agnostic, zero-touch MetaOS that follows a collaborative IoT-Edge-Cloud architecture supporting flexible deployments
Agriculture, Energy, Social, Ports, Manufacturing

Swarm AI 2023-2026
Fully open-source, decentralized, and secure Swarm programmability framework for edge devices and leveraging various AI/ML accelerators
Health, Energy, Manufacturing
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The Claridge – Brussels, Belgium | 10-11 May 2023

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

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**TERMINET Reference Architecture**

- **Microservice-oriented** application deployment across edges and the continuum
- **Resource Orchestration Components**
  - Vertical and Dynamic Resource Orchestrator
- **Storage and Streaming Analytics Components**
  - Storage and Streaming Analytics Component
- **Security and Privacy Components**
  - Attestation Gateway
- **Application Components**
  - Federated Learning Framework for privacy-preserving ML model training
  - Dashboard

**Interoperability through multi-access distributed edge networks supported by novel orchestration schemes**


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Federated Approach – Privacy by Design
TERMINET Project Identity & Consortium

TERMINET aims at providing a novel **next generation reference architecture** based on cutting-edge technologies such as Software Defined Networking (SDN), multiple-access edge computing (MEC), and virtualisation for next generation IoT. In addition, TERMINET introduces **new, intelligent IoT devices** for low-latency, market-oriented use cases. Finally, TERMINET intends to bring more **efficient and accurate decisions to the point of interest to better serve the final user**.

**TERMINET USE CASES**

1. UC #1: User-Centric Devices in Smart Farming
2. UC #2: Pathway of Personalized Healthcare
3. UC #3: Smart, Sustainable and Efficient Buildings
4. UC #4: Prediction and Forecasting System for Optimizing the Supply Chain in Dairy Products
5. UC #5: Group Training Surgery Using VR enabled IoT Technologies
6. UC #6: Mixed Reality and ML Supported Maintenance and Fault Prediction of IoT based Critical Infrastructure
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Thank you for your kind attention!

The Claridge – Brussels, Belgium | 10–11 May 2023

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This Communication is part of a project that has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement N°101069732

DISTRIBUTED INTELLIGENCE ARCHITECTURE IN aerOS

EU CEI Concertation Meeting
Brussels, May 10th, 2023
Prof. Carlos E. Palau (UPV) – Project Coordinator
aerOS creates a network-compute fabric, on top of which reusable distributed IoT applications can be deployed on aerOS service fabric following an AI-driven service placement, consuming the IoT data, that are discovered in the aerOS data fabric.

- Service deployment and management following cloud-native principles (K8s, Helm charts, KubeEdge and beyond).
- Federated orchestration in multi-stakeholder environments
- Event mesh and serverless to connect services and apply AI for the orchestration in the continuum.
- Frugal AI/ML techniques for managing services lifecycle
**FEDERATED ORCHESTRATION IN aerOS**

- aerOS continuum is composed of Infrastructure Elements in various domains.

**Registry of underlying IEs and peers IE.**

**Every IE contains a Federated Context Broker (FIWARE ORION)**

The far-end IEs directly connect to IoT devices

**How the continuum is orchestrated:**

An application must be deployed in the continuum.

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DATA FABRIC and EVENT MESH

- aerOS proposes an innovative way of managing among that can reside anywhere across the continuum.

  - Data Fabric forming a data continuum allowing distributed intelligence.

- Service mesh principles (e.g., Istio) enhanced with Dynamic structure (Event mesh).

- Customized AI models via OpenFAAS, serverless functions.
This Communication is part of a project that has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement N°101069732

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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.
x-Sensors/Devices

01: SSI: DIDs, VCs

02: Create their DAO - Organize through it

03: Choose/Define their AI model/optimization

04: Use the preferred Accelerator

x-Networks

x-ML-Algorithms

05a: Automated Decision Making/HITL

05b: Optimize & Collect KPIs

x-Specialist

SDK
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