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 Nº101069732

Pitch
EU CEI Concertation Meeting
Brussels, May 10th, 2023
Prof. Carlos E. Palau (UPV) – Project Coordinator
CONTEXT AND ORIGINS

The unprecedented data explosion and the evolving capabilities of virtual infrastructures, set the scene for developing a new paradigm for data and compute resource management in EU.

Processing needs to be performed closer to the data sources (often smart devices), in an effort to minimise latency, save bandwidth, improve security, guarantee privacy and increase autonomy.

ISSUES

- Wide variety of deployment models and open standards
- Existing legacy investments
- The challenge of seamlessly integrating various edge technologies into a homogeneous “continuum” remains open

Cloud centricity and cost
Network management
All-around virtualisation
Security & trust
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**GOAL, ARCHITECTURE AND USE CASES**

- **aerOS overarching goal** is to design and build a virtualised, platform-agnostic meta operating system for the IoT edge-cloud continuum. As a solution, to be executed on any Infrastructure Element within the IoT edge-cloud continuum – hence, independent from underlying hardware and operating system(s).

- **User Applications (no aerOS)**
  - User services
  - aerOS Basic Services
  - aerOS Runtime

- **Hypervisor/Container Runtime**
- **Operating System**
- **Hardware**

- **aerOS Basic Services**
- **aerOS Runtime**

- **Manufacturing:** Data-Driven Cognitive Production Lines (Manufacturing Autonomy Level 4 – MAL4)

- **Renewable energy:** Containerised Edge Computing near Renewable Energy Sources

- **Maritime ports:** Smart edge services for the Port Continuum

- **Machinery:** High Performance Computing Platform for Connected and Cooperative Agricultural Mobile Machinery to Enable CO2 Neutral Farming (HPCP-F)

- **Smart Buildings:** Energy Efficient, Health Safe & Sustainable Smart Buildings

• ...using context-awareness to distribute software task (application) execution requests
• ...supporting intelligence as close to the events as possible
• ...supporting execution of services using "abstract resources" (e.g., virtual machines, containers) connected through a smart network infrastructure
• ...allocating and orchestrating abstract resources, responsible for executing service chain(s)
• ...supporting scalable data autonomy
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Flexible, scalable, secure, and decentralized Operating System

F. Risso, Politecnico di Torino (Italy) – Technical coordinator
Is the Edge-to-Cloud continuum already here?

Without FLUIDOS

With FLUIDOS

© FLUIDOS | Flexible, scalable, secure, and decentralised Operating System
Approach

Extensible, Modular Nodes with Resource-agnostic Abstraction Capabilities

Borderless Continuum through Intent-based, Scalable, Fluid and Decentralised OS

Seamless, Zero-trust (and touch) Security and Privacy

Cost-Effective and energy-aware ICT Infrastructures

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Reduced costs

Increased agility in software development and deployment

Reduced energy consumption and more effective ICT infrastructures

New business pathways

Public implementation of FLUIDOS influencing key open-source communities in the area

A vibrant community of early adopters, embracing new paradigms toward edge-native computing
IoT2Cloud Operating System

Project overview

Francesco D’Andria (ATOS)
10/05/2023 Concertation event

Towards a functional continuum operating system

Funded by the European Union
ICOS in a nutshell

Administrative data

Name: Towards a functional continuum operating system
Horizon Europe call: Horizon-CL4-2021-DATA-01-05
Coordinator: ATOS
Technical coordinator: UPC
Duration: 36 months
Starting date: 01 September 2022
EU contribution: 10,997,675 €
Cascade funding: 1,900,000 €

Use cases

- In-car Advanced Infotainment and Multimedia Management system
- Agriculture Operational Robotic Platform
- Railway Structural Alert Monitoring system
- Energy Management and Decision Support system
IoT2Cloud Operating System

1. Modeling strategy for proactive continuum management (dynamic deployment, configuration, migration, anomalies detection, SLA deviations, etc.)

2. Decentralized AI-assisted approach (online training under changing conditions, FL for privacy, etc.)

3. Dynamic and flexible data federation between devices

4. Open and unified programming model

5. Transparent deployment on top of native OSs

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

Key Innovation

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

Economic Impact

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

EU Competitiveness

The ICOS ecosystem to 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.
Towards a functional continuum operating system

For more information please contact:
francesco.dandria@atos.net
Vision of the project

NebulOuS will develop a novel Meta Operating System and platform for enabling transient fog brokerage ecosystems that seamlessly exploit edge and fog nodes, in conjunction with multi-cloud resources, to cope with the requirements posed by low latency applications.

It will accomplish substantial research contributions in the realms of cloud and fog computing brokerage by introducing advanced methods and tools for enabling secure and optimal application provisioning and reconfiguration over the cloud computing continuum.

www.nebulouscloud.eu
NebulOuS and EU-CEI

Technical contributions
- Resource brokerage
- Application optimisation
- Data communication overlay

Application domains
- Agriculture of tomorrow
- Energy and utilities
- Logistics and transportation
- Crisis management

Open Solutions Registry
- Documentation
- Packaged solutions
- Interoperable interfaces
- Experience registry
- Meeting the community

Application forum
- Requirements gathering
- Experience exchange
- Adoption of foreign solutions
- Projects adopting foreign applications
- Joint marketing efforts

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Commission. Neither the European Union nor the granting authority can be held responsible for them. | Grant Agreement No.: 101070516
NEMO
NExt Generation Meta Operating System

PROJECT OVERVIEW

EC Cluster 4
Concertation and Consultation on
Computing Continuum

Brussels, 10-11 May 2023

Harry Skianis, PhD
TM, Synelixis Solutions SA

NEMO receives funding from the EU Horizon Europe research and innovation Programme under Grant Agreement No. 101070118
NEMO Identity Card

Title: Next Generation Meta Operating System
Grant agreement ID: 101070118
H2020 Call: Horizon-CL4-2021-DATA-01-05
Funding Instrument: RIA (Research and Innovation Action)
Coordinator ATOS – Technical Coordinator SYNELIXIS
Duration: 36 months – Starting Date: 1st September 2022
EU Contribution: 10.5 MEuros – Cascading Funding: 1.8 MEuros
26 Partners – 9 Countries
8 Use Cases – 5+1 Living Labs/Pilots
**NEMO: Next Generation Meta Operating System**

1) **Technological Innovations**
- Full stack, fully configurable, cloud-native, data aware meta-OS
- Bring intelligence closer to data/make AI integral part of meta-OS
  - Self-Organized/Healing Network Clusters/5G/6G Integration
  - Cybersecure micro-Service Secure Execution Environment (mSEE)
  - SLO/EE based self-optimized meta-Orchestrator
  - ZeroOps Plug-in mechanism
- Cybersecurity, Privacy Compliance & Federated ML verticals

2) **Strengthening the EU competitiveness**
- Fully compatible with DataSpace evolution/standards
- Pre-commercial exploitation components (MOCA)
- FAIR datasets/Smart–X Labs (Farm, Energy, Mobility, Industry, Media)
- Widespread penetration / Open X Access, Source, Standards, Calls
- 1.8M€ for testing and adoption via 2 Open Calls

3) **Expected (Technical, Economical, Environmental, Social) Impact**
- Novel components, tools, methods
- Dataspaces & IoT-Edge continuum integration in reality
- New paradigms in Smart-X Apps delivery
- Push processing to cloud => directly reduce CO2
- Smart Agriculture: reduce pesticides/spraying/soil erosion….
- Closing the digital gap by enabling Smart-X Edge processing
- Reinforcing competitiveness via open-source & Open Calls
Thank you for your attention!

Harry Skianis, SYNELIXIS
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A lightweight software stack and synergetic meta-orchestration framework for the next generation compute continuum

Anastasios Zafeiropoulos, National Technical University of Athens
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Concertation and Consultation on Computing Continuum: From Cloud to Edge to IoT
Brussels, 10-11/04/2023
Main Innovations

- **an IoT and edge computing software stack** for leveraging virtualization of IoT devices at the edge part of the infrastructure and supporting openness and interoperability aspects in a device-independent way.

- **a synergetic meta-orchestration framework** for managing the coordination between cloud and edge computing orchestration platforms, through high-level scheduling supervision and definition, based on the adoption of a “system of systems” approach.

### Virtual Object Stack (VOSTack)

<table>
<thead>
<tr>
<th>Edge/Cloud Convergence (Application-Oriented)</th>
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<tbody>
<tr>
<td>Orchestration Management Interfaces</td>
</tr>
<tr>
<td>(Deployment, Monitoring, Scaling, Live Migration, Mobility)</td>
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<tr>
<td>Generic/Supportive Functions</td>
</tr>
<tr>
<td>(Data Management, Decentralized AI, Authentication, Authorization, Blockchain, Firewalling, Virtualized Functions, Multi-tenancy)</td>
</tr>
<tr>
<td>IoT Device Virtualized Functions</td>
</tr>
<tr>
<td>(e.g., video transcoding in case of a camera, image analysis in case of a face detection sensor)</td>
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<tr>
<th>Physical Convergence (IoT Device-Oriented)</th>
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<tbody>
<tr>
<td>Autonomy and Ad-hoc Networking</td>
</tr>
<tr>
<td>(Bootstrapping, Self-configuration, Self-healing, Ad-hoc networking, Energy-efficiency)</td>
</tr>
<tr>
<td>Interoperability, Security and IoT Device Management</td>
</tr>
<tr>
<td>(Protocol bindings, Semantic Interoperability, Registration of resources, Security, IoT Device multi-tenancy)</td>
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</tbody>
</table>
Synergetic Orchestration Mechanisms
Thank you!