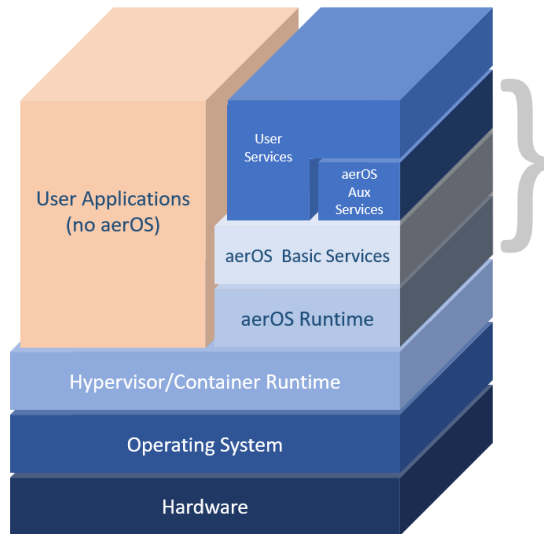aerOS view at April 2024

Meta OS cluster workshop

3rd April 2024 - *Online*

Ignacio Lacalle and Vasilis Pitsilis

GOAL, ARCHITECTURE AND USE CASES

- …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

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)

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

Renewable energy: Containerised Edge Computing near Renewable Energy Sources
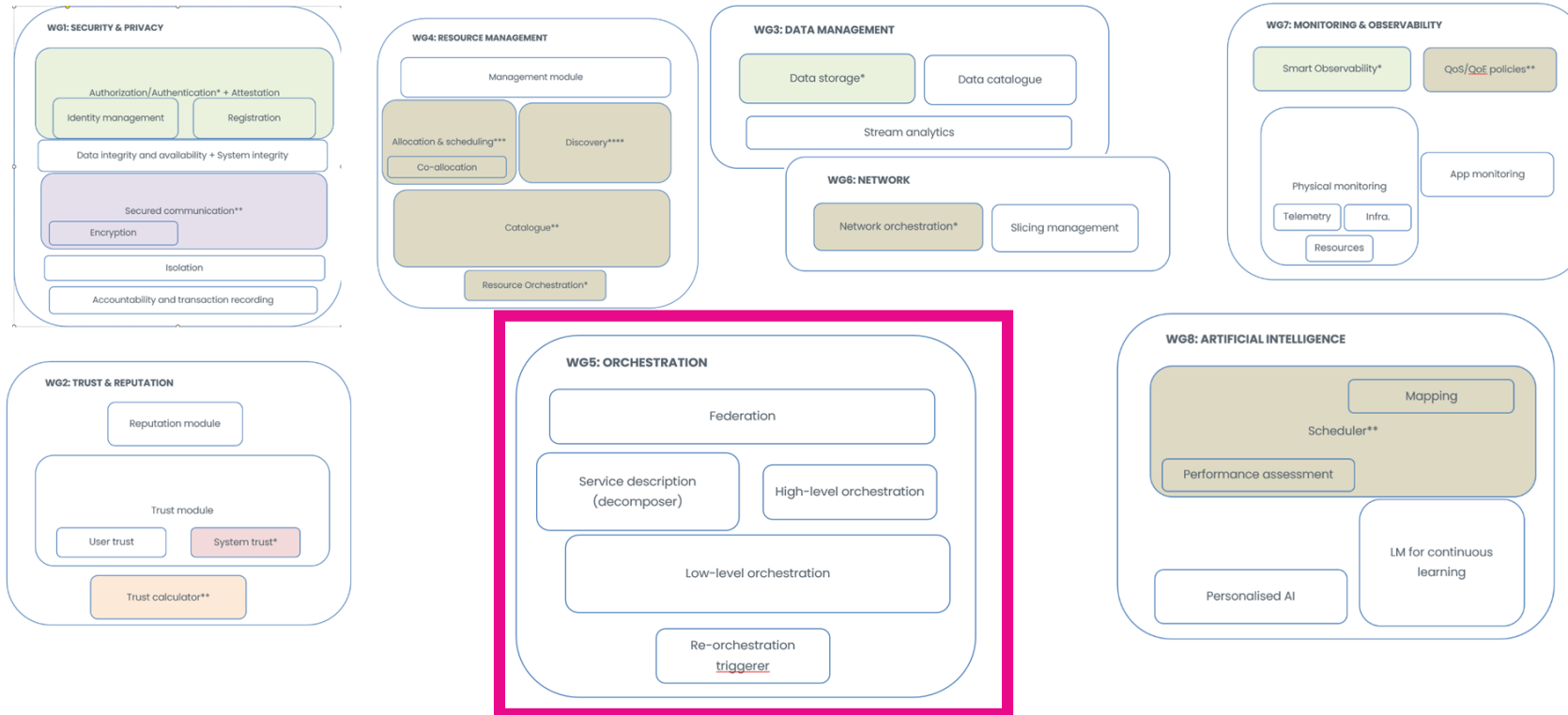
Machinery: High Performance Computing Platform for Connected and Cooperative Agricultural Mobile Machinery to Enable CO2 Neutral Farming (HPCP-F

Maritime ports: Smart edge services for the Port Continuum

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

aerOS project

aerOS perspective w.r.t. meta OS landscape

WG1: SECURITY & PRIVACY
- Authorization/Authentication* + Attestation
  - Identity management
  - Registration
- Data integrity and availability + System integrity
- Secured communication**
  - Encryption
- Isolation
- Accountability and transaction recording

WG2: TRUST & REPUTATION
- Reputation module
- Trust module
  - User trust
  - System trust*
- Trust calculator**

WG4: RESOURCE MANAGEMENT
- Management module
- Allocation & scheduling***
  - Co-allocation
- Discovery****
- Catalogue**
- Resource Orchestration*

WG3: DATA MANAGEMENT
- Data storage*
- Data catalogue
- Stream analytics

WG6: NETWORK
- Network orchestration*
- Slicing management

WG5: ORCHESTRATION
- Federation
- Service description (decomposer)
- High-level orchestration
- Low-level orchestration
- Re-orchestration triggerer

WG7: MONITORING & OBSERVABILITY
- Smart Observability*
- QoS/QoE policies**
- Physical monitoring
  - Telemetry
  - Infra.
  - Resources
- App monitoring

WG8: ARTIFICIAL INTELLIGENCE
- Scheduler**
  - Mapping
  - Performance assessment
- Personalised AI
- LM for continuous learning

Key open source technologies leveraged:
- KubeEdge
- NGSI-LD
- KrakenD
- FIWARE
- KeyCloak
- IOTA
- Redpanda
- Morph-kgc
- PowerTOP
- Cilium
- Zenoh
- OpenAPI
- DCAT
- Kopf
- Helm

Main focus of aerOS: Orchestration, Data Accesibility and Interoperability, Service Monitoring, Heterogeneous underlying systems, automation in the continuum.

Distributed state repository for domains federation
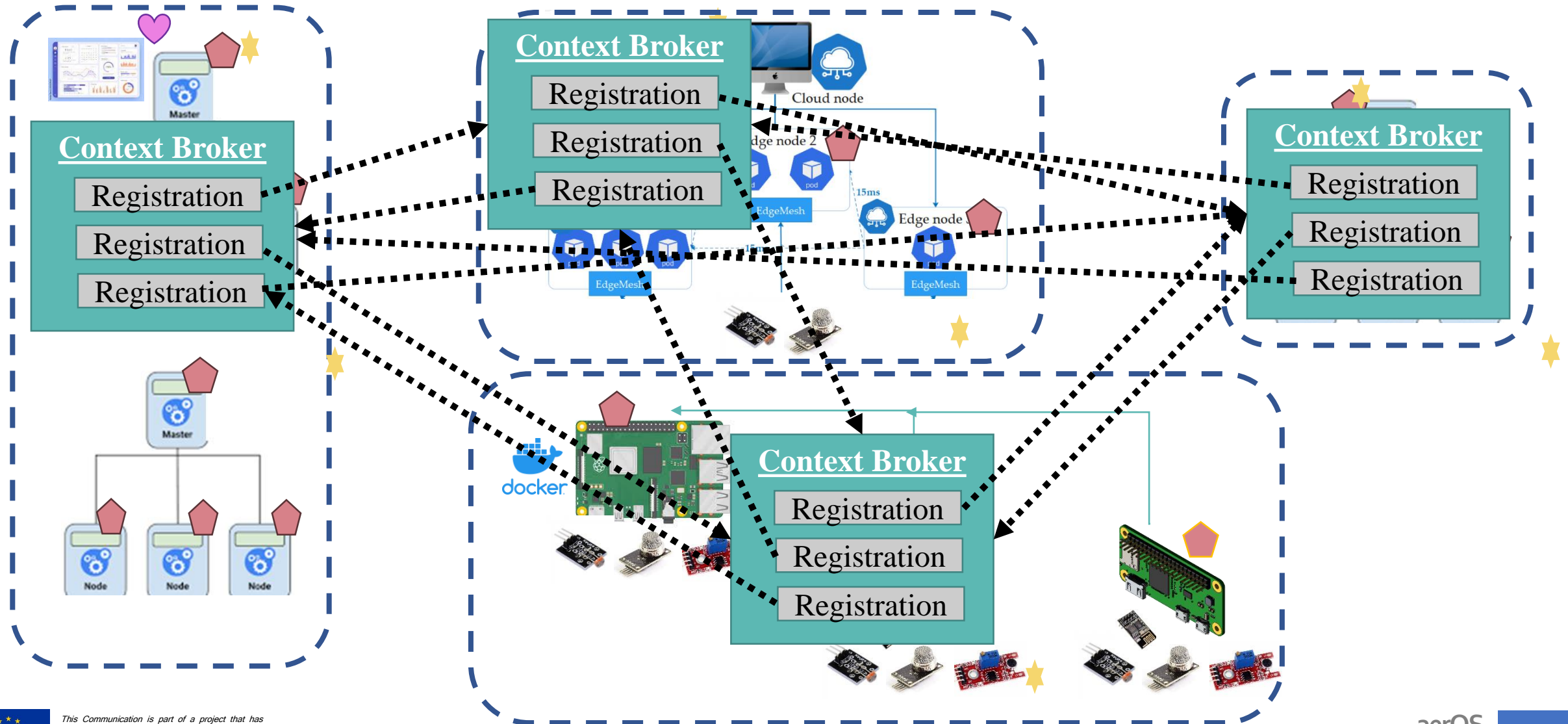
Two-layer service orchestration
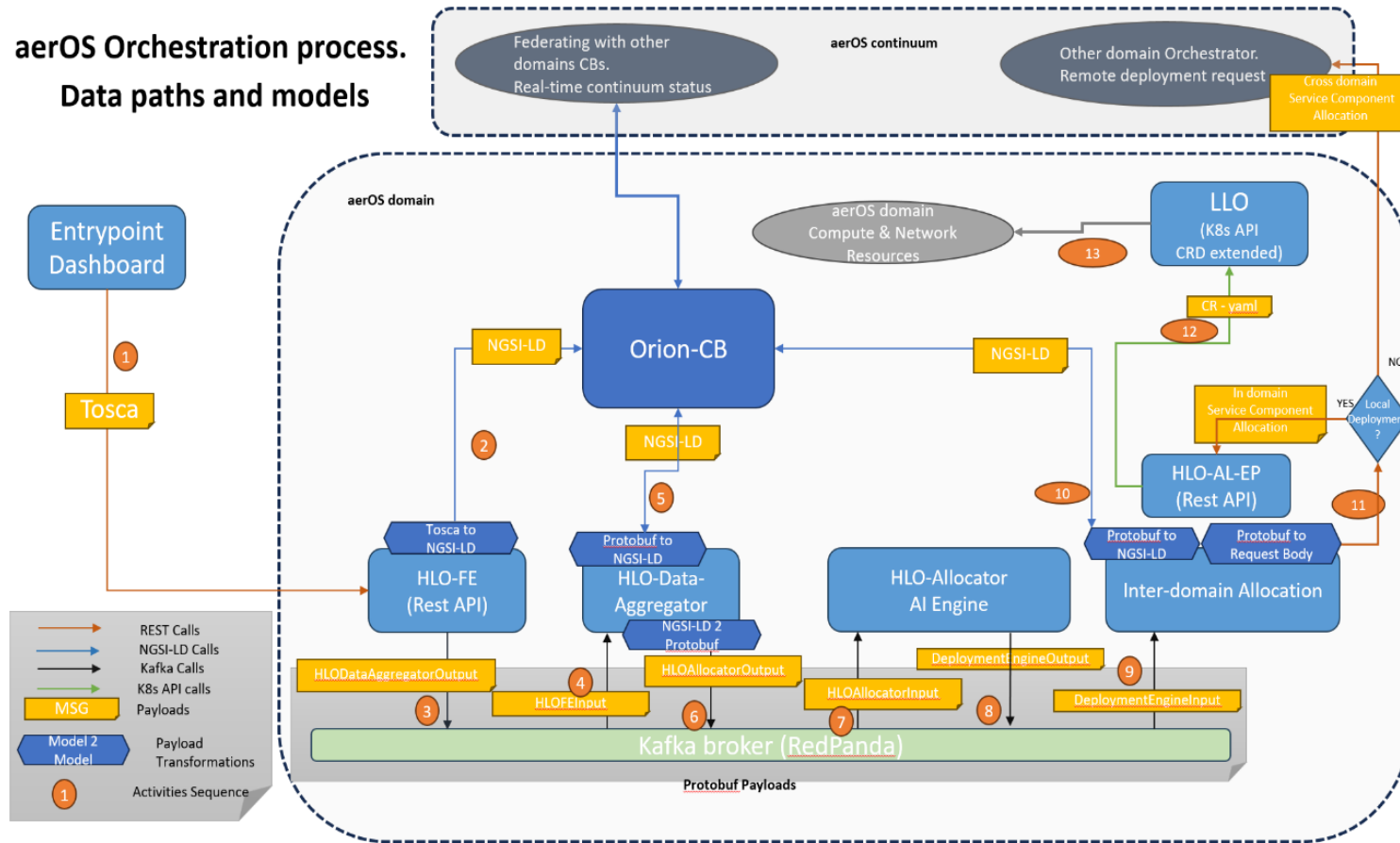
- Homogeneous description of services
  - Custom TOSCA model

- Indication of SLA and requirements via user-friendly portal (UI)

- Supports heterogeneous container management frameworks for workload deployment:
  - K8s, Docker, containerd

- Lightweight messaging
  - Redpanda

- Decentralization BOTH in decision and in deployment

Data Fabric
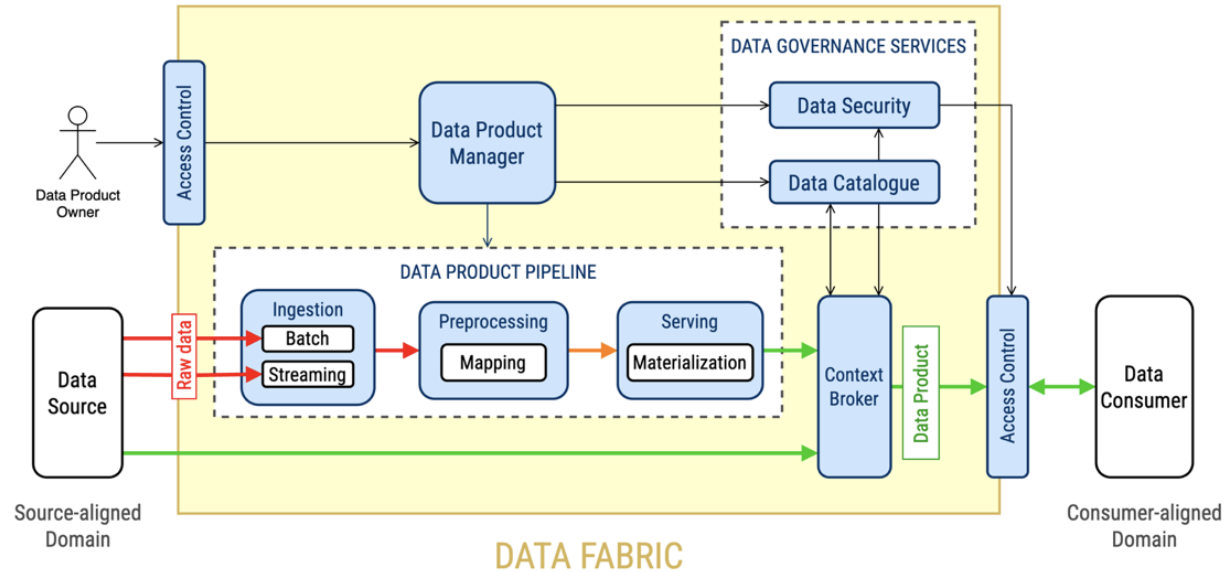
o Data products → Batch data sources enabled. Several extensions to Morph-KGC tool.

o Data security → Validated basic role-based authentication and authorization using Keycloak + OpenLDAP.

o Data catalog → aerOS user metadata (from LDAP) integrated in the knowledge graph.

Automating the continuum: scripting and DevPrivSecOps

- Inclusion of security and privacy tests in the software development lifecycle

- Guaranteed security and privacy in the deployment of components in aerOS and beyond

- Will be made available for all projects to follow the process

What can be anticipated for the future of the continuum?

- **Security, privacy and data spaces** for the continuum.

- Advanced (frugal, explainable, trustworthy) AI mechanisms for improving continuum performance: robustness, **autonomy, traceability, governance.**

- Underlying **network automation**, IP-abstraction and connectivity by service names (eBPF, kernel technologies…).

- Achievement of a true AI-based cognitive mesh with ambient intelligence.

- **Miniaturization** of workloads' containers and packages.

- Business models for effective **federation** of resource sharing in **multi-stakeholder scenarios**.

The next calls in the programme must target long-term goals:

- **European values**: GDPR natively and lightweight DLT to govern all continuum transactions (sovereign continuum).

- **Europe's own technology must stand out**: Alternative CPU architectures completely embedded in the continuum, prominently RISC-V.

- **True tactile deployments**: Reconfiguration of the continuum in runtime in milliseconds time.

- **Metaverse of the continuum**, including VR simulation and IoT-powered ubiquitous data. Self-organizing networks with automatic formation, maintenance, and adaptation to ensure optimal data flow, load balancing, and resource allocation in complex, distributed computing environments

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aerOS Open Calls

- **Two** open calls to be conducted

1st Open Call Schedule		2nd Open Call Schedule	
Announcement	M13	Announcement	M20
Submission Phase	M14-M17	Submission Phase	M21-M24
Evaluation Phase	M18-M19	Evaluation Ph...	M25-M26
Start Participation	M20	...+ P...	...27
End Participation			M34

Sept-23
Oct-23 to Jan-24
Feb-24 to Mar-24
Apr-24
Nov-24

Apr-24
May-24 to Aug.-24
Sep-24 to Oct-24
Nov-24
Jun-25

- A total of **900k€** will be distributed to...

- Expected ~15 contribution...

- Each open call will be funded with a...

- Each open call funded proposal will have to ...one ... of the three pilots.

Round #2 Opening on May 2024!!

What's the focus of each round?

Round #1
(1) extension of functionalities delivered by aerOS, (2) expansion of application of aerOS in the five use case verticals considered in the project

Round #2
(3) application of aerOS to verticals outside of these considered in the project

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EUROPEAN IOT-EDGE-CLOUD

THANK YOU!

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&

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