EUCloudEdgeIoT.eu

Future visions and research directions 2025-2027
Cloud-to-Edge-to-IoT for European Data

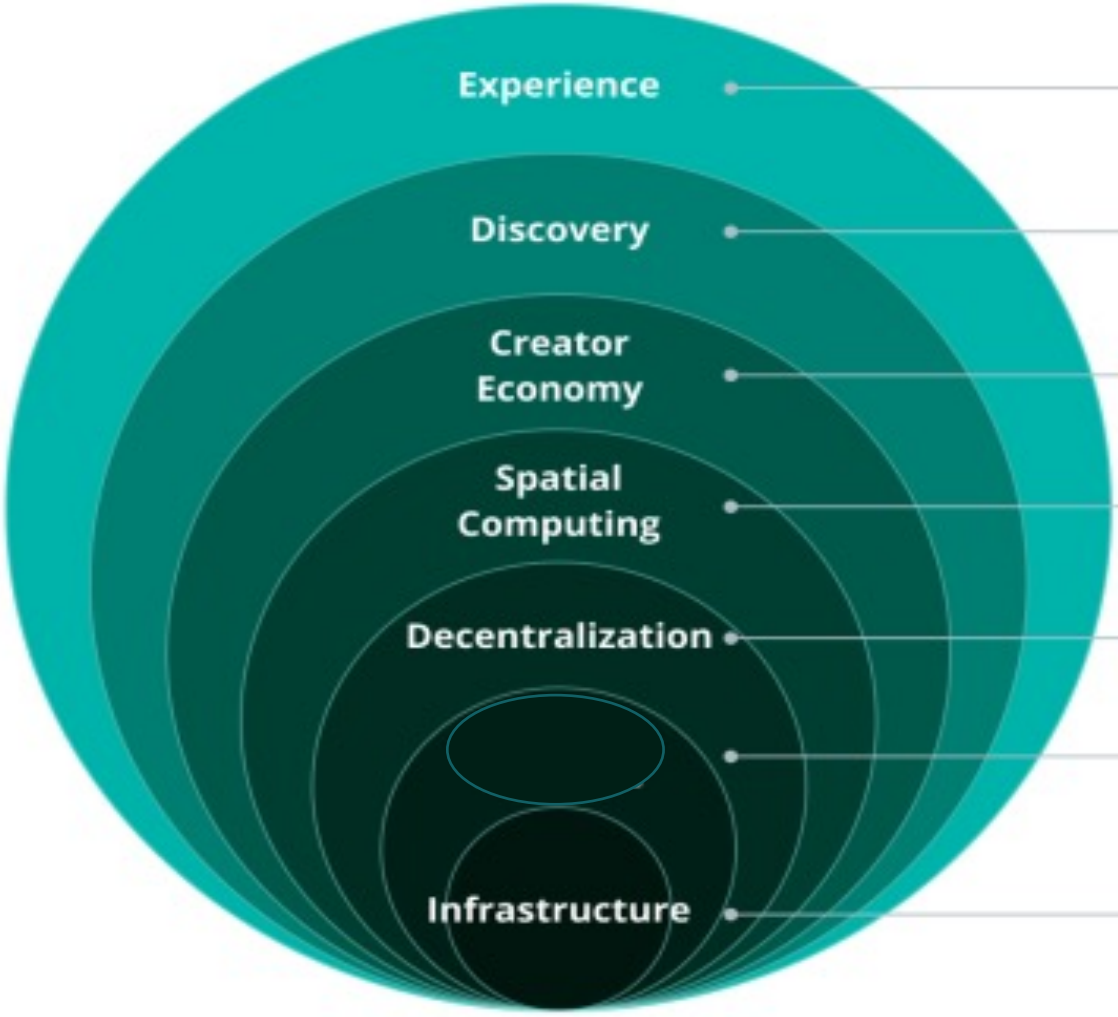
Wrap Up

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

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

Organized by: **Open Continuum |** Supported by: Unlock CEI and SWForum

Evolving Cloud to Edge to IoT Computing Continuum



Physical and Virtual Worlds

Across federated resources, MetaWeb

Tooling, hide complexity, xOps, automation

Context Awareness, Local Decision, Immersive Environments, security, privacy, blockchain

Distributed resources,, new MetaOses,

Any-to-Any Infrastructure

European Commission

Computing Continuum Infrastructure / EU Cloud Servers

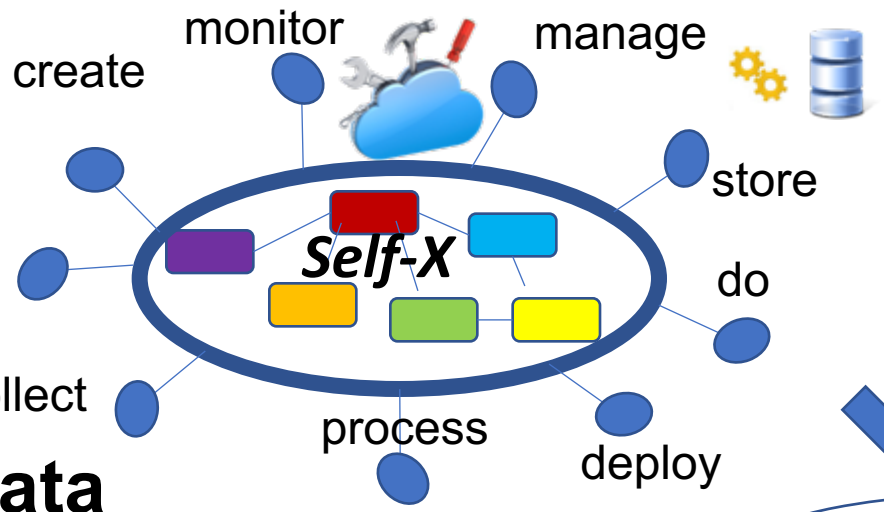
- **Challenge: Achieve Autonomy in the Computing Continuum**
  - The race to new Hardware (HiPEAC)
  - RISC-V as alternative Open Source ISA to be released throughout the Continuum
  - Federation of cloud eco-systems to support heterogeneous Hardware platforms (European Processors: European Cloud Processor, European Edge Processor, European IoT Processor)
  - Energy aware computing continuum with European technology (AIOTI)
  - Effective business models for federation of heterogeneous, multinant resources
- **Challenge: Improve operations in the continuum**
  - Advanced mechanisms are needed to improve operations of the Continuum for performance, robustness and autonomy with multiple providers
  - Miniaturisation and context aware self configuration of workloads
  - New algorithms to enable virtual machines following policy settings
  - Management of hyperdistributed resources – migrate AI to near data operation
  - Federated catalogues with services/data from cloud, Edge and IoT resources for publication and Discovery (FIWARE)

Cognitive Cloud to Edge Continuum

- Self adapting Cloud (sense – learn – optimize - adapt)
- Energy aware Operation Systems / Applications
- New runtime management solutions (e.g. with reinforced learning) for the continuum
- Traceability of data and usage across the continuum
- AI-enhanced automated continuum
- Programming models for the whole continuum
- Apply AI to all the components of the continuum to integrate and compose services
- Decentralized optimization
- Cognitive systems of systems
- Decentralized Identity and Access Management
- Convergence with 5G/6G
- Semantic interoperability across services and data

HIPEAC Vision: Evolution towards a MetaWeb

- ***Dynamic*** construction of applications from **Distributed Services** (local or remote)
- Taking into account ***non-functional requirements*** (time, latency, locality, energy, privacy, cost, …)
- **SPATIAL WEB infrastructure**
- Build on top of existing technologies (e.g. IP, REST)



Cyber world

Local, distributed, decentralized resources (swarm, federated, fog, ..)

Data

Actions

Trusted computing base

Secure exchanges

Build on a trustable, distributed & smart **meta-level "OS*"**

Company/private data

Everything as a Service

Physical Quantites

Physical World
All sectors of the economy

Running on edge hardware

Cross sectors, **avoiding "silos"** *(common interoperable technology)*

*OS: **O**rchestrating **S**ystem

Commission

Next Generation MetaOS and distributed IoT-Edge objects

- Merging the physical and virtual world: *Data inflation, heterogeneity and task concurrency*
- Distributed Intelligence and Collaborative Systems @the IoT-Edge Continuum
- *Autonomy @the Edge* enabled by AI, ML, Digital Twins, mesh networks, Cyber Physical Systems
- *Industrial Metaverse ahead of consumer metaverse*

  → enables novel tools for enhancing the physical world in real time
- Challenges of the Cloud-Edge-IoT continuum
  - Transition towards an Industrial MetaWeb: (any to any)

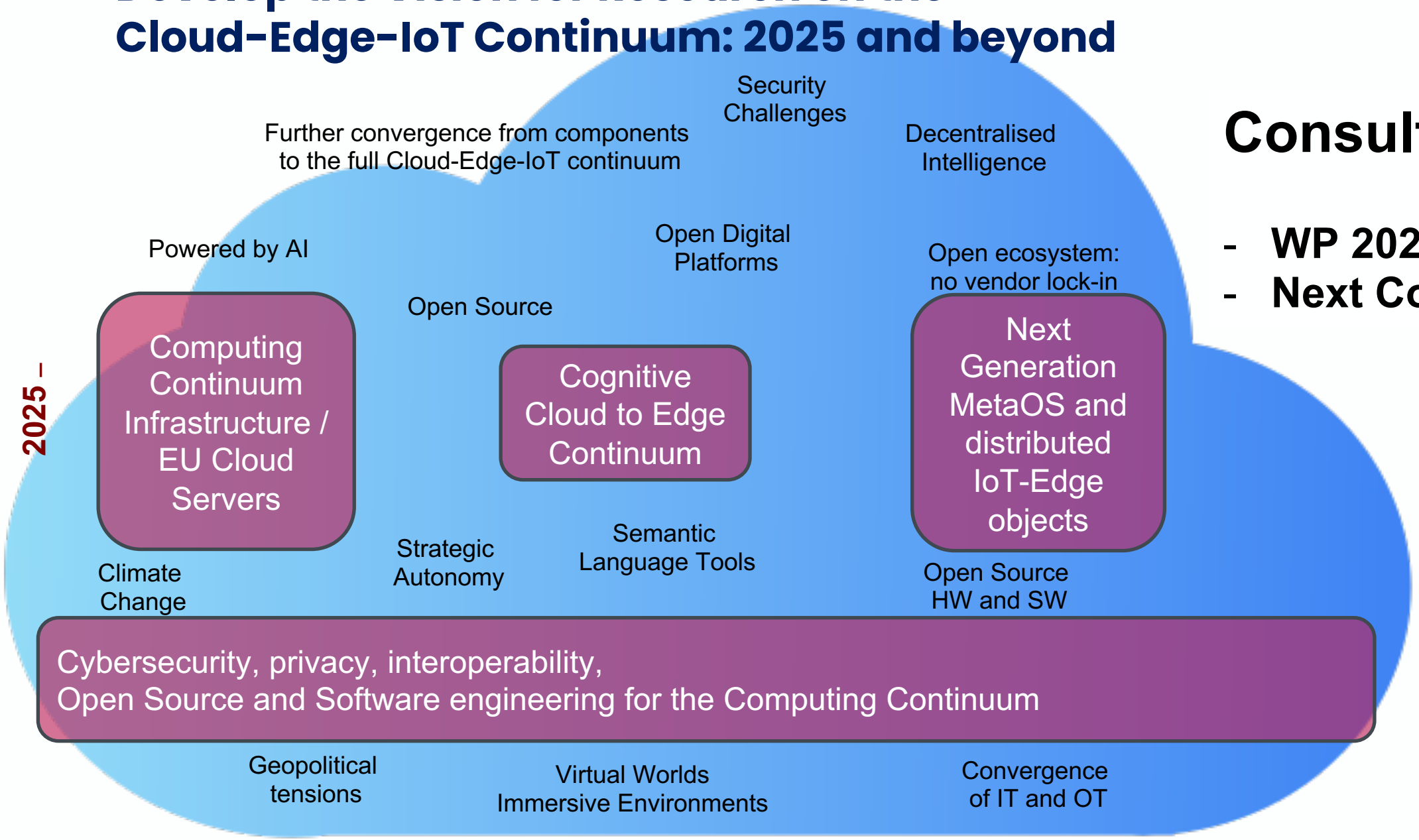
    → Data manager + Resources orchestrator adapted to distributed edge architectures

    → Metaverse Standard Forum to drive industrial standards at early stage
  - Design of collaborative, autonomous Industrial IoT systems
  - Introducing immersive technologies towards the Industrial Metaverse

Cybersecurity, privacy, interoperability, Open Source and Software engineering for the Computing Continuum

- (sec)Dev(sec)Ops for complex systems, using AI (e.g. ML and Reinforced learning) for all phases of the SDLC and SOLC.
  - Automation
  - ZeroTouch provisioning
  - Self-learning and self-healing
  - Inclusion of safety aspects / requirements in the DevOps pipeline
- Low code platforms
- Standardization efforts for interoperability
- Ensure data confidentiality in the cloud-edge continuum
- Management of security in the software supply chain
- (Federated) IAM and ZeroTrust
- New software engineering mechanisms for the development of (hybrid) quantum software
- Open hardware and software

Develop the Vision for Research on the Cloud-Edge-IoT Continuum: 2025 and beyond



Consultation:

- **WP 2025 – 27**
- **Next Commission**

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Thank you for your contribution!

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Next Generation MetaOS and distributed IoT-Edge objects

- **Industrial Metaverse** to extend the physical world: