eSAAM 2023

on Cloud to Edge Continuum

The European Computing Continuum: Initiatives, Community, and Directions

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The CloudEdgeIoT Initiative

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UNLOCK CEI AND OPEN CONTINUUM

Horizon Europe Coordination and Support Actions

HORIZON-CL4-2021-DATA-01

EUCloudEdgeIoT.eu

The European Cloud, Edge & IoT Continuum

UNLOCK CEI

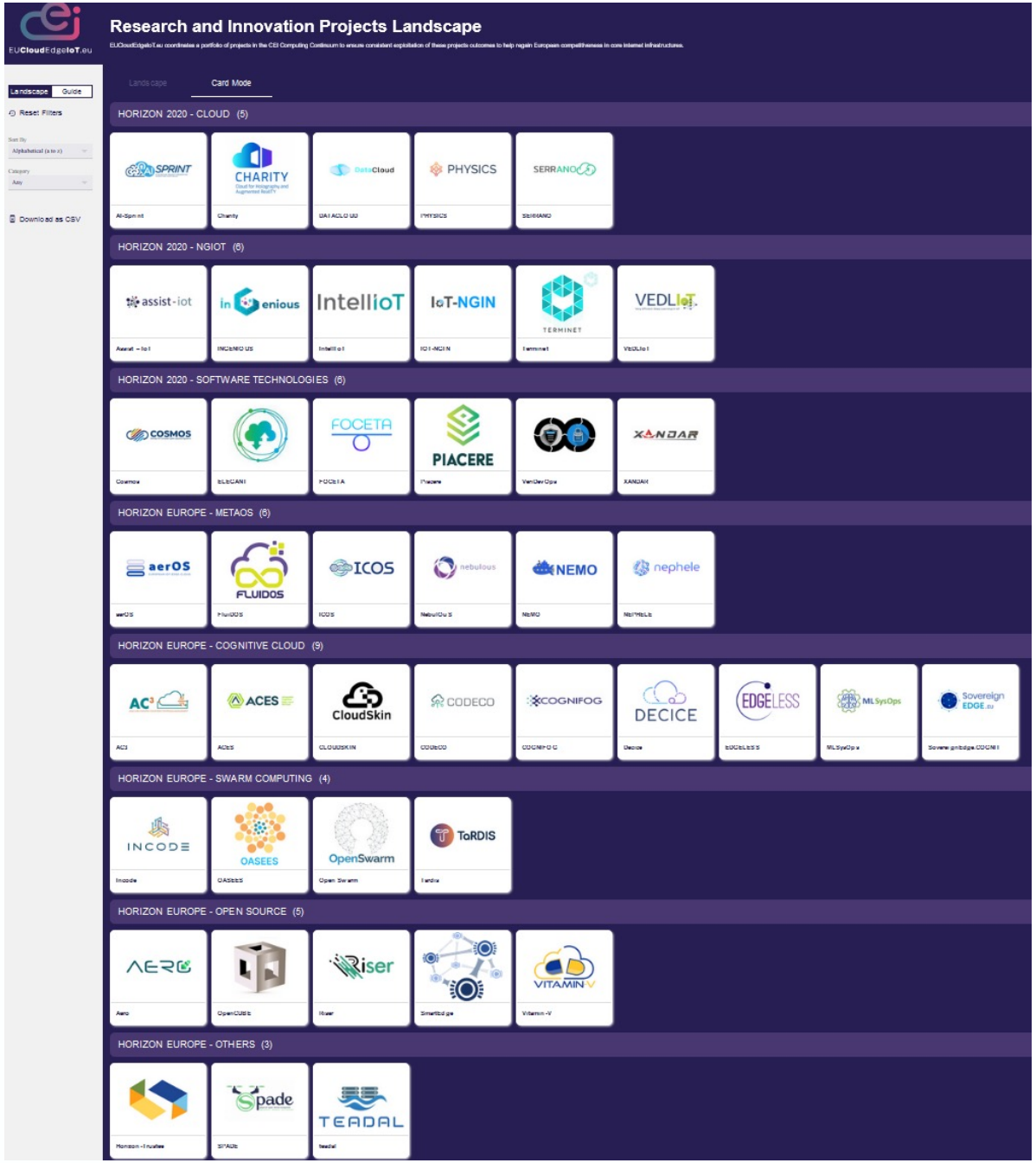
Start Date: June 2022
Duration: 30 Months
Consortium: 6 Beneficiaries
Coordinator: IDC

Open Continuum

Start Date: September 2022
Duration: 24 Months
Consortium: 5 Beneficiaries
Coordinator: Martel Innovate

THE EUCEI PROJECT PORTFOLIO

- More than 40 Research and Innovation projects onboarded
- Both Horizon Europe and H2020 are covered
- Topics spanning the Computing Continuum
  - Cloud Computing
  - Next Generation IoT
  - Software Technologies
  - Meta-Operating Systems
  - Cognitive Cloud
  - Swarm Computing
  - Open Source



EUCEI TASK FORCES

Strategic Liaisons

Task Force 1

Open Continuum
INSIDE

Liaison with EU initiatives

Interactions with AIOTI/ECS/Gaia-x, etc.

Share results of strategic analysis

Identification of common ground for the computing continuum

Open Source Engagement

Task Force 2

Open Continuum
ECLIPSE

Strategy for European digital autonomy in edge-to-cloud through Open Source

Contribute to the definition of a common open architecture for the computing continuum

Architecture

Task Force 3

Open Continuum
ATOS/EVIDEN

Taxonomy definitions

Enable the architectural discussion among projects in the area of IoT/Edge and Cloud to create a continuum.

Identification of the thematic areas and building blocks.

Ecosystem Engagement

Task Force 4

UNLOCK-CEI
BLUSPECS

Coordination of Open Calls activities

Definition of commercial pilots

Commercial relationships and workshops

Market & Sectors

Task Force 5

UNLOCK-CEI
IDC

Demand market adoption, drivers and challenges

Use-cases characterisation

Define relevant value chains

Sector specific needs/requirements

Commercialisation support

Communications

Task Force 6

Open Continuum
& **UNLOCK-CEI**
Martel &
Trust-IT

Joint branding and community

Coordination of Common events

Amplification of RIAs activities

Sustain a continue debate on CEI continuum

TF1 – Strategic Liaisons

ACTIVITIES

- **Liaison with EUCEI continuum community**
  - Roadmap analysis - Started but not concluded
  - Outcome - technology map with white spaces
  - ready by Oct/Nov 2023
- **Invite EUCEI Open Communities (meeting announced shortly)**
  - Dec 7 , Brussels (tbc)
  - Major point of interaction
    - technology map, industrial interest and white spaces
    - how to address overlaps and white spaces
- **Invite RIAs to liaison meeting**
  - Nov 7, 9-11 CET (tbc)

TF Objective: Dialogue on road mapping focus (early results)

- most roadmaps are application driven
- fundamental tech roadmaps are rare in SW domain
  - standardisation bodies provide some (IETF, W3C, OMG)
  - no roadmaps regarding SOA, SoS, SoS interop, SoS engineering
- the EUCEI objective will require agreements on fundamental tech

TF2 – Open Source Engagement

ACTIVITIES

- **Promote the potential of Open Source as an innovation and collaboration driver**
  - Participating actively to the strategic events prepared and addressed by Task Force 2 for the entire EUCloudEdgeIoT Community, for getting in touch with other initiatives and EU Projects

- **Enlighten industry and research stakeholders on the benefits of a long term Open Source Strategy (OSS)**
  - Learn about the Open Source sustainability aspect and best practices.
  - Have the opportunity to meet with the other RIAs and share information about Open Source approach and components

TF3 - Architecture

ACTIVITIES

- **Taxonomy definitions**
  - Homogenise the terminology needed for the continuum ensuring all stakeholders involved in the value chain speak the same language.
  - Standardise the definitions of the compute pipeline, mapping them with the data pipeline and industrial glossaries.
- **Enable the architectural discussion among projects in the area of IoT/Edge and Cloud to create a continuum**
  - Design a common reference architecture for the continuum and promote it as a standard while ensuring the European digital autonomy.
  - Identify commonalities to avoid effort duplication in software developing.
  - Identify gaps and future research challenges that must be addressed in coming years.
- **Identification of the thematic areas and building blocks.**
  - Provide a common vision for the continuum, beyond cloud, edge and IoT silos.
  - Share and spread the research community point of view.
  - Discussion forum for positioning Europe ahead of competition.

TF4 – Ecosystem Engagement

ACTIVITIES

- **Supporting the participation of SMEs through Open Calls**
  - Common coordination of MetaOS cluster Open Calls
  - Organisation of events
  - Sharing best practices and resources

  - Over 40 opportunities for members to participate in the MetaOS cluster between August 2023 and February 2024
    - Check out the links here: https://eucloudedgeiot.eu/open-calls/

- **Exploring market opportunities for components and use cases**
  - Focus on the role of SMEs and the participation of open call beneficiaries
  - Identification of exploitation opportunities through use case development
  - Mapping of routes to market

  - Sharing of existing routes in HPC value chains.

TF5 – Market & Sectors

ACTIVITIES

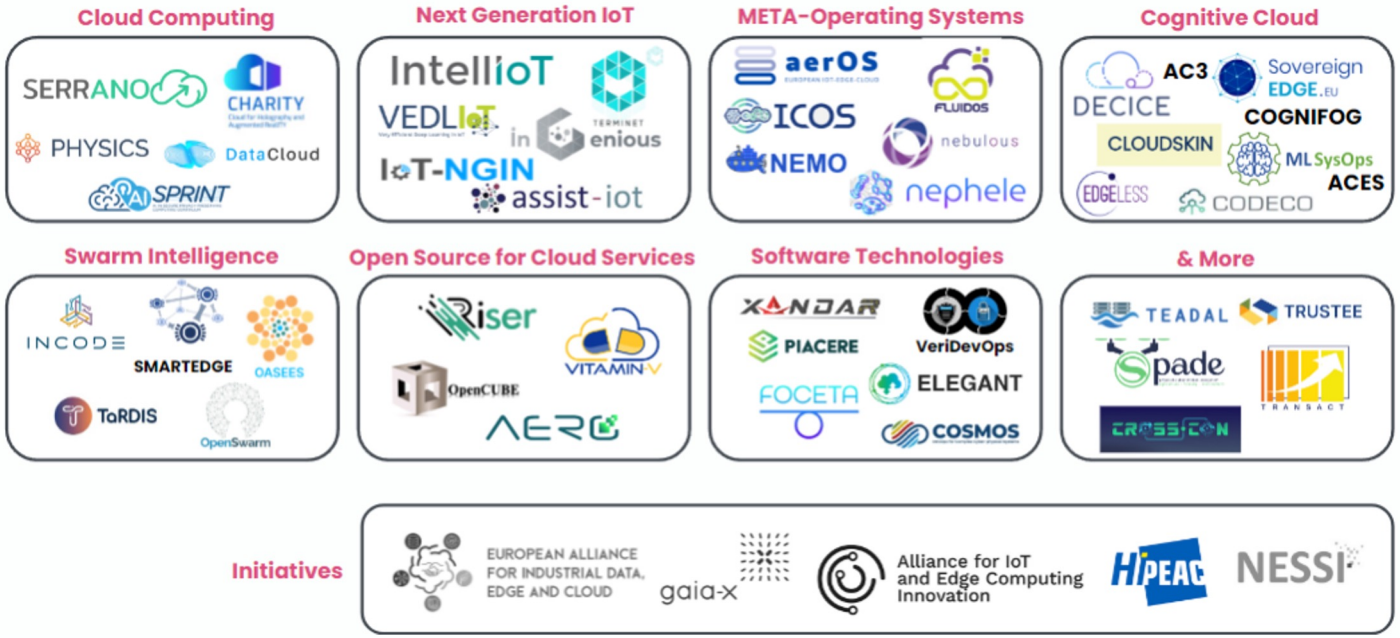
- **Knowledge generation and sharing in terms of CEI demand market and the adoption drivers and barriers**
  - Get in touch with other initiatives (especially those that engage with Industrial stakeholders) to collaborate for the analysis and mapping of demand market

- **Support projects in the exploitation and commercialisation of their use-cases**
  - Get in touch with other initiatives (especially those that engage with Industrial stakeholders) to create a dialogue between demand and supply and decrease the adoption gap

TF6 - Communications

ACTIVITIES

- **Community Building**
  - Become part of the EUCEI community. Current members in the image (45 RIAs).
- **Monthly TF6 Meetings**
  - Participate in our meetings and disseminate your event. Have the opportunity to join efforts with the RIAs.



- **Monthly News Digest**
  - Write an opinion article that opens the newsletter.
- **Open Continuum Summit (tbc with EC)**
  - Participate as a speaker in our next flagship event.
- **EUCEI Webinars**
  - Collaborate in the next Open Continuum or UNLOCK-CEI webinar, as a speaker or organiser.
- **Value Chain Adopter Workshops**
  - Join sector specific workshops organised by UNLOCK-CEI to discover spotlight use cases and CEI demand drivers

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What's Next

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Nexus Forum Event | 5-6 October 2023

- https://opennebula.io/innovation/nexusforum2023/
- Event organised by OpenNebula, 5-6 October 2023
- EUCEI organised Horizon Europe session: Friday, 6th October (9:00-10:30)
  - 10min presentation slots to ongoing Horizon Europe projects with R&D activities relevant to the future implementation of a federated cloud-edge infrastructure across the EU.
  - Facilitate contacts between these projects and those EU industry participants involved in RDI activities with higher TRLs and in co-funded FID projects (IPCEI-CIS).

- Event-zero of a series, by the upcoming CSA NexusForum.EU
  - Starting in January 2024, running for 30 months
  - Cooperates with the EUCloudEdgeIoT initiative
  - Connects with European industrial initiatives (European Alliance for Industrial Data, Edge and Cloud, IPCEI-CIS), International cooperation, longer-term research roadmaps

- **SovereignEdge.COGNIT**
- **AC3**
- **ACES**
- **CODECO**
- **OASEES**
- **TALON**
- **CLARUS**
- **6G-SANDBOX**
- **MEDINA**

EUCEI at EBDVF 2023 - 25-27 October 2023

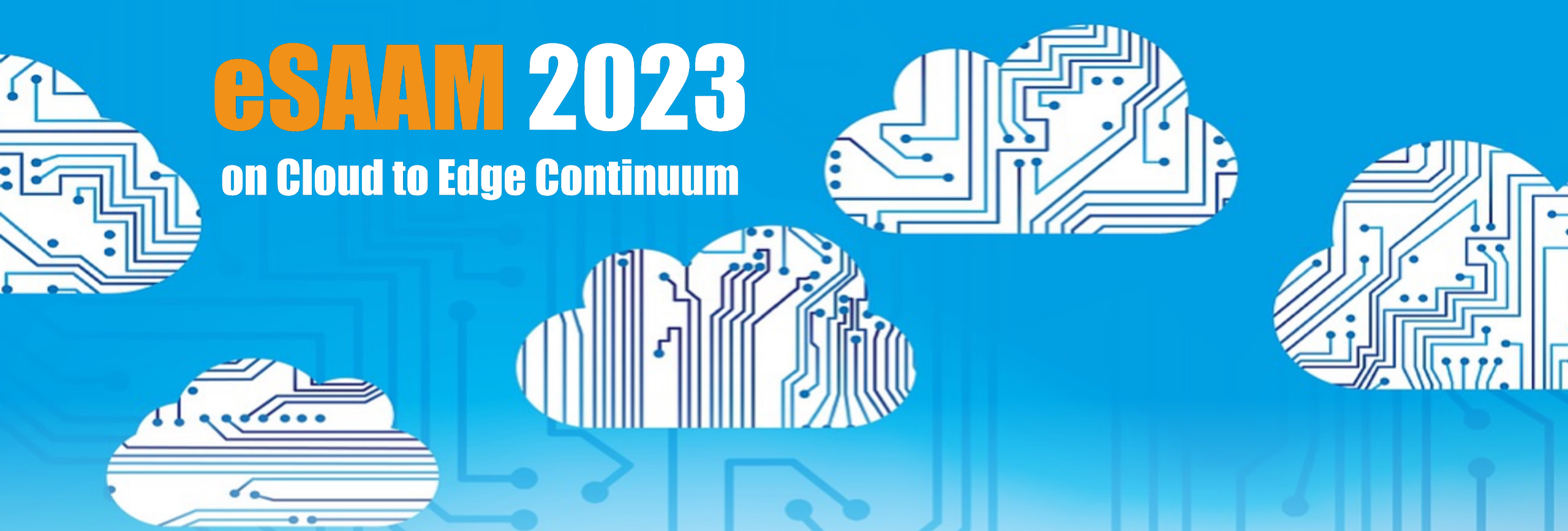
EUCEI presence

- Participation at joint 60 min session with TaRDIS, INCODE and ACES. European efforts on sustainable decentralized, cognitive clouds system. EUCEI to moderate session.
- Organisation of a dedicated **session on CEI in transportation/mobility** The session details are currently under preparation. NEMO and AerOS from TF6 will join, together with two projects focused on mobility (EMERALDS and GREEN.DAT.ai)
- Organisation of a dedicated **session on CEI and data spaces in Manufacturing** as a second phase event of the TF5-TF6 "manufacturing insights webinar" held in July 2023.

Website: https://european-big-data-value-forum.eu/

EUCEI at ENLIT 28-30 November 2023

- **EUCEI booth** in the EU project zone for the three days
- Intervention in a joint panel session - focused on energy data spaces
- Website: https://www.enlit-europe.com/



eSAAM in Context

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Themes for eSAAM Papers

- **AI and Edge Intelligence**
  - AIoT, Federated Learning, AI Models, MLOps, Predictive Maintenance, Intelligent Manufacturing
- **Open-source SW/HW and European sovereignty**
  - RISC-V, Data Spaces, Gaia-X, Verticalised Pilots
- **SW Engineering for the Continuum**
  - Architecture, Design Patterns, Virtualisation, Orchestration, Tools, IDEs, DevSecOps, Infrastructure as Code
- **Cross-cutting Concerns and Non-functional Properties**
  - Cybersecurity, Performance, Resilience, Seamless Continuum

Concertation/Consultation Event

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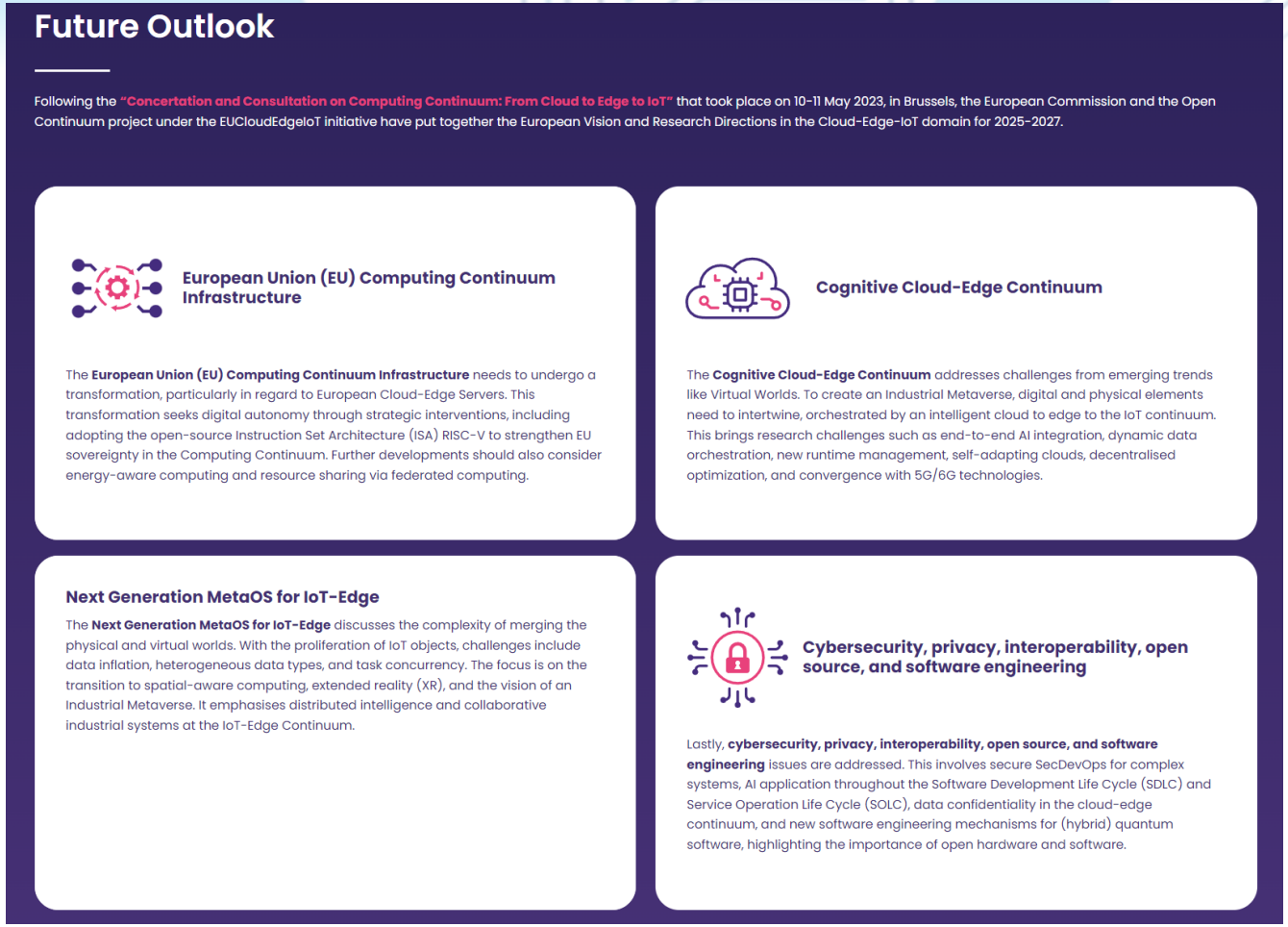
- [Brussels, 10-11 May 2023]
  - 120 attendees
  - 45 projects presenting
  - 7 Research roadmaps discussed
  - 30+ Expressions of Interest (EoI)
- **Future-oriented Second Day**
  - Outlook on R&I in 2025-2027
  - Strategic Roadmaps from key European associations and initiatives
  - EoI from individual researchers and experts
  - Four macro-themes have been identified from the contributions
  - All available on the Web site



Future Outlook

Following the "Concertation and Consultation on Computing Continuum: From Cloud to Edge to IoT" that took place on 10-11 May 2023, in Brussels, the European Commission and the Open Continuum project under the EUCloudEdgeIoT initiative have put together the European Vision and Research Directions in the Cloud-Edge-IoT domain for 2025-2027.

European Union (EU) Computing Continuum Infrastructure

The **European Union (EU) Computing Continuum Infrastructure** needs to undergo a transformation, particularly in regard to European Cloud-Edge Servers. This transformation seeks digital autonomy through strategic interventions, including adopting the open-source Instruction Set Architecture (ISA) RISC-V to strengthen EU sovereignty in the Computing Continuum. Further developments should also consider energy-aware computing and resource sharing via federated computing.

Cognitive Cloud-Edge Continuum

The **Cognitive Cloud-Edge Continuum** addresses challenges from emerging trends like Virtual Worlds. To create an Industrial Metaverse, digital and physical elements need to intertwine, orchestrated by an intelligent cloud to edge to the IoT continuum. This brings research challenges such as end-to-end AI integration, dynamic data orchestration, new runtime management, self-adapting clouds, decentralised optimization, and convergence with 5G/6G technologies.

Next Generation MetaOS for IoT-Edge

The **Next Generation MetaOS for IoT-Edge** discusses the complexity of merging the physical and virtual worlds. With the proliferation of IoT objects, challenges include data inflation, heterogeneous data types, and task concurrency. The focus is on the transition to spatial-aware computing, extended reality (XR), and the vision of an Industrial Metaverse. It emphasises distributed intelligence and collaborative industrial systems at the IoT-Edge Continuum.

Cybersecurity, privacy, interoperability, open source, and software engineering

Lastly, **cybersecurity, privacy, interoperability, open source, and software engineering** issues are addressed. This involves secure SecDevOps for complex systems, AI application throughout the Software Development Life Cycle (SDLC) and Service Operation Life Cycle (SOLC), data confidentiality in the cloud-edge continuum, and new software engineering mechanisms for (hybrid) quantum software, highlighting the importance of open hardware and software.

Conclusions

- **Original Cloud / IoT convergence turned into a full-fledged Computing Continuum (consider also B5G/6G, HPC, QC)**
- **Interplay with Big Data, Artificial Intelligence, Security is key**
- **Computing Continuum spans well beyond technical topics**
  - Issues: Geopolitical, socio-economic, ethical, environmental, legal
  - Ambition and challenges for Europe (Twin Transition, Digital Compass 2030 goals, Trustworthy AI)
- **Research and Innovation is a multi-faceted pillar**
  - Academic scientific progress, open-source and open standards, political and market forces, lively and inclusive communities

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Thank you!

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