Creating Synergies with the IPCEI-CIS Architecture & the Virt8ra Integration Framework

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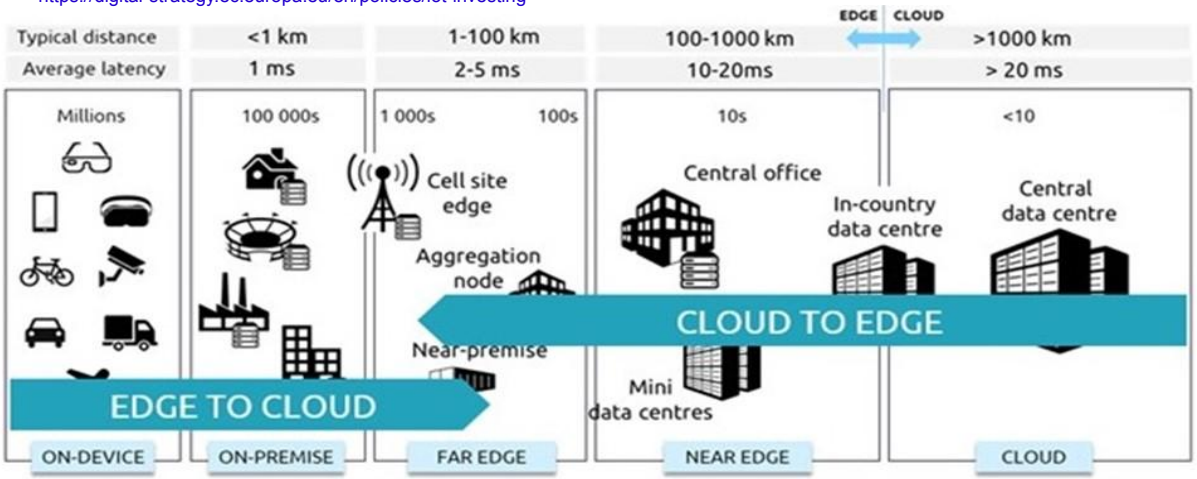
Agenda

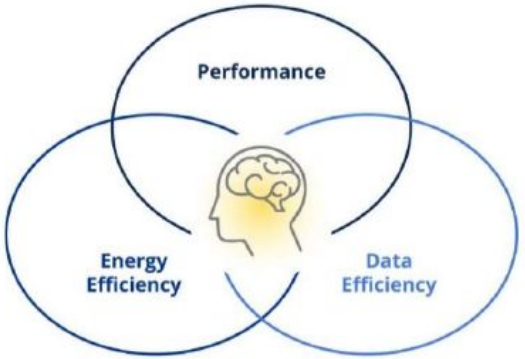
- **Cloud, Edge & IoT**
- **IPCEI-CIS**
  - Introduction
  - General Overview
  - Cross-Cutting Aspects
  - State of the art and future challenges
- **Virt8ra**
- **IPCEI-CIS → O-CEI**

Cloud, Edge & IoT

Research directions

https://digital-strategy.ec.europa.eu/en/policies/iot-investing





https://ec.europa.eu/newsroom/dae/redirection/document/102590

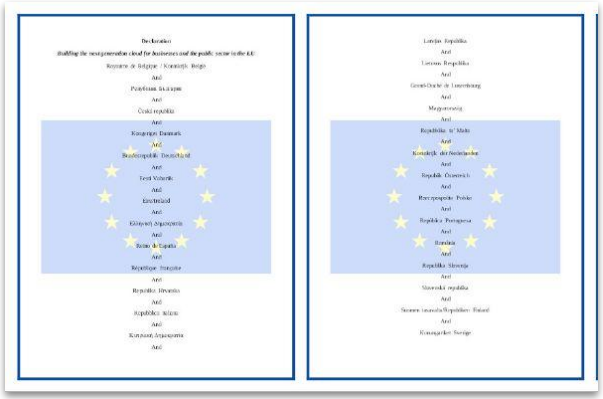
- A fresh opportunity to meet the demand for next-generation data processing infrastructures
- Investigate suitable network architecture and control mechanisms to handle the processing of massive data in a secure and private manner
- Address latency, security, privacy, and environmental needs
- Combines federated learning and homomorphic encryption, that allow organisations to glean insight on their customers without hoarding personal data.
- There is a need for end-to-end intelligent enablement for the orchestration of the data, computing, and AI capacity across the cloud-to-edge/IoT continuum
- SecDevOps to ensure data confidentiality in the cloud-edge continuum

IPCEI-CIS

Fixing the EU Cloud Market

In October 2020, all 27 EU Member States signed a joint declaration on "**Building the next generation cloud for businesses and the public sector in the EU**":

- "*The EU has a unique opportunity to address the need for more data sharing and decentralised data processing, closer to the user (at the edge)*".
- "*Completely interoperable, **open**, multi-vendor cloud platforms and services, based on European, international or **open source standards**, will enable users to migrate effectively to the cloud (...)*".

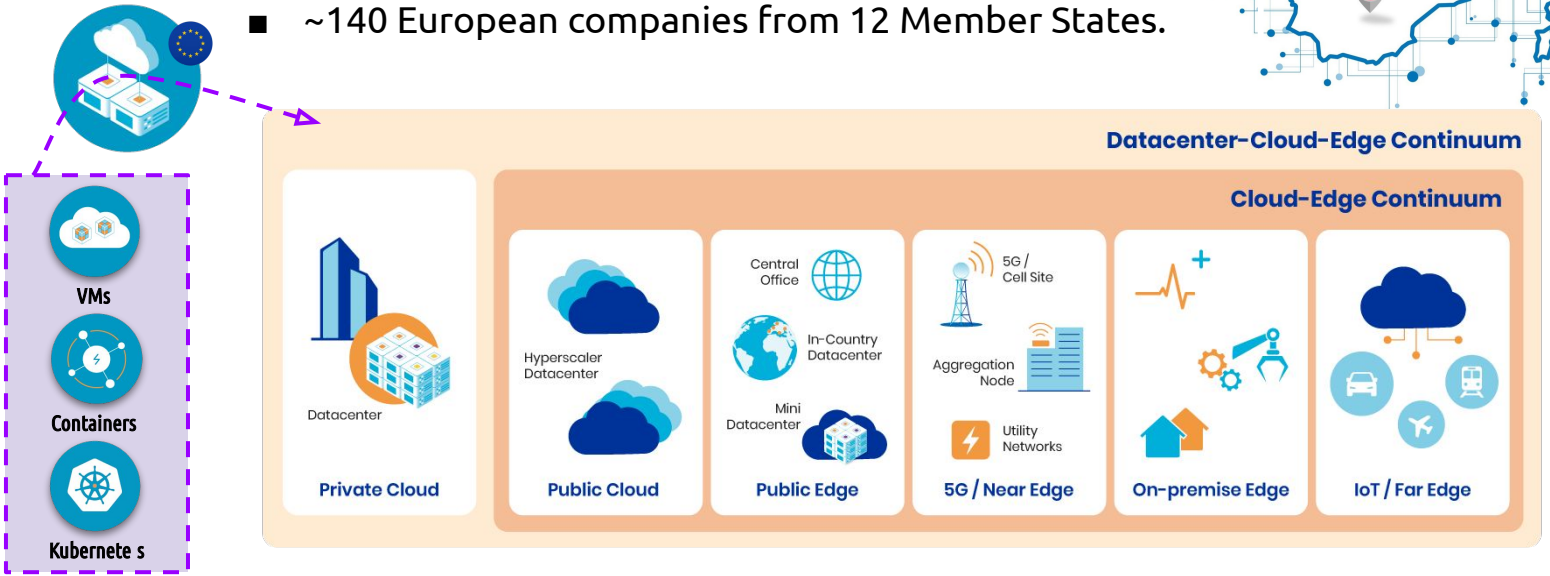


The Signatories agreed on an ambitious investment plan gathering private, national and EU efforts and leading to the next generation of EU cloud and edge services…

IPCEI-CIS

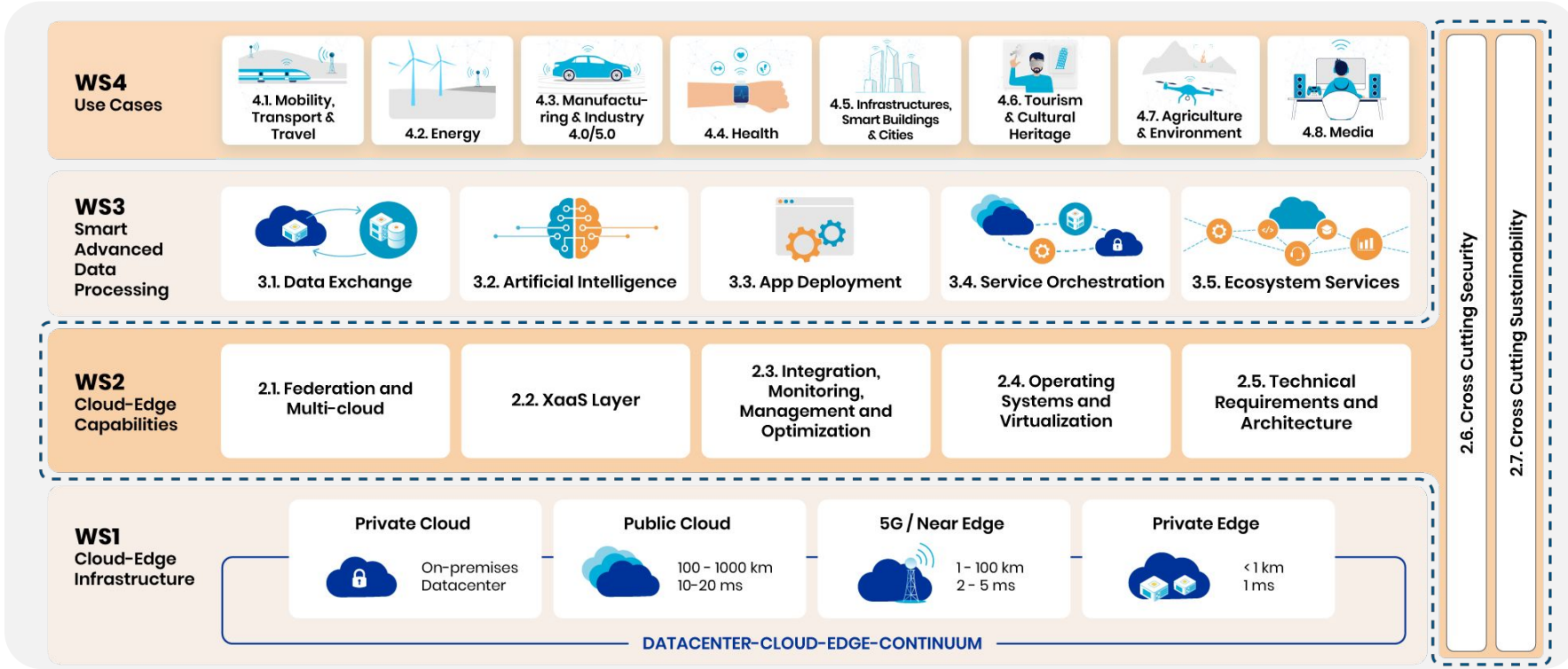
Fixing the EU Cloud Market

- Enable Multi-Provider Cloud-Edge Continuum
- Strengthening of EU digital industry
- Development of European open source technologies:
  - It is the largest open source project in EU history!
- Strategic programme approved by the EC in December 2023:
  - 1,2b EUR in State Aid + 1,4b EUR in private investment.
  - ~140 European companies from 12 Member States.



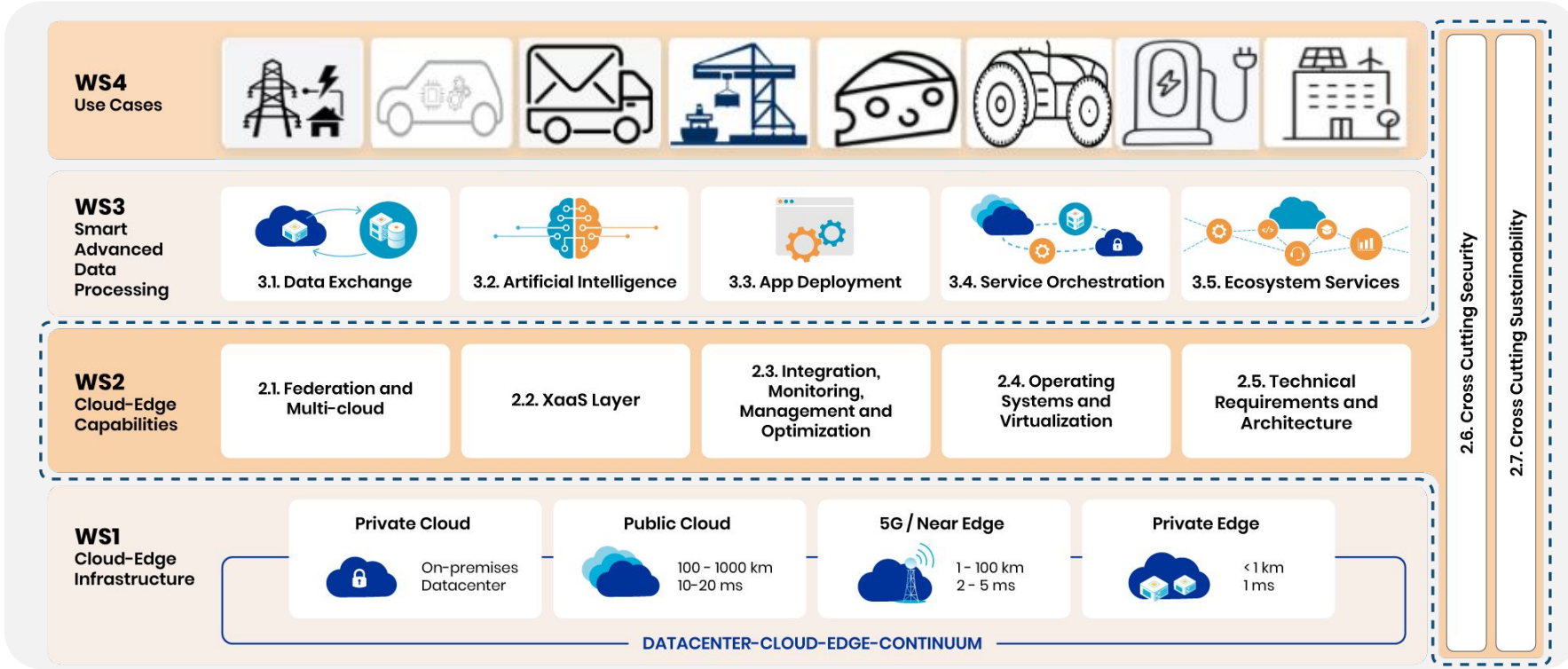
IPCEI-CIS

General Overview



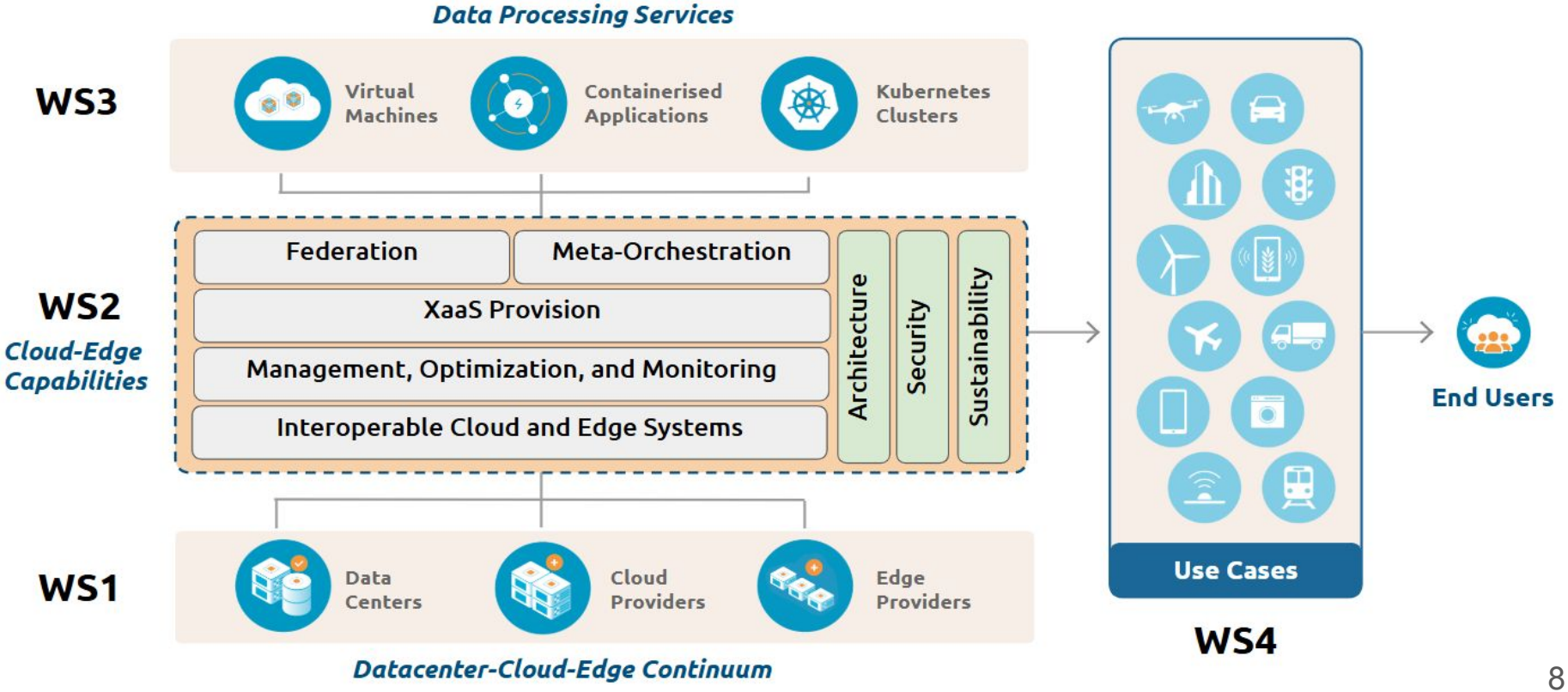
IPCEI-CIS

Mapping O-CEI Pilots



IPCEI-CIS

General Overview



IPCEI-CIS

Cross-Cutting Aspects

Cybersecurity

- Advanced cybersecurity services by incorporating AI based approaches.
- Cybersecurity of interoperable telco/edge workloads.
- Solutions for secure control and data transparency.
- Security components for composable data transfer services.
- Quantum-safe logical and hardware cryptographic components.
- Automated detection and mitigation of cyber security threats.

Energy efficiency

- Monitoring of interoperable telco/edge workloads to enable energy optimization.
- Advanced functionality for energy usage analysis and modelling across the cloud edge continuum.
- AI solutions to optimize energy efficiency of data processing.
- Services for carbon footprint management.

Interoperability

- Open reference architecture for the multi provider cloud edge continuum.
- Business interoperability.

IPCEI-CIS

SoTA and Future Challenges

STATE OF THE ART

Cloud-Edge Hybrid Architectures

- Mostly based on **proprietary**, **complex** technologies, leading to **vendor lock-in**.
- **Centralized cloud structures** that assume highly **homogeneous** datacenters.

Multi-provider Interoperability and Portability

- **Low adoption of standards**, with **abstraction layers** based on containers with **reduced security** (i.e. K8s).
- Storage and network model **not well suited for the highly distributed** cloud-edge continuum.
- **Partial use of automation techniques** (e.g. IaC) for infrastructure provisioning automation.
- **Lack of specific edge node architectures** able to meet the needs of HPC and 5G/telco/IoT environments.

Multicloud Management and Orchestration

- Lack of **AI used to optimize and automate** cloud/edge infrastructure management.
- Centralized control planes that **do not allow the federation** of cloud and edge infrastructures.
- Limited support for **optimized orchestration**, **energy efficiency,** and enforcement of **security policies**.

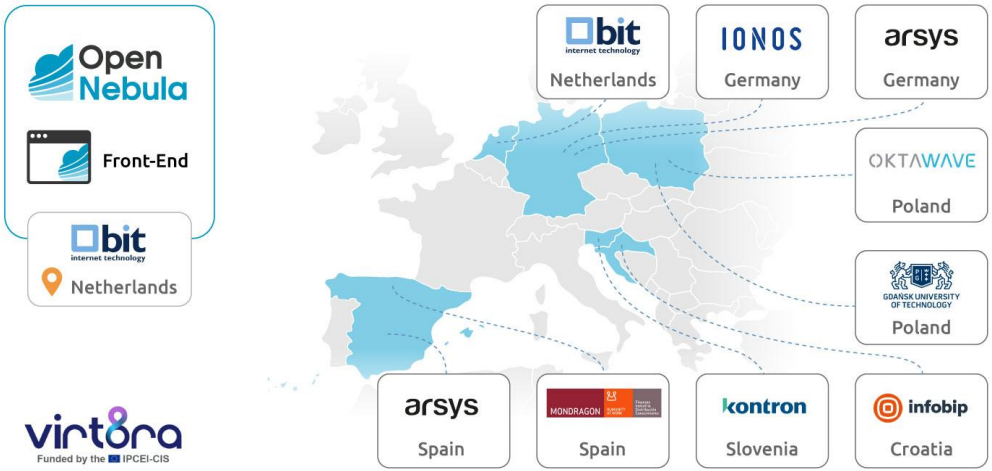
Use Cases

- Deployed as **static solutions** on a **case-by-case basis,** lacking automation, interoperability and portability.
- Creating **silos in strategic sectors** based on different technological stacks and ad hoc implementations.
- **Jeopardizes the consolidation of a cloud-edge continuum** and an associated industry ecosystem.

- ➢ Emergence of new **edge providers**.
- ➢ Emergence of **tens of thousands** of geographically distributed edge nodes and resource **heterogeneity**.
- ➢ Need for complete **automation** of cloud edge operations.
- ➢ New **security threats** and larger impact of vulnerabilities.
- ➢ Preference for **energy-efficient** nodes.
- ➢ Infrastructure **dynamicity** and **volatile** devices.
- ➢ Dependency on **general-purpose**, **public** networks.
- ➢ Widely **distributed** environments.
- ➢ **Ecosystem** integration
- ➢ **Data** Storage and Collection
- ➢ **Interoperability**

The virt8ra integration framework

The IPCEI-CIS software stack for virtualization



https://virt8ra.eu

- A cloud-edge infrastructure testbed that **combines bare-metal resources from eight IPCEI-CIS partners across six EU Member States**.
- Its purpose is to provide a space for the integration of the different virtualization components and **relevant use cases**.
- A robust open source alternative for managing digital infrastructures.
- Based on a **sovereign, open source software stack**.

The virt8ra integration framework

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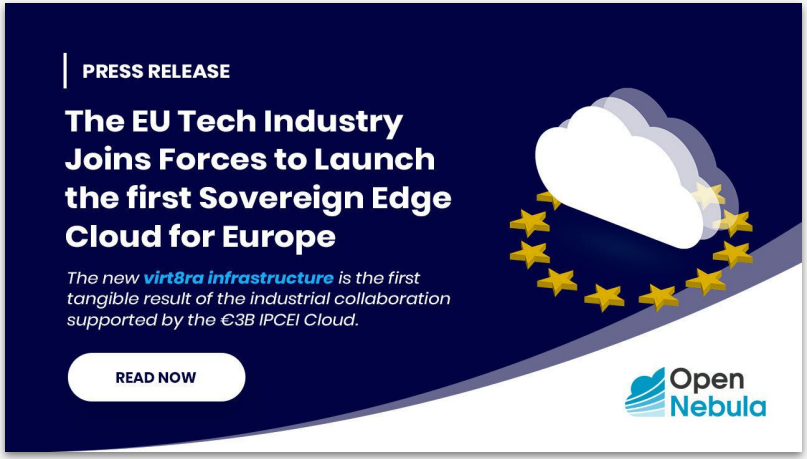
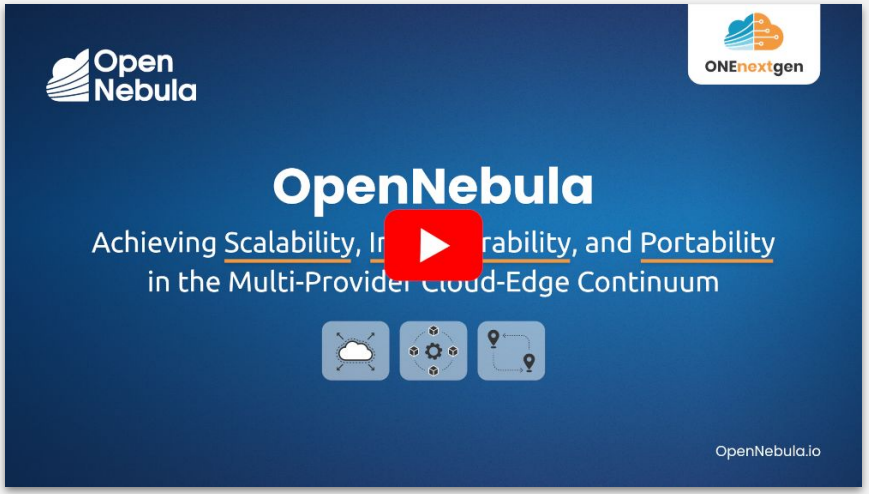
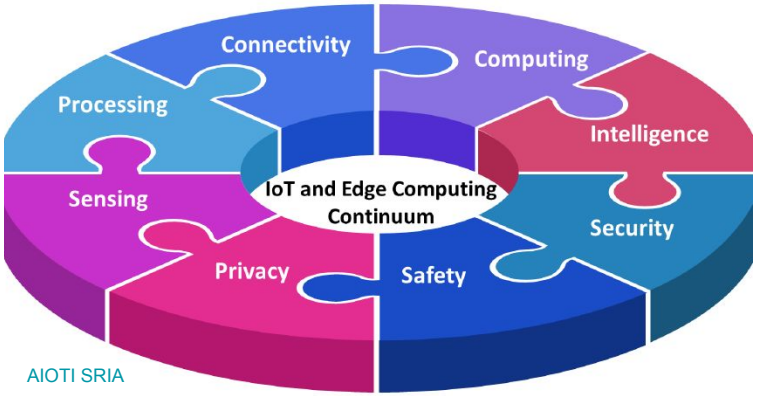




Cloud-Edge Continuum

The foundation of CloudEdgeIoT



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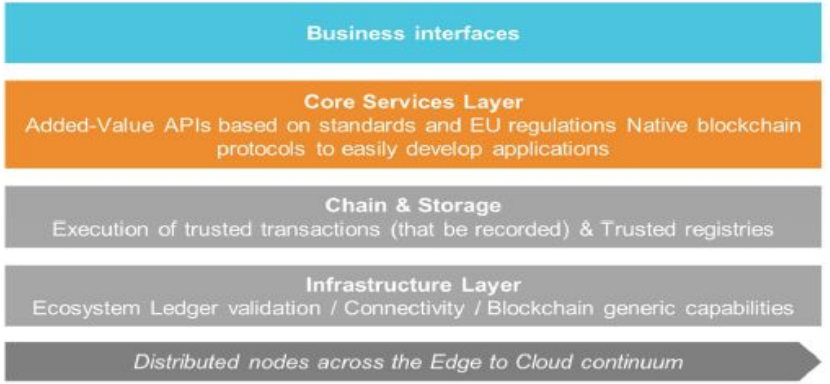

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- Integrate e2e capabilities such as processing, storage, connectivity, **computing**, sensing, intelligence, **security**, safety, and **privacy**
- Enabling value creation via the provision of platform and application services across the EU
- Cloud-edge continuum resources to support IoT edge capabilities, intelligence
- Technological basis for the initial roll-out of advanced data processing capabilities for key sectors
- Distributed end-to-end security technologies supporting their complex behaviour and data sharing
- Develop European DLT services following the model of EBSI

IPCEI-CIS → O-CEI

Making the O-CEI compliant with the IPCEI-CIS Architecture

- IPCEI-CIS is building technology components to cover gaps and lead First Industrial Deployments (FID) in 8 strategic domains to implement a distributed European cloud and edge infrastructure.
- IPCEI-CIS will facilitate to reach the Digital Compass target of 10,000 climate-neutral, highly-secure edge nodes deployed across the EU by 2030.
- Build solutions to provide HPC services distributed across the cloud-edge continuum.
- Accelerate the cloud-edge uptake among SMEs, strategic industries, and public administrations by addressing emerging data processing demand and will foster the EU global technological leadership in the cloud-edge sector
- O-CEI blueprints can adopt IPCEI-CIS functional components, interfaces, and open source technologies, already benefiting from interoperability and exploitation.
- Avoid duplication of efforts.
- Promote the active involvement of the broader EU industry in the long-term improvement of the O-CEI blueprints and the project's use cases.

Open Nebula

Thank you very much

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