

IPCEI on Next Generation Cloud Infrastructure and Services (IPCEI-CIS)

-Value Chain-

DRAFT

Disclaimer: this document has been drafted for the purpose of facilitating discussions in preparation to the potential IPCEI on Next Generation Cloud Infrastructure and Services (IPCEI-CIS) and is not a final value chain orientation document.

To seize the data opportunity and optimally respond to end-users' expectations in terms of computing capabilities, real-time, ultra low latency, data security, interoperability, sustainability, the EU needs to become a global leader in data processing (cloud and edge) via investing into the development and first industrial deployment of a highly scalable next generation of cloud-edge infrastructure and services. The core of the next generation infrastructure and services is the "Distributed Multi Provider Cloud-Edge Continuum", which is composed of a common centralized and decentralized data processing infrastructure, smart processing services and platform functionalities that aim at ultra secure and low power storage, ultra low latency data exchange and added value creation:

- Companies including SMEs, industrial sectors and public institutions get access to common, highly secure, interoperable and real-time data processing capacities with low power consumption.
- Citizens and businesses are getting better-off with better service delivery.
- New innovative, green business solutions and process efficiencies will be enabled by data processing technologies across the EU and beyond.
- Users can shift between service providers based on data portability while avoiding vendor lock-in.

Such a cloud-edge continuum will be based upon a common Multi-Provider data processing infrastructure, enabling value creation via the use of platform and application services as well as services provided across the EU territory, fulfilling key requirements of latency and bandwidth guarantee, assured data integrity, access security, resilience and sustainability. Boundaries will also disappear between cloud and edge computing in establishing the cloud edge continuum as technological basis for the first industrial deployment of cutting-edge data processing capabilities for key economic sectors such as automotive, manufacturing, energy, logistics as well as for service sectors such as tourism, education or public services (smart cities, health and more). The multi provider cloud-edge continuum will be a pillar for enabling the first industrial deployment of key digital technologies and applications like smart networks and services (e.g. AI), data driven robotics, data spaces applications and cloud-edge federation services.

The goal of the IPCEI-CIS is thus to develop and first industrially deploy the key interdependent building blocks and the associated transverse requirements (sustainability, cybersecurity) along the strategic value chain of the Distributed Multi Provider Cloud-Edge Continuum.

The value chain logically combines technological features and R&D&I aspects under each of its key building blocks to structure a common integrated project based on multiple projects. In each building block of the value chain and along the entire technology stack (infrastructure, platform and services) interoperable, reliable and measurable framework conditions in relation to cybersecurity, sustainability, sovereignty, standardization and capabilities as horizontal requirements for a trusted cloud-edge continuum need to be guaranteed. The identified key building blocks and horizontal requirements along the value chain are detailed below:

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Step 1: Infrastructure

Data processing in edge and cloud systems need suitable and highly scalable software and compatible hardware packages, this implies far edge data centres, fast energy-efficient next generation processors for data processing and communication, and dedicated components for real-time and security-critical data transfer operations. This IPCEI-CIS also focus on the evaluation of compatible soft- and hardware components. The deployment of advanced services requires significant increases in performance in terms of transmission rates, bandwidth, energy consumption, reliability and real-time capability.

Step 2: Interconnections

Next generation smart processing infrastructures will progressively rely on cloud and edge servers, edge devices and Internet-enabled mobile devices. Their combination will allow low power virtual interconnections among cloud and edge capabilities and their integration into future smart networks. This will enable the management of customer-oriented interconnectivity, interoperability and data or service portability, specific requirements with regard to end-to-end security, low power and ultra-low latency in data transfer and storage, real-time processing, bandwidth availability and load balancing for complex processes. Software Defined Networking (SDN) technologies will improve network transparency and interoperability. The next generation cloud-edge interconnection, including the telco edge computing infrastructure, will bring data processing capacities closer to where end users are physically located, making the multi provider cloud-edge continuum accessible across the EU.

Step 3: Foundation Services

An increasing number of real-world applications, including industrial processes, require the execution of highly specialized functions quickly and without errors. These applications require a high automation degree, ultra-low latency in data processing, reliability, access control, energy-saving options, and need to fulfil strict latency and resilience requirements. The establishment of a common highly automated Operation System, for orchestration e.g. load balancing, latency and resource optimization needs to be developed. End-to-End Security is necessary while sharing resources and co-locating network functions. By using compute resources outside of the well-established data centre security controls, security challenges emerge both at the level of digital and physical security.

Step 4: Processing Services

Platform Services are cloud-based services where the provider offers to a customer an environment and tools for developing, deploying and managing applications across the multi provider edge-cloud continuum. To set up tailored services and new computing options in an interoperable and portable manner, the meshing of cloud providers, edge operators and infrastructure facilities is required. This is the basis to support the development and first industrial deployment of smart processing services designed to address multiple use-cases, on top of the platform services. These smart processing services will create further value by implementing AI-based technologies (e.g. federated learning), big data services, digital twin approaches, simulation and modelling data services.

Step 5: Initial Roll-out

The progress made in terms of connectivity, latency, data exchange, data processing and computing capabilities through the multi-provider edge cloud continuum enable the deployment of innovative use cases at first industrial deployment stage, showcasing a high scalability and interoperability of services and data in different domains, like manufacturing, energy, mobility, health and public services. A wide variety of sectors can benefit from digital twins, virtual factories, remote operation and assistance, autonomous robots and other innovative services. The digitalisation of those sectors and industries will generate enormous amounts of data that can be used to maximize economic value. The sharing of data and its combined exploitation through advanced techniques of data analytics and AI, will allow companies and public administrations to build tailored products and services for customers and citizens.