EU PRE-ASSESSMENT FICHE FOR IPCEI CANDIDATES

IPCEI ON DEPLOYING LARGE-SCALE DECENTRALISED AND FEDERATED EDGE COMPUTING INFRASTRUCTURE AND SERVICES (IPCEI-ECI)

The objective of this fiche is to provide a preliminary assessment of whether an industrial policy initiative in a given area (be it a specific technology, value chain or sector) would be a suitable candidate for an IPCEI.

The questions aim at ensuring that an industrial strategy initiative by Member States in a given area is warranted, aligns with EU objectives and would meet the eligibility criteria set out in the IPCEI Communication.

The objective of the fiche is not to come up with a final decision as to whether launching an IPCEI in a given area, but to assess if it would be necessary to conduct more analytical work to design a potential IPCEI.

Please limit the length to 10 pages.

1. OVERALL DESCRIPTION OF THE INITIATIVE

Please describe the overall planned area of intervention and the intended possible nature of policy intervention/projects. This could be linked either to specific technology, a value chain or a sector / value chain.

The objective of the Initiative would be to define a common European standard for edge-computing and the additional first industrial deployment of a large-scale European Cloud-Edge Computing infrastructure. This will need to be deeply integrated in high-end communication networks (5G/6G) to ensure access to data services with ultra-low latency (a few milliseconds) across the EU. As laid out in the February 2024 White Paper on Europe's digital infrastructure needs[1], the initiative contributes to creating the ecosystem of a Connected Collaborative Computing Network ("3C Network") on European scale. Furthermore, the objective is to identify other edge-based infrastructures and tools and ensure the integration and interoperability among different types of developed infrastructure solutions (such as European blockchain service infrastructure solutions based on decentralized and distributed nodes, data spaces in their function as tools and governance models, decentralized governed AI solutions). With integration of the Initiative into the European connectivity network, the new generation of digital solutions will contribute to a more resilient and robust infrastructure, following efficiency and competitiveness of the European economy and its strategic autonomy. It would contribute directly to the balanced deployment of climate-neutral highly secure edge nodes across Europe, as targeted by the European Digital Decade Policy

[1] https://digital-strategy.ec.europa.eu/en/library/white-paper-how-master-europes-digital-infrastructure-needs

Programme, through the combined deployment of computing and communication technologies.

Relation to IPCEI-AI technology proposal:

The deployment of a large-scale European Cloud-Edge Computing infrastructure will form a critical building block for Europe's ability to meet the ever-increasing compute demands of AI. Generally, cloud as technology serves as basic infrastructure for common AI-Services.

Diverse types of AI models and inference processing have different requirements for compute infrastructures: generative AI and large language models have an increasing demand for high-performance computing, only available at large scale clouds and HPC centres today. On the other hand, edge and cloud are suitable for inferencing over these large language models, as well as for predictive AI processes. The large-scale European Cloud-Edge Computing infrastructure must provide a diversity of computing power, when the computing capacity of cloud and HPC become federated. This will provide alternative computing resources to address the computational requirements of the diverse types of AI models and for the complete AI lifecycle – from training, deployment to inference – and at scale. Leveraging a new cloud-edge infrastructure for the inference of generative AI and large language models, along with the execution of predictive AI processes will help ensure that EU businesses of all sizes have access to the necessary variety of AI computing capacity.

Today, the requirement to gather, process, and transmit massive amounts of data to the central cloud is a roadblock for many AI use cases. In this sense, Edge computing is starting to act as a critical component for AI execution closer to where data are generated as part of a distributed edge and cloud environment for AI. This encompasses multiple use cases like video surveillance and analysis and asset/equipment monitoring, tracking, or performance optimization, to cite a few. Edge computing enables more immediate AI processing of the massive data volumes generated at the Edge, the intelligent interpretation of this data in minimal processing times (milliseconds), while providing a more secure processing environment and lowering data transmission costs. Moreover, the execution of inference of generative AI and large language models, along with the execution of predictive AI processes has been demonstrated suitable for the types of compute resources often available in Edge computing environments. The reason is that these processes obtain enough computational resources by relying on general purpose hardware enriched with lower-end hardware accelerators, for instance, in GPUs, smart network interface cards (smartNICs) and field programmable gate arrays (FPGAs). Future market predictions indicate that the confluence of AI and edge computing will continue to evolve, enabling more powerful real-time analytics and decision-making at the edge. Furthermore, today computation is not necessarily depending on dedicated computing environments, such data centres, which would need additional power to transmit all the data coming with AI use cases. The objective is therefore also to combine on-device edge with the rest of computing categories and different type of cloud-edge services in collaborative, decentralized and distributed computing environments. Orchestration of the different computing resources and devices will require intelligent, beyond state-of-the-art solutions.

2. POLITICAL AND INDUSTRIAL POLICY OBJECTIVES

This section aims at assessing the key policy objectives of the initiative from an economic, industrial and research objectives.

2.1. What is the problem that the initiative aims at solving? What is the "cause" of the intervention and why is it important?

Digital networks are evolving and becoming reliant on cloud and edge computing technologies. Today, the cloud computing market is dominated by a limited number of non-EU players that lock-in users to their specific ecosystems of products and services. Progressively, these international actors are embracing edge innovations and permeating the services and products of European telco operators and network equipment providers, which do not have access to European services of comparable breadth and depth. This poses a substantial risk to the economic security and technological sovereignty of digital networks as critical infrastructures, while it limits Europe's ability to respond to the growing compute needs for industries, such as autonomous vehicles, advanced robotics, digital twins and AI.

2.2. To what EU policy objectives will the initiative contribute? Will it make a significant impact on sustainable growth?

The IPCEI-ECI will contribute to accelerating the EU's digital transition. It is mentioned as one scenario to accompany the connectivity sector's transition towards a computing continuum in the Commission's 2024 White Paper on "How to master Europe's digital infrastructure needs?". Moreover, the edge nodes target of the Digital Decade Policy emphasises the strategic importance that edge computing technology plays as part of the European Data Strategy[2]. The strategy highlights the role of edge computing as the infrastructure required to meet the demand for highly distributed and decentralised data processing in order to optimally handle and extract value from the constantly increasing data deluge generated by the widespread deployment of connected objects and their growing requirements for intelligent behaviours. The European Data Strategy additionally details how edge computing provides an important opportunity for European Edge services and technology providers to overcome existing dependencies to foreign cloud providers, unveiling emerging options for technical leadership, while unlocking economic and sustainability benefits and allowing data producers to have stronger control over their data.

Along these lines, edge computing's strategic value is underlined as an indispensable component of the digital network infrastructures and services of tomorrow[3]. While edge and cloud computing and virtualisation are altering the design of today's connectivity infrastructures, which are increasingly becoming integrated connectivity and computing infrastructures, the necessity for timely edge nodes deployment as part European Telco Edge Cloud capacities is becoming more prominent.

2 https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/european-data-strategy_en

3

Likewise, edge and cloud computing is regarded as one of the key technologies, together with high-performance computing, cloud computing, and AI (software), for processing large amounts of data. All these technologies facilitate making decisions or predictions based on data-driven analysis and are object of further risk assessment with Member States, as critical technology areas for the EU's economic security[4].

Examples of Use-Cases:

Edge computing has tremendous relevance for many sectors of the European industries, particularly manufacturing and robotics, and is pivotal for enhancing the competitiveness of the EU in the global landscape. In manufacturing, where efficiency, precision, and real-time responsiveness are paramount, edge computing offers transformative benefits. By processing data closer to where it is generated, such as on factory floors or within robotic systems, edge computing reduces latency and enables faster decision-making. This capability is crucial for optimizing production processes, predicting maintenance needs, and improving overall operational efficiency.

Moreover, in robotics, edge computing enhances autonomy and responsiveness of robotic systems. Robots equipped with edge computing capabilities can analyse sensor data in real-time, enabling them to adapt swiftly to changing environments and tasks. This results in more agile and efficient manufacturing operations, ultimately leading to higher productivity and lower costs.

From a competitiveness standpoint, leveraging edge computing within manufacturing and robotics strengthens the EU's position by fostering innovation and technological leadership. It reduces dependency on foreign cloud providers, vendor lock-ins, enhancing data sovereignty and security. Furthermore, it unlocks new economic opportunities for European edge services and technology providers, opportunities for innovative SMEs on supply side, promoting growth and job creation within the EU. By integrating edge computing into the digital infrastructure strategy, the EU can establish itself as a leader in advanced manufacturing technologies, ensuring sustainable economic development and maintaining global competitiveness in the digital age.

2.3. What are the industrial policy challenges to overcome in the area and in what timeframe?

The deployment of a large-scale European Cloud-Edge Computing infrastructure has an important role as an essential component for future digital networks. As digital networks are evolving and becoming reliant on cloud and edge computing technologies, European telco operators and network equipment providers are increasingly dependent on foreign cloud hyperscale services in the absence of European services of comparable quality and scope. These solutions establish closed ecosystems of products and services, which compromise the freedom of choice and interoperability of the resulting combined compute and communication infrastructures.

The training and deployment of AI requires unprecedented capacity for data storage and processing. AI can only reach its full potential if the necessary hardware and software

[4] Commission Recommendation of 03 October 2023 on critical technology areas for the EU's economic security for further risk assessment with Member States, https://defence-industry-space.ec.europa.eu/commission-recommendation-03-october-2023-critical-technology-areas-eus-economic-security-further_en

are in place to utilise AI models at scale. Inadequate access to software and infrastructure can lead to the emergence or the deepening of compute divides, limiting advances in productivity and negatively affecting competitiveness. A large-scale European Cloud-Edge Computing infrastructure, including for use in AI inference of generative AI and predictive AI, can help overcome this challenge.

Deploying a European edge-node infrastructure, while presenting huge potential, is a complex undertaking that entails several challenges and requires careful prioritization. Key challenges include:

- Security: Protecting sensitive data and preventing cyber-attacks are key, especially given the growing attack surface represented by a ubiquitous infrastructure.
- Scalability: The infrastructure must be able to adapt to growing and fluctuating computing and storage needs, while ensuring high availability.
- Standardization: The lack of globally accepted standards for edge-nodes can slow down the adoption of this technology and increase costs.
- Governance: A clear and consistent regulatory framework at European level is needed to address issues such as privacy, security and liability.
- Reliability and Resilience: Reliability and resilience are crucial aspects when deploying a large-scale edge cloud infrastructure for time-sensitive, critical services. Such an infrastructure must be able to operate continuously and withstand unforeseen events, ensuring the availability of services even in the event of failures or disasters.
- Investment: Initial investments for the development and deployment of such an infrastructure are high, requiring strong collaboration between the public and private sectors.

2.4. What types of research and development and innovation or first industrial deployment activities ([5]) would the initiative entail?

2.5. It is necessary to invest in research on intermittent computing and the complexity associated with the global network and to drive 5G/6G innovation towards edge-node device capabilities.For RDI-activities, explain their content and why they would they be of major innovative nature or constitute an important added value in light of the state of the art?

N/A

[5] Regular upgrades without an innovative dimension of existing facilities and the development of newer versions of existing products do not qualify as first industrial deployment.

2.6. For FID activities, how would they allow for the development of a new product or service with high research and innovation content or the deployment of a fundamentally innovative production process?

N/A

2.7. Is the initiative related to an integrated infrastructure project in the environmental, energy, transport, health or digital sectors? If yes, please explain why it is of great importance for the respective EU strategies or why it will contribute significantly to the internal market.

Yes, the initiative focuses on an integrated infrastructure in the digital sector that is set to significantly contribute to internal market by catalysing a European ecosystem of Connected Collaborative Computing (3C") Networks. Concretely, this Initiative would aim for the large-scale deployment of the strategic data processing cross-border infrastructure necessary to support the large number of edge nodes necessary to meet Europe's edge computing ambition and on which to run the output of the IPCEI - Next Generation Cloud Infrastructure and Services (IPCEI-CIS) and a new type of multi-purpose data processing facilities relying on IPCEI-CIS software developments. With the objective to guarantee the economic security of the large-scale Cloud-Edge infrastructure deployment, a relevant element would be the integration of innovative microelectronics and communication solutions resulting from the IPCEI - Microelectronics and Communication Technologies (IPCEI ME/CT). Overall, the cloud-edge infrastructure deployment advancements identify in the Alliance on Industrial Data, Edge, and Cloud strategic industrial roadmap.

3. EU DIMENSION

This section aims at assessing the relevance of an intervention at EU level in the proposed area.

3.1. What would be the added value of an EU collaboration in this area?

The fragmentation of the EU market for electronic communications networks and services along national borders could impact the ability of operators to reach the scale needed to invest in the networks of the future, in particular in view of cross-border services, important for an effective deployment of IoT, and a more centralized operation. While the single market, on average, delivered on price, it did not deliver on the deployment of advanced infrastructures and servicese. It remains slow, which means that business users today in the EU do not have access to advanced industrial and IoT services as well as commercial private networks. In the future, the issue of quality of services for consumers will also became much more important due to the emergence of new use cases. Besides potential immediate solutions to restrict unjustified discrimination, cross-border edge computing services and networks in the EU could be a sustainable solution with much broader benefits in terms of reach and quality both for consumers and business users.

3.2. Which general positive spill-over effects to the EU economy/society would the initiative deliver?

The IPCEI-ECI will have general positive spill-over effects in different sectors of the EU economy and society, as the initiative would provide the infrastructure on which applications benefiting various verticals could be run (e.g., transport, energy, industrial manufacturing, agriculture, healthcare etc.). It is therefore expected to boost competitiveness and growth.

3.3. Would the initiative address or aim to prevent a significant EU strategic dependency? If yes, please describe which dependency and how the initiative addresses it.

Yes, the initiative is set to reduce strategic dependencies on non-EU cloud providers, which are otherwise expected to increase, as the inevitable opening of the traditionally "closed" electronic communications network in a Network-as-a-Service (NaaS) approach exposes network capabilities to third parties.".

4. MARKET DIMENSION

The objective of this section is to assess whether there is a need for public intervention in the area.

4.1. What are the important market, systemic failures, or societal challenges that the initiative will address? Why is public intervention necessary?

The challenges are described in the Commission's 2024 White Paper on "How to master Europe's digital infrastructure needs?". Moreover, the Digital Decade Policy Programme sets out a target of 10,000 climate-neutral highly secure edge nodes to be deployed by 2030 as well as targets for adoption of digital technologies, such as cloud, big data and AI, by European companies. The 2023 Report on the state of the Digital Decade underlined the risks for the achievement of these targets. Edge computing is still at its infancy in Europe.[6] While the first data collected by the Edge Observatory[7] show that Europe is on track in the initial phase of edge nodes deployment, the trajectory will get much steeper in the coming years. Under current trends, and further coordination and incentives on European scale, the targets are unlikely to be met by 2030.

While it is necessary to speed up the take-up of new technologies and services, it will not be possible without networks capable of expanding and maturing. Modern digital networks would stimulate the development of new use cases, creating business opportunities contributing to the digital transformation of Europe. Hence, the impact of missing the Digital Decade digital infrastructure targets would be far-reaching, going beyond the scope of the digital sector, and would lead to missed opportunities in innovation areas such as automated driving, smart manufacturing, and personalised health care.

[6] Report on the state of the Digital Decade 2023, SWD Digital Decade Cardinal Points, section 2.4.
[7] https://digital-strategy.ec.europa.eu/en/policies/edge-observatory

The EU has established ambitious targets under the Digital Decade Policy Programme 2030. By 2030 all European households should be served by a Gigabit network, and all populated areas covered by next generation wireless high-speed networks offering performance at least equivalent to that of 5G. Achieving these goals will require substantial investments from the private sector, as well as support from public funding including from EU programmes such as Horizon Europe, CEF Digital and the Recovery and Resilience Facility.

The study on the "Investment and funding needs for the Digital Decade connectivity targets" ([8]), based on the WIK-Consult's cost and viability model, estimates that around €114bln in investment will be required to achieve the fixed Gigabit coverage goal using Fibre-to-the-Premise (FTTP). €33.5bln is estimated to be needed for the provision of "full 5G service" (with additional base stations and small cells, mostly for the mid or high 5G bands).

The resulting total investment needs to reach the current Digital Decade targets is about €148bln in investment, with an addition of between €26bln and €79bln depending on the deployment mode, for the main transport paths. This makes the overall investment gap reach at least €174bln, including the public funds that may be required, but more likely beyond €200bln, depending on the options considered. It is important to note that, as 2030 approaches, the more intense, industrial use of connectivity for internet 4.0 scenarios, and the increasing security requirements, are likely to push the investment needs much higher.

Edge computing offers many competitive advantages to the companies, such as reduced latency, increased security and the possibility of developing new services.

Furthermore, there is need for professional training in industries through webinars, events, workshops or by encouraging the presence of professionals with adequate training to enhance these technologies in industries.

4.2. Is there an existing EU value chain in the area? If so, describe its functioning and its major players in Europe.

There are a variety of value chains in Europe, and different segments of the value chains are fragmented at the moment. This is why they are lacking the scalability and efficiency. There is evident need for different sectors (such as communication network equipment providers, edge and cloud service providers, internet node operators, chips developers and manufacturers etc) to work together while developing harmonized standards applicable across Europe.

4.3. How would the initiative contribute to Europe's competitiveness and ability to face of competition from outside the EU? Describe the major current, and possible potential non-European, competitors.

5G's requirement to offer high performance services – specifically with regards to low latency – brings the need for the 5G network (and in the future, 6G) to support novel

([8]) https://digital-strategy.ec.europa.eu/en/library/investment-and-funding-needs-digital-decade-connectivity-targets

features for deployment of distributed edge cloud infrastructure. Resulting network infrastructures constitute a combination of network and computing technologies. Initial approaches for this convergence are being developed by non-EU cloud providers with their mobile edge computing services. These offerings are often conceptualised in two different levels of offerings for near and far edge. Near edge is intended to make use of telecom operator infrastructure and often result in joint go-to-market approaches between cloud and telecom. Additionally, far edge considers the deployment of a complete data centre in-house in a certain telco user location. Notably, existing examples do not only consist in a software platform but include the hardware platform on which the telco user deploys these services. While existing mobile edge computing and telecom cloud offerings from non-EU playerss are recent in the market, concerns on technology independence, interoperability and vendor lock-in are often being raised, due to the critical nature of telco infrastructures that sustain processes of major importance for European industries and have been already recognized by the European Commission as a key pillar for shaping Europe's digital transition. Edge computing will remain a key technology with a great potential for return on investment for industries. Furthermore, Europe needs to develop technological skills to compete on global scale, especially in AI, cloud and edge computing. Global pressure increases the complexity of the market for European companies.

4.4. Is there a pipeline of private projects in the area that needs de-risking/ financing?

TBD

4.5. On which basis can individual projects be integrated in a common structure/roadmap or programme aiming at a coherent, systemic approach?

TBD

4.6. How would the IPCEI contribute to leverage or trigger more private investments or financing from the market in the technology area concerned?

TBD

5. IPCEI VALUE-ADDED

The objective of this section is to assess whether an IPCEI would be an efficient tool to intervene in the given area.

5.1. Can the area be supported by other EU and/or national policy interventions not involving funding? Describe policy instruments that could be used to reach the envisioned result.

TBD

5.2. Can the area be supported by alternative EU funding tools, such as Horizon, DEP, CEF? If these do not suffice, then explain why not.

No, these programmes can support part of the R&D and implementation of new technologies, however the costs associated with the implementation of such technology as described in the IPCEI-ECI requires an extra amount of funds not available in these instruments. In addition, the FID component is a pivotal component that can only be addressed through the IPCEI-ECI.

5.3. Can the area be supported by other appropriate State aid instruments, such as CEEAG, RDIF, GBER? If these do not suffice, then explain why not.

TBD

5.4. What would be the specific benefits of using the IPCEI tool rather than other tools in the given area?

TBD

5.5. Would an existing industrial alliance or the creation of an industrial alliance facilitate an EU ecosystem in the relevant area?

TBD

5.6. How will you promote SME participation in the IPCEI ecosystem?

Edge computing is seen as a technology suitable to reduce costs and support the adoption of AI and IoT in small and medium-sized enterprises (SMEs). It has high potential to facilitate industrial applications and smart cities. The market is moving towards solutions that combine cloud and edge, ensuring flexibility and distributed computational capacity. Another aspect that could push companies to participate is the financing methods. Therefore, it is appropriate to invest in an industrial/commercial deployment aspect rather than research, in particular on edge services.

The development of edge computing could be an opportunity to reduce the digital divide, especially in less developed areas such as southern Europe, making AI accessible also to small and medium-sized businesses.

6. NEXT STEPS

The objective of this section is to assess what additional analyses are required for deciding whether to continue working on an IPCEI in the given area.

6.1. Based on the above, should the given area be further considered in-depth for a potential IPCEI? Summarize the conclusion using 1) the need for an active government role; 2) the need for EU collaboration; 3) why

IPCEI is better suited than other instruments to realise the desired outcome.

6.2. What additional analyses/information would be needed to refine the assessment and come to a final verdict?

There will be a need for active involvement of the MS to stimulate the interest of the relevant European stakeholders. The IPCEI instrument will foster European collaboration among partners and industries.

ANNEX: LINK WITH IPCEI COMMUNICATION ELIGIBILITY CRITERIA

Eligibility Criteria for IPCEI	**Assessment in fiche**
3.1. Definition	
Integrated project (§13)	*To be assessed later in design phase but some elements could be included in* 4. Market dimension *section* (questions 4.1 to 4.5)
3.2 Common European Interest	
Contribution to EU objectives and strategies (§14)	Section 2. Political and industrial strategy objectives (question 2.2)
Overcoming important systemic or market failures, or societal challenges (§15)	Section 2. Political and industrial policy objectives (question 4.1)
Minimum 4 Member States (§16)	*To be assessed later in design phase but some elements could be included in* 4. Market dimension *section* (question 4.1 to 4.6)
Spill-overs to economy and society (§18)	Section 3. EU dimension (question 3.2)
Co-financing by the beneficiaries (§19)	*To be assessed later in design phase but some elements could be included in* 4. Market dimension *section* (question 4.6)
Compatibility with DNSH (Is there an EU value chain to mobilise? (§20*)*	*To be assessed in design phase*
Addressing a clearly identified and significant strategic dependency (§21)	Section 3 EU dimension (question 3.3)
Major innovative nature, in the light of the state of the art in the sector (§22)	Section 2. Political and industrial policy objectives (questions 2.4, 2.5)
First industrial deployment (§23-24)	Section 2. Political and industrial policy objectives (questions 2.4, 2.5)
Infrastructure projects in the environmental, energy, transport, health or digital sectors (§25)	Section 2. Political and industrial policy objectives (question 2.7)
3.3 Importance of the project	
Importance of the project (§26)	Section 2. Political and industrial policy objectives (questions 2.1 to 2.7)