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EXPRESSION OF INTEREST:

ON FUTURE VISIONS AND RESEARCH DIRECTIONS 2025-27 IN THE AREA OF CLOUD-TO-EDGE-TO-IOT FOR EUROPEAN DATA

By **Abilian SAS**

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MOTIVATION

The Cloud-Edge-IoT continuum is rapidly evolving, and the integration of new standards and technologies is driving the need for more intelligent and autonomous systems at the edge. As we move beyond 2025, the development of a Cognitive Cloud-Edge Computing Continuum will be crucial to advancing automation and dynamic adaptation of resource management across IoT devices and Edge and Cloud computing models. Therefore, it is important to identify emerging trends and game changers to shape the future of the European research and innovation programmes.

Two additional factors specially motivate us as a European company with R&D and economic activities grounded on the Digital Sovereignty and Open Source values and principles:

- **Digital sovereignty** should plays a critical role in the development of a cloud-edge-IoT continuum in Europe, allowing our block to maintain control over its digital infrastructure, services, and data. This will ensure privacy and security for citizens, promotes innovation and economic growth, and allow for the development of new technologies and services that are tailored to the needs of the European market. By fostering a strong digital economy and supporting European startups and SMEs, digital sovereignty contributes to the overall economic prosperity of the region, while promoting control, security, and innovation in the digital sphere in line with the European values.

- **Open source and open standards** play a crucial role in the development of the Cloud-Edge-IoT continuum as they offer numerous benefits, including promoting collaboration, accelerating adoption, ensuring interoperability, and reducing costs. These open approaches can help create a more inclusive and collaborative ecosystem for developing innovative solutions that can benefit everyone. While there may be challenges with potential fragmentation of standards and securing the open source software supply chain, these can be addressed through collaboration, the development of widely adopted open standards, rigorous testing and validation, and the establishment of open source businesses, communities, and organizations.

CURRENT STATUS

Currently, the Cloud-Edge-IoT continuum is undergoing a transformational shift towards hyper-distributed computing, leveraging automation techniques to optimize resource management across devices and computing models. Software engineering challenges are also emerging as developers struggle to manage the complexity of these distributed systems. Numerous standards and open source projects are competing for developers mindshare and users adoption.

RESEARCH CHALLENGES

Here are some of the research challenges we have identified at Abilian R&D Lab:

- **Interoperability**: The cloud-edge-IoT continuum involves the integration of various devices, systems, and platforms, which can pose challenges for interoperability. Developing standard (open) protocols and interfaces that enable seamless communication and data exchange between these devices is a key challenge.

- **Security, privacy and data sovereignty**: The cloud-edge-IoT continuum involves the processing and transfer of sensitive personal, corporate or government data, which can make it vulnerable to cyber attacks, and should remain in the control of their respective owners / custodians. Therefore, ensuring the security and privacy of the data is of utmost importance.

- **Edge Intelligence**: As more processing power is shifted to the edge, there is a need to develop intelligent edge devices that can perform complex computations and make decisions in real-time. Developing hardware, algorithms and models that enable intelligent decision-making at the edge is a key research challenge.

- **Efficiency**: Enabling efficient resource management and orchestration across the continuum to support dynamic adaptation and automation.

- **Scalability and heterogeneity**: The cloud-edge-IoT continuum involves a large number of different devices and systems, which can pose challenges for scalability. Developing scalable architectures, programming languages and platforms that can accommodate the growing number of devices and systems and heterogeneity of data formats and protocols is a key challenge.

- **Open standards and open source**: Developing open standards and open-source (software and hardware) platforms for the cloud-edge-IoT continuum can help promote interoperability, innovation, and competition, while also ensuring digital sovereignty and privacy. The programme should also encourage the sharing of data and knowledge to advance research in the field, including the use of open data initiatives. Developing these platforms, standards and best practices is a key research challenge to ensure the security and reliability of systems.

- Promoting the use of the **open cloud** to enable collaboration, innovation and ownership in the development of the cloud-edge-IoT continuum, and to accelerate the digital and green transitions through **human-centered** technologies and innovations:

  - **Tailoring and customisation**: Supporting the development of applications and services that are tailored to the specific needs and requirements of different industries and user segments.

  - **Usability and accessibility**: Developing user-friendly interfaces and experiences that enable users to easily interact with the system and access its capabilities is a key challenge. This requires understanding user needs and preferences, and designing interfaces that are intuitive, engaging, accessible and accommodating to users with diverse needs.

  - **Trust and transparency**: As the cloud-edge-IoT continuum involves the processing and transfer of sensitive data, ensuring trust and transparency in the system is critical. Developing mechanisms that enable users (individuals or organisations) to understand how their data is being used, to control its use and to migrate them from one platform to another, is a key challenge.

  - **Data portability**: The ability to move data between different systems or platforms, which is becoming increasingly important in the context of the Cloud-Edge-IoT continuum, and presents numerous challenges related to data and technology heterogeneity, security, interoperability, privacy, scalability and standardisation.

  - **Ethical considerations**: The cloud-edge-IoT continuum can pose ethical challenges related to privacy, security, and fairness. Developing ethical frameworks that guide the design and use of the system is a key challenge.

  - **Personalization**: Developing personalized experiences that cater to individual user needs and preferences requires leveraging data and AI to gain insights into user behavior and preferences, and tailoring experiences accordingly.

  - **Co-creation**: Engaging users and stakeholders in the design and development process requires developing participatory design processes that enable users to provide input and feedback on the system, and to contribute to its development.

ABOUT ABILIAN

Abilian is a French open source vendor that provides a range of software solutions and services to help organizations manage their information and collaborative work. Abilian's solutions are designed to facilitate knowledge sharing, teamwork, and project management within businesses, government agencies, and non-profit organizations.

Some of Abilian's main software products include:

1. Abilian SBE (Social Business Engine): A collaborative platform that allows users to share information, communicate, and collaborate on projects.

2. Nua: a self-hosted cloud platform (PaaS).

3. Abilian Core: A flexible and extensible framework for building information management and social networking applications.

Abilian is committed to the principles of open source software. This approach allows organizations to tailor Abilian's solutions to their specific needs and requirements, and also promotes collaboration and innovation within the open source community.

Abilian is a member of CNLL (the French association of open source businesses), Euclidia (the European Cloud Industrial Alliance) and the European Alliance for Industrial Data, Cloud and Edge.

More info: www.abilian.com / www.nua.rocks

ABOUT THE AUTHOR

Dr Stefane Fermigier is a French entrepreneur, software engineer and researcher, and advocate of open source software and digital freedoms. He is the founder and CEO of Abilian, a company that develops enterprise information management solutions based on open source software. He is also known for founding the French software company Nuxeo, which specializes in enterprise content management systems. Prior to that, he was an associate professor in mathematics at the University Paris VII.

He has participated in 8 collaborative R&D projects funded by the European commission, the French government and the Paris Region, since 2005; he has to his credit 20 scientific publications (according to Google Scholar), with 260 citations to date and an impact factor (h-index) of 10.

He has co-founded and held leadership positions in several organisations dedicated to the development of the open source ecosystem and digital sovereignty in France and Europe:

- Euclidia (2021), the European Cloud Industrial Alliance.
- APELL (2020), the European open source business association.
- The CNLL (2010), the French open source business association.
- The GTLL (2007), the business and innovation cluster for open source in Ile-de-France (part of the Systematic Paris Region cluster).
- EuroLinux (2000), a federation of European free software associations, which was created to fight against software patents between 2000 and 2005.
- AFUL (1998), the French-speaking association of Linux and free software users.