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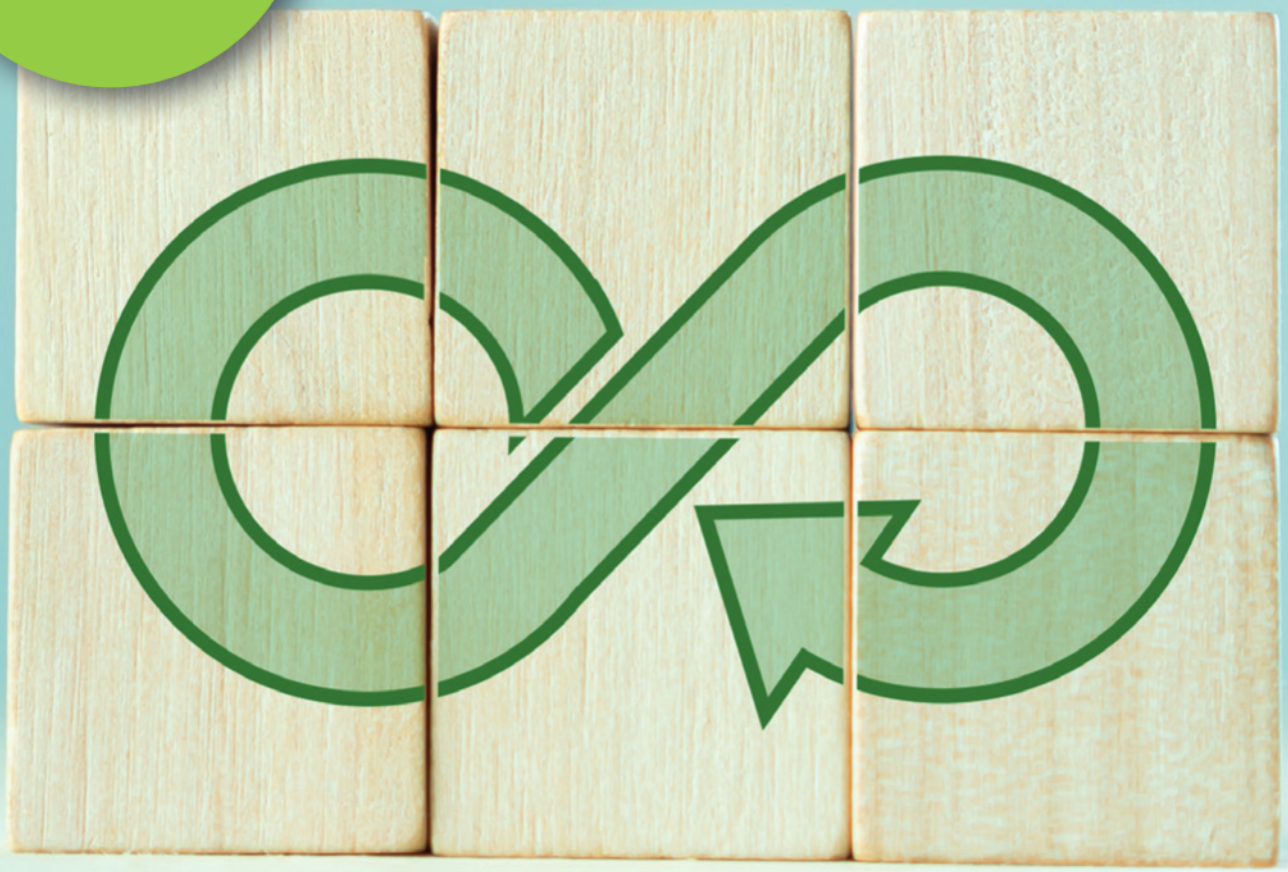


Sustainable computing systems, from production to end of life

How to build a European open web index

Creating the Earth's digital twin

On forging a computer architecture career, with Alex Ramirez

With the number of connected devices constantly growing, and the data that these devices generate climbing into the zettabytes, orchestration and distribution are becoming increasingly complex problems. In this article, Agathe Veillon (SixSq) explains how a number of European projects are using SixSq's Nuvla technology to manage IoT-edge-cloud orchestration.

IoT-edge-cloud

Building a simple, secure, and future-proof infrastructure

The blooming of internet of things (IoT) sensors in cloud infrastructure has precipitated an explosion of data generation from devices on the 'edge' of the network. Building intelligent, efficient and balanced IoT-edge-cloud infrastructure, with data analysis and storage checkpoints at the edge, has become one of the main challenges of distributed computation.

41.6 billion. This is the number of IoT devices foreseen to be connected by 2025 (versus 12.3 billion in 2021). These devices are expected to generate up to 79.4 zettabytes (ZB) of data. That's about 25,000,000 times as much as Netflix's catalogue, so enough to keep us entertained for some time. It's also enough to give you, at the very least, a headache when you think of the carbon footprint generated to store, and eventually process, this vast amount of data – both in terms of energy consumption and network usage.

This huge amount of raw data also sets challenges in terms of efficiency, latency, cost, and security, so how can we address this enormous problem? One recent concept could be the answer: the compute continuum. Establishing a smooth continuum between IoT sensors, edge devices and the cloud allows the distribution of data processing across the different layers. In this configuration, data flows from the IoT to edge devices, which perform the first data analysis, and the resulting information and data are then sent to the cloud for further processing, delivering a more resource- and energy-efficient solution. However, this requires communication and data flow between the different layers as much as management of the devices, which are not that easy to enable.

Several EU-funded research initiatives aspire to tackle this and use distributed computation among the continuum to set new standards.

EXTRACT

The **EXTRACT** project takes a holistic approach to the processing of data with extreme characteristics (high volume, variety, velocity, veracity). This allows the consortium to tackle issues such as handling vast amounts of data and real-time processing. To enable this, EXTRACT data-mining workflows will take advantage of a first step of data analysis at the edge, to optimize data processing in terms of speed and volume.

The performances of these data-mining workflows will be tested by two real-life use cases: the creation of a real-time personal evacuation route (to be used in the event of an emergency) in the city of Venice, and the optimization of raw telescope data observation, applied to transient astrophysics.

ICOS

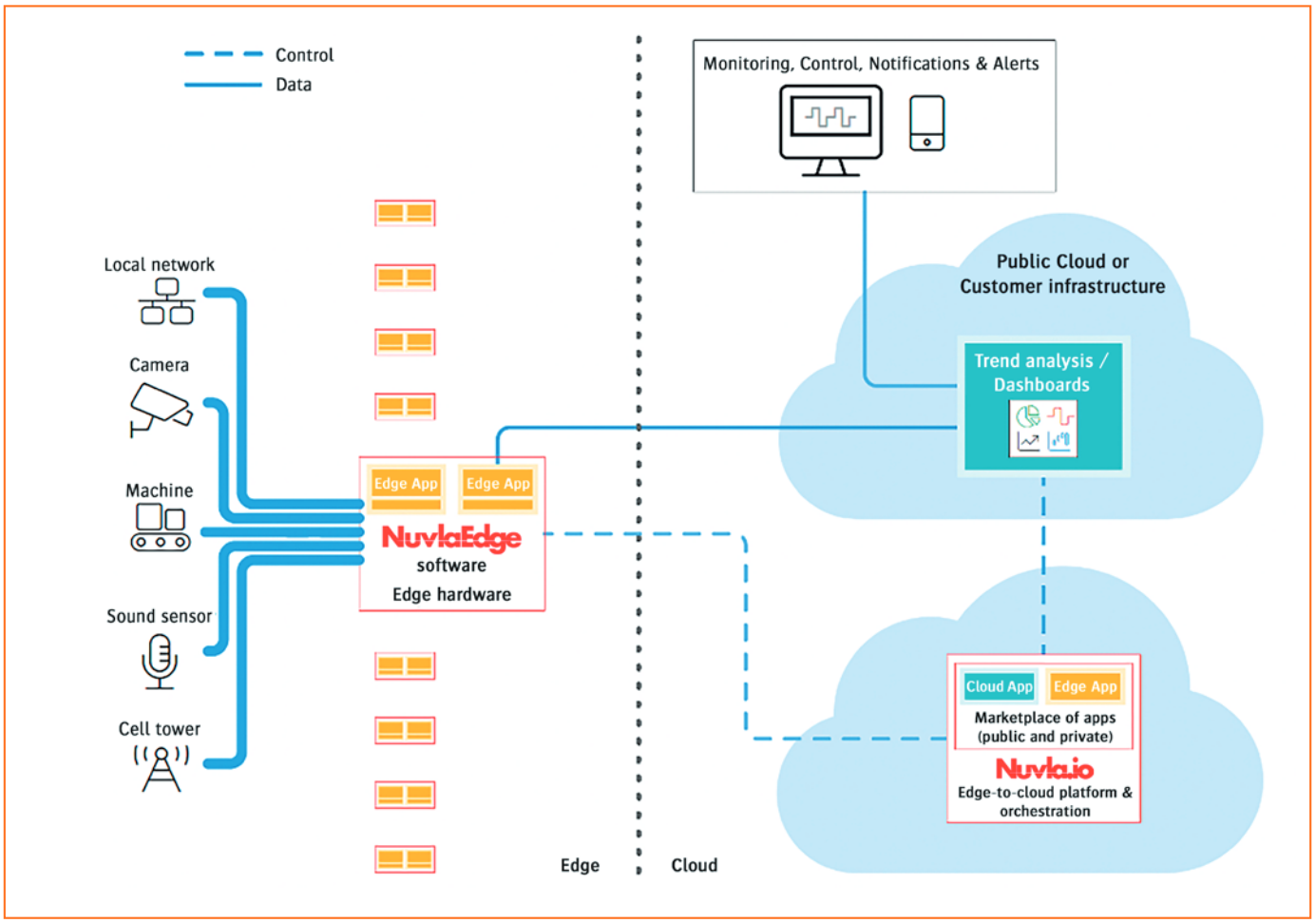
The **ICOS** project is also building a compute continuum between IoT, edge and cloud, based on decentralization and autonomy of the different nodes.

ACES

Finally, the research initiative **ACES** (Autopoietic Cognitive Edge-cloud services) will rely on machine learning and predictive algorithms (mostly related to workload placement) to increase the intelligence and autonomy of edge and cloud devices and enhance their overall efficiency.

Orchestrating this continuum between the IoT, edge devices and cloud services is one of the main challenges. Edge devices and IoT peripherals can, for instance, experience discontinuity in their connection to the network, which raises issues in the data-mining workflow.

To support EU research initiatives, SixSq brings its Nuvla technology to several projects. Nuvla is a combination of an edge-to-cloud remote management platform and an open-source software agent, NuvlaEdge. The agent runs directly on the edge



Overview of IoT-edge-cloud orchestration delivered by Nuvla

device and enables remote communication with the Nuvla platform, from which all devices and the applications running on them can be monitored. Various actions can be taken on the devices and the applications.

The platform also offers a dedicated B2B marketplace from which users can deploy, monitor and update either third-party apps provided by domain experts or their own apps on edge devices. Research and innovation projects benefit from the IoT-edge-cloud connectivity provided by Nuvla, enabling the data and control flow between these three layers. Projects have access to a secure, scalable, cloud and hardware agnostic environment to create, manage and monitor their edge devices and deploy their own apps, at scale.

As a catalyst for innovation, it's important for European research to be transferred to industry, delivering products and services to business. Using user-friendly tools like Nuvla is a way to bridge from research to commerce, while increasing the efficiency and sustainability of infrastructures.

FURTHER INFORMATION

Nuvla on the SixSq website
sixsq.com/products

EXTRACT project
extract-project.eu
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ACES project
aces-edge.eu
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ICOS project
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