

IEoT

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Project Websites

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IEoT—Intelligent Edge of Things

The evolution from local towards virtualized data storage and computation has changed the way we use our digital services and brought some clear benefits over traditional systems. We are witnessing a change from separate person-to-person, person-to-machine and machine-to-machine (IoT) computing towards the Internet of Everything (IoE) computing. On the other hand, Edge computing is a key technology to unleash the full potential of new communication technologies, since it enables deploying computational tasks near the end-devices and therefore opening novel business opportunities around real-time cloud services for wirelessly connected mobile and IoT nodes. As such, this project took the concept of Edge computing and introduced a third local tier (mist) in addition to the cloud and fog conventional tiers (please see Fig. 1). We used AI to unleash the full potential of each Edge architectural tier to meet different application requirements.

Main focus

This project focused in developing intelligent technology solutions and business cases around major areas of intelligent edge IoT computing:

- Intelligent adaptive wireless mobile IoT edge platform,
- Intelligent three-tier Edge-IoT data and service architecture,
- Intelligent, secure and privacy-preserving Edge-IoT technologies.

The common denominator for each of these areas is the use of distributed artificial intelligence (DAI), including machine learning (ML) and deep learning (DL), algorithms to optimise the operation of different technologies covered by these three areas to achieve 1) real-time performance, 2) high level of security and privacy, 3) improved cost, resource-and energy-efficiency, and 4) scalability and manageability.

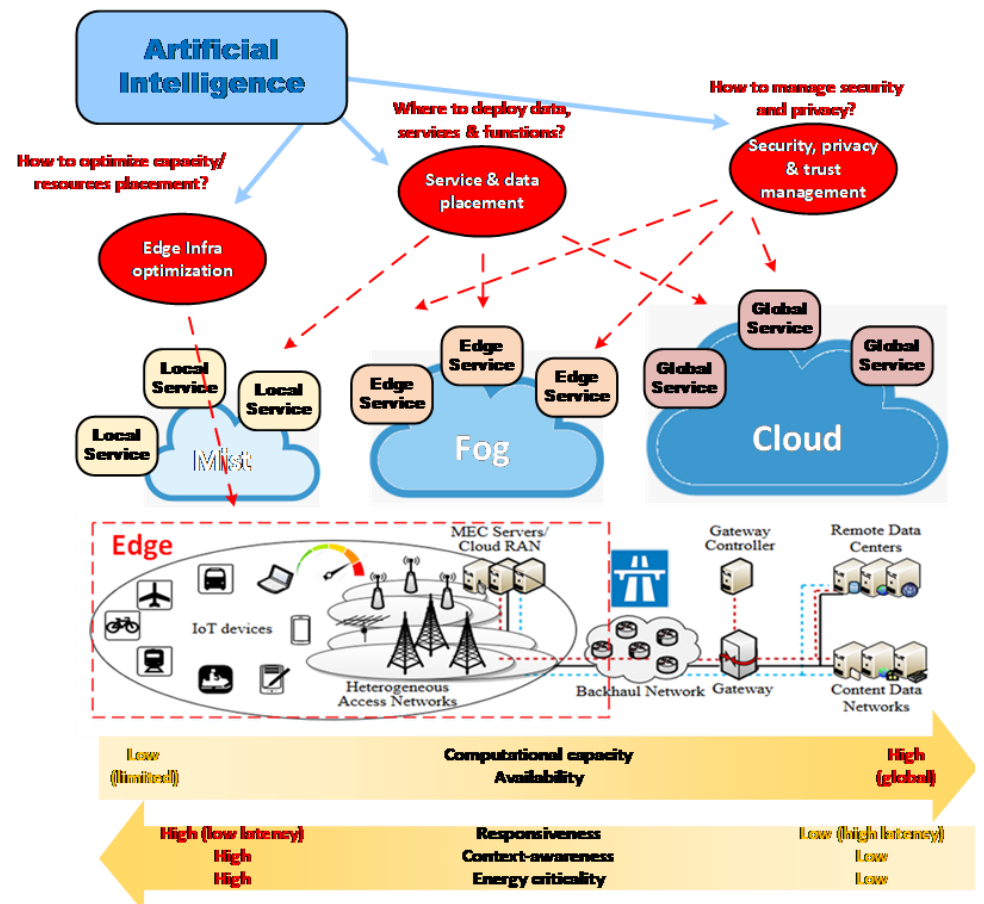


Figure 1: 3-tier IEoT architecture

Approach

The developing of a flexible and robust 3-tier reference architecture (Fig. 1) that counts on novel AI-enabled technologies on the various levels of the Edge IoT to achieve a high level of QoE perceived by user, as well as security and privacy, improved costs, resource and energy-efficiency. We followed guidelines such as:

- Real-time analysis & decision-making deployed on the edge;
- Sensitive data kept as local as possible;
- Operation of most critical functions ensured in any situation;

Being the end-goal to promote sustainability and business efficiency by optimizing resource-, cost-, and energy-efficiency

Achieved results

The main result regarding the work done by this consortium is the successful development of a flexible, yet solid, 3-tier architecture that:

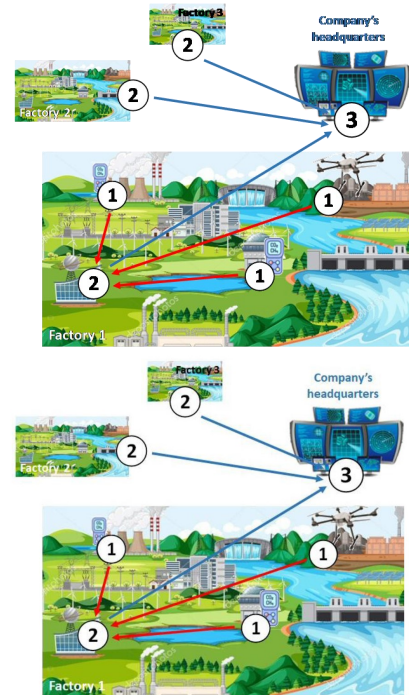
- ◆ shows the advantages of a 3-tier IEOt model that, with a better distribution of computational power allows, in the use-cases explored, that the “fog” layer be handled by a small laptop, as the most demanding tasks can be performed at the “cloud” level. On the other hand, the simplest tasks, at the edge nodes (“mist”), can be performed by very simple devices, that don’t require more than very small computational power and short-range communications means as they just need to connect to the local edge servers. This way we get an important balance between

used resources (energy, volume, cost) and system responsiveness and availability where needed;

- ◆ is the basis of an operational model that can be easily adapted to different scenarios;
- ◆ shows the feasibility of an operational model considering both static and dynamic edge nodes in both terrestrial and aerial applications;
- ◆ present innovations regarding network security, adapted to the computational power available in each of the 3-tiers.

The consortium presented, at the end of the project, a demonstrator (called: “grand-demo”) that showed the work done by all the partners and included the achievements that show the advantages of this architecture.

Moreover, we started, over one year ago, to transpose the IEOt 3-tier architecture to real-life scenarios, where it brings these advantages over more traditional approaches. One of such examples is the worker monitoring in hazardous environments, where both static (deployed around the factory) and dynamic (monitoring drones) sensors ensure the workers’ safety on tier-1 “mist”, while edge servers on tier-2 “fog”, guarantee an efficient monitoring of the factory’s premises by collecting and processing the data related to the environment. A tier-3 “cloud” server gathers both results and historical data in order to enable the adjustment of common parameters and the fine-tuning of the system:



Tier 1 “mist” : sensor devices and drones
Tier 2 “fog” : factory monitoring center
Tier 3 “cloud” : main server at the company’s headquarters

Figure 2: An example of the application of the IEOt 3-tier architecture

Impact

The biggest impact expected by the usage of this reference architecture is the optimization of efficiency by distributing the needed processing power over the layers of an ecosystem that is jointly working to guarantee that, in each layer, we don’t need to have more resources than the ones needed to perform the specific tasks for that layer. This depends on parameters like responsiveness, availability and energy criticality. Tasks that demand more resources can be handled by the layers above thus optimizing the whole ecosystem, contributing to the sustainability of the business application.

About CELTIC-NEXT

CELTIC-NEXT is the EUREKA Cluster for next-generation communications enabling the digital society. CELTIC-NEXT stimulates and orchestrates international collaborative projects in the Information and Communications Technology (ICT) domain.

The CELTIC-NEXT programme includes a wide scope of ICT topics based on new high-performance communications networks supporting data-rich applications and advanced services, both in the ICT sector and across all vertical sectors.

CELTIC-NEXT is an industry-driven initiative, involving all the major ICT industry players as well as many SMEs, service providers, and research institutions. The CELTIC-NEXT activities are open to all organisations that share the CELTIC-NEXT vision

of an inclusive digital society and are willing to collaborate to their own benefit, aligned with their national priorities, to advance the development and uptake of advanced ICT solutions.

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