# Internship Proposal for Final Year MSc or MEng Students (6 months)

# IoT Service Orchestration for Edge Computing

For over a decade, centralized cloud computing has been broadly adopted by Information Technology (IT) professionals. The on-demand and elastic delivery of resources (computation, storage, and communication) in the cloud had been an accelerator of the development of the Internet of Things (IoT), which consists mainly of constrained devices (e.g., sensors, actuators, and other access devices). Despite the benefits of combining IoT and cloud computing, such a combination also brings several challenges. First, the extremely rapid growth of the number of IoT devices generates huge volumes of data that may lead to traffic congestion on the network core and data center overload. Second, the considerable physical distance between IoT devices and cloud data centers results in high communication delays, which may be unacceptable for some time-sensitive applications (e.g., high-quality video streaming, interactive mobile gaming, augmented reality, and mission-critical applications) requiring low end-to-end latency (e.g., 10 ms or even 1 ms). Third, it is difficult for applications deployed in the cloud to quickly adapt to changes in the local context (e.g., precise user location and local network conditions) of distributed mobile devices.

Aiming to address these cloud challenges, relatively recent research efforts introduced the concept of Edge Computing (EC), which extends the cloud computing capabilities closer to end-users (i.e., at the edge of networks). EC adds a new layer of distributed computing nodes between end-user devices and cloud data centers. Therefore, applications running on EC can perform actions close to its users before connecting to the cloud, thus (i) reducing the network overhead, (ii) providing faster responses, and (iii) getting local contextual information most efficiently.

As promising as EC is, it also faces some issues. In particular, a relevant problem to be addressed is the Management and Orchestration (MANO) of resources. A role of MANO is to decide where and when to place multiple applications/services (i.e., whether on a node in the edge or within the cloud) according to infrastructure's resource constraints, applications' Quality of Service (QoS) requirements and other desired goals.

Motivated by the above facts, the objective of this internship is twofolds. First, to set-up an edge computing platform, and then to develop an orchestration to management tool allowing to handle the lifecycle of IoT services using cutting-edge technologies, such as OpenStack, Kubernetes and Docker Containers.

**Bibliography:**

1. Bilal, Kashif, et al. "Potentials, trends, and prospects in edge technologies: Fog, cloudlet, mobile edge, and micro data centers." Computer Networks 130 (2018): 94120.

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3. W. Shi, J. Cao, Q. Zhang, Y. Li and L. Xu, "Edge Computing: Vision and Challenges," in IEEE Internet of Things Journal, vol. 3, no. 5, pp. 637646, Oct. 2016. doi:10.1109/JIOT.2016.2579198

4. A. C. Baktir, A. Ozgovde and C. Ersoy, "How Can Edge Computing Benefit From Software-Defined Networking: A Survey, Use Cases, and Future Directions," in IEEE Communications Surveys & Tutorials, vol. 19, no. 4, pp. 23592391, Fourth-quarter 2017. doi: 10.1109/COMST.2017.2717482

5. W. Yu et al., "A Survey on the Edge Computing for the Internet of Things," in IEEE Access, vol. 6, pp. 69006919, 2018. doi: 10.1109/ACCESS.2017.2778504.

**Keywords:** Edge/Cloud computing, service orchestration, Internet of Things

**Desired Competencies:** Linux administration, Networking technologies, Python/Go/Shell Script Languages, DevOps Automation (OpenStack, Kubernetes, Docker)

**Duration & period:** 5 to 6 months, starting February 2019.

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**Remuneration:** regulatory bonus of internships in France (see https://www.service-public.fr/professionnels-entreprises/vosdroits/F32131).