Week 24

The Technical Challenges of Edge Computing

It is important to note that augmenting the computational capacities of edge devices through Edge Computing is not a replacement for cloud, on the contrary they are complementary paradigms that need to be employed together. However, it is not a straightforward attempt to deploy extra computational resources at the edge of the network and establish this complementarity while letting them be accessible ubiquitously. There are many significant challenges in addition to the complexity of the technologies such as the mobility, limited energy and computational resources of the edge devices, heterogeneity, scalability, reliability, security and privacy issues. Some of these technical challenges are already being addressed in the literature.

However, even in the case where each technical challenge is resolved, one meta-challenge is that the resulting system and its internal interactions are very complex. Some of the reasons creating this complexity are as follows:

1) Service Synchronization & Orchestration: Typical client-server style interaction assumed for the cloud services are based on two tiers. However, Edge Computing resources will also need to interact with the cloud servers. This will entail a minimum of three tier architecture with its own set of coordination and orchestration requirements. An intermediate networking layer should orchestrate the interaction between edge servers and the central cloud, and inter-Cloudlet communications. Moreover, even intra-Cloudlet operations should be handled properly with this networking layer in order to provide a smooth cooperation throughout the edge tier.

2) Seamless Service Delivery: The connectivity at the edge computing infrastructure may be intermittent with mobility. In this respect, to achieve seamless service delivery, handover mechanisms that consider multi-tenancy on the same local cloud and multiple service providers will be required.

3) Service-Centric Structure: As the focus shifts to the service itself rather than its location, traditional IP-based operations become infeasible to handle the interactions between clients and servers. In an Edge Computing facility, this problem is more emphasized as the service itself may reside on a number of local servers as well as it may partially reside on local servers and the cloud. A service centric design that handles all the complexities involved is a necessity.

4) Soft State: Unlike its cloud counterpart which operates on hard state and permanent data, Edge Computing services may not always assume the availability of the local infrastructure. Soft state incurs much more complex scenarios and should handle the fall-back operations for the end user.

Even the partial list above indicates that there exists a multi-faceted technical challenge that is difficult to solve using the classical distributed system (client-server) paradigm. Developing, provisioning and configuring new applications will be challenging through that approach. This will create a barrier for the practical deployments of the novel Edge Computing solutions.