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**Doctoral School:**

**MATHEMATIQUES ET INFORMATIQUE**

**PhD Research Offer (title and short presentation)**

**Quality of Service based Content Optimization in Mobile Edge Environment**

**Context:**

In today mobile network such as 3GPP network architecture, the introduction of new network functionalities could take a long time from the standardizing process to the implementation and deployment stages. This long process can dissuade network operators to innovate and to invest in new value-added services. In this architecture, the use of specialized networking components and specific hardware-platform suffer from limited flexibility in scaling/upgrading and openness, indeed, each new service should comply with the standard and the existing interfaces. Mobile Edge Environment is a concept supported by big stakeholders (such as Huawei, IBM, Intel, Nokia, Vodafone,...) which relays on proposing to end-user, and mobile application developers a set of context-related services aiming to enhance the mobile broadband experience while being transparent to the 3GPP specification and the existing interfaces. In this context, specific solutions have to be designed to support important functions such as resources management, control, mobility and reliability to mention few of them. The aim of this thesis is to study how Mobile Edge Environment as a new paradigm can enable innovative application such content delivery optimization and enhance the user quality of service and quality of experience.

**Challenges:**

There are different challenges to be solved in order to allow applications from different providers to run at the edge of the mobile network while providing optimized behaviors:

1. Dynamic placement of virtualized network functions (VNF). The concept of Network Functions Virtualization (NFV), resulting in some network functions such as Radio Access Network, quality of services, firewall, multicasting, caching, deep packet inspection, etc. to be implemented in software as virtualized network functions (VNF). Operator can construct and manage its network dynamically and enable network functions to be instantiated, connected, or chained, to achieve the overall network functionality depending on traffic volumes, service requests, or high-level objectives. Operator is willing to open the mobile edge environment to third-party partners to exploit some data and vital value (big data) of the mobile network to propose innovative applications which uses the VNF. The main challenge facing the operator is to ensure that VNF should not degrade the overall services performance while providing flexibility, elasticity and short innovation cycle for providing optimized content delivery and a guarantee of quality of service as two scenarios.
2. Defining a programmable and Software-Defined Networking (SDN). This allow abstracting and externalizing specific control plane functionalities within the network functions to logically-centralized controllers running a collection of applications for local and/or end-to-end optimized network operation. The defined interface should be resilient and should not affect network availability while it should have the necessary fault tolerance mechanisms to ensure that it is operating according to the expected behavior.
3. Achieving a unified resource management. This enables to coordinate and to manage the overall network resources (CPU, bandwidth...) across the entire domain (core and edge) and to ensure the expected performance for the content delivery application scenario and for guarantee of end-to-end quality of service. The proposed unified resource management should ensure that operational and management functions are not overly complex.

**Thesis schedule:**

The schedule of this thesis will be organized in the three above mentioned topics of interest. Some specific focus will be done on:

- State of the art of Mobile Edge Computing, VNF, and SDN.

- Studying the virtualization of mobile edge /core network function. Specifically, which are the function to position at the network edge in order to improve the user experience, cut down the network operator costs and enable rapid deployment of new services.
- Specifying and analyzing the collected big data at the Edge to predict and contextualize the provided services in different scenario such as CDN delivery, IoT (Internet of Things), Location Tracking, Radio Access Network aware Content Optimization, Service performance Optimization, etc. the focus will be of providing optimized content delivery such as VoD streaming and IPTV solution with high quality of service guarantee.
- Definition and validation of a solution implementing the content delivery scenario in mobile edge environment while ensuring a guarantee of Quality of Service provisioning.
- Writing papers and possible contribution to the standardization effort of Mobile Edge Computing (c.f. ISG MEC).
- Writing and defending the Ph.D thesis.