Chapter 2
Next Generation Multi-Access Edge-Computing Fiber-Wireless-Enhanced HetNets for Low-Latency Immersive Applications

Amin Ebrahimzadeh
INRS, Canada

Martin Maier
INRS, Canada

ABSTRACT

Next generation optical access networks have to cope with the contradiction between the intense computation and ultra-low latency requirements of the immersive applications and limited resources of smart mobile devices. In this chapter, after presenting a brief overview of the related work on multi-access edge computing (MEC), the authors explore the potential of full and partial decentralization of computation by leveraging mobile end-user equipment in an MEC-enabled FiWi-enhanced LTE-A HetNet, by designing a two-tier hierarchical MEC-enabled FiWi-enhanced HetNet-based architecture for computation offloading, which leverages both local (i.e., on-device) and nonlocal (i.e., MEC/cloud-assisted) computing resources to achieve low response time and energy consumption for mobile users. They also propose a simple yet efficient task offloading mechanism to achieve an improved quality of experience (QoE) for mobile users.

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INTRODUCTION

The Internet has constantly evolved from the mobile Internet dominated by human-to-human (H2H) traffic to the emerging Internet of Things (IoT) with its underlying machine-to-machine (M2M) communications. The advent of advanced robotics, along with the emerging ultra responsive networking infrastructures, will allow for transmitting the modality of touch (also known as haptic sensation) in addition to the traditional triple-play traffic (i.e., voice, video, and data) under the commonly known term *Tactile Internet*. The term Tactile Internet was first coined by G. P. Fettweis in 2014. In his seminal paper, Fettweis (2014) defined the Tactile Internet as a new breakthrough enabling unprecedented mobile applications for tactile steering and control of real and virtual objects by requiring a round-trip latency of 1-10 milliseconds. Later in 2014, ITU-T published a Technology Watch Report (2014) on the Tactile Internet, which emphasized that scaling up research in the area of wired and wireless access networks will be essential, ushering in new ideas and concepts to boost access networks' redundancy and diversity to meet the stringent latency as well as carrier-grade reliability requirements of Tactile Internet applications.

The IoT without any human involvement in its underlying M2M communications is useful for the automation of industrial and other machine-centric processes while keeping the human largely out of the loop. In contrast, according to Maier et al. (2016) and Maier et al. (2018), the Tactile Internet, which allows for the tactile steering and control of not only virtual but also real objects via teleoperated robots, will be centered around human-to-robot/machine (H2R/M) communications, thus calling for a human-centric design approach. To give it a more 5G-centric flavor, the Tactile Internet has been more recently also referred to as the 5G-enabled Tactile Internet (see Simsek et al. (2016) and Aijaz et al. (2017)). Andrews et al. (2014) have argued that unlike the previous four generations, future 5G networks will lead to an increasing integration of cellular and WiFi technologies and standards. Furthermore, the importance of the so-called *backhaul bottleneck* needs to be recognized as well, calling for an end-to-end design approach leveraging on both wireless front-end and wired backhaul technologies. Or as once eloquently put by J. G. Andrews et al. (2013), "placing base stations all over the place is great for providing the mobile stations high-speed access, but does this not just pass the buck to the base stations, which must now somehow get this data to and from the wired core network?".

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