Novel Processing and Transmission Techniques Leveraging Edge Computing for Smart Health Systems

Abstract

The growing number of chronic disease patients, emergency and disaster management, that demand constant monitoring and examination of human biosignals and vital signs, have increased the prominence of telemonitoring systems. There is also a top national interest worldwide to reduce costs of healthcare services while maintaining high-quality care to patients. Coinciding with this worldwide interest, the rapid advances in Edge Computing, wireless communication technologies, Internet of Things (IoT), and Big Data have facilitated the development of smart-health (s-health) systems. S-health systems leveraging the wide range of technologies (e.g., smartphones, wearable devices, and portable health devices) enable providing efficient continuous-remote healthcare services. However, the need of delivering decent healthcare services to the patients while reducing healthcare costs is a challenging issue. S-health systems require recording, transmitting and processing large volumes of multimodal medical data generated from different types of sensors and medical devices, which is challenging and may turn some of the remote health monitoring applications impractical. One of the promising approaches for enabling s-health is adopting edge computing capabilities with next generation wireless networking technologies to provide real-time and cost-effective healthcare services.

In this thesis, we present our vision for the benefits of exploiting multi-access edge computing (MEC) within the field of s-health. We envision a MEC-based architecture and discuss the benefits that it can bring to realize context-aware approaches so that the s-health requirements are met. In particular, we propose four main approaches that can be implemented leveraging such an architecture to provide efficient data delivery, namely, adaptive data classification and compression at the edge, data-specific transceiver design for healthcare applications, distributed in-network processing and resource optimization, and dynamic networks association. The first approach allows for efficient and low distortion compression, while ensuring high-reliability and fast response in case of emergency applications leveraging fuzzy classification and feature extraction techniques. The second approach proposes an efficient transceiver design that reduces amount of transmitted data, while considering the characteristics of the acquired data as well as maintaining application Quality-of-Service (QoS) requirements. The third approach enables data transfer from mobile edge nodes to the cloud in an energy-efficient and cost-effective manner leveraging available network resources and

applications' characteristics. The fourth approach focuses on how to benefit from the integration of multiple Radio Access Technologies (RATs) within the MEC architecture, in order to meet the applications' requirements, and optimize medical data delivery. Finally, we discuss several opportunities that edge computing can facilitate for s-health to inspire more research in this direction.