Thesis: Resource Management in Mobile Edge Computing for Compute-Intensive Application

Abstract: With current and future mobile applications (e.g., healthcare, connected vehicles, and smart grids) becoming increasingly compute-intensive for many mission-critical use cases, the energy and computing capacities of embedded mobile devices are proving to be insufficient to handle all in-device computation. To address the energy and computing shortages of mobile devices, mobile edge computing (MEC) has emerged as a major distributed computing paradigm. Compared to traditional cloud-based computing, MEC integrates network control, distributed computing, and storage to customizable, fast, reliable, and secure edge services that are closer to the user and data sites. However, the diversity of applications and a variety of user specified requirements (viz., latency, scalability, availability, and reliability) add additional complications to the system and application optimization problems in terms of resource management. In this research proposal, we aim to develop customized scheduling and strategies that are needed to handle the resource management problems in different use cases: i) Firstly, we propose an energy-efficient framework to address the problem of partial task offloading with the purpose of minimizing the transmission cost and deadline satisfaction. Our experiment and simulation results indicate that partial task offloading provides better energy savings, especially for resource-constrained edge systems; ii) Secondly, we develop customized edge frameworks for real-time video analytics. Our frameworks can handle both the energy-efficient resource management and video configuration adaptation. Through evaluation that uses an edge prototype, we demonstrate the framework’s success in satisfying diverse latency, outcome accuracy, and energy consumption requirements of heterogeneous applications. iii) Finally, to address the dynamism edge environments, we propose solutions that integrate Dynamic Spectrum Access (DSA) and Cooperative Spectrum Sensing (CSS) within an edge system. Similarly, we show the high efficiency of the proposed strategy in capturing dynamic channel states and enforcing intelligent channel sensing and task offloading decisions. The outcomes of this research seek to benefit the future distributed computing, smart applications, and data-intensive science communities to build effective, efficient, and robust MEC environments.

Committee:

- Professor Saptarshi Debroy, Mentor, Hunter College
- Professor Ping Ji, John Jay College
- Professor Jun Li, Queens College

Outside member:

- Professor Devarshi Ghoshal, Facebook Inc.