Network softwarization is among the most significant innovations of computer networks in the last few decades. The lack of uniform and programmable interfaces for network management led to the design of OpenFlow protocol for the university campuses and enterprise networks. This breakthrough coupled with other similar efforts led to an emergence of two complementary but independent paradigms called software-defined networking (SDN) and network function virtualization (NFV). As of this writing, these paradigms are becoming the de facto norms of wired and wireless networks alike.

This dissertation mainly addresses the scalability aspect of SDN for multiple network types. Although centralized control and separation of control and data planes play a pivotal role for ease of network management, these concepts bring in many challenges as well. Scalability is among the most crucial challenges due to the unprecedented growth of computer networks in the past few years. Therefore, we strive to grapple with this problem in diverse networking scenarios and propose novel solutions by harnessing capabilities provided by SDN and other related technologies. Specifically, we present the techniques to deploy SDN at the Internet scale and to extend the concepts of softwarization for mobile access networks and vehicular networks. Multiple optimizations are employed to mitigate latency and other overheads that contribute to achieve performance gains. Additionally, by taking care of sparse connectivity and high mobility, the intrinsic constraints of centralization for wireless ad hoc networks are addressed in a systematic manner. The state-of-the-art virtualization techniques are coupled with cloud computing methods to exploit the potential of softwarization in general and SDN in particular. Finally, by tapping into the capabilities of machine learning techniques, an SDN-based solution is proposed that inches closer towards the longstanding goal of self-driving networks. Extensive experiments performed on a large-scale testbed corroborates effectiveness of our approaches.