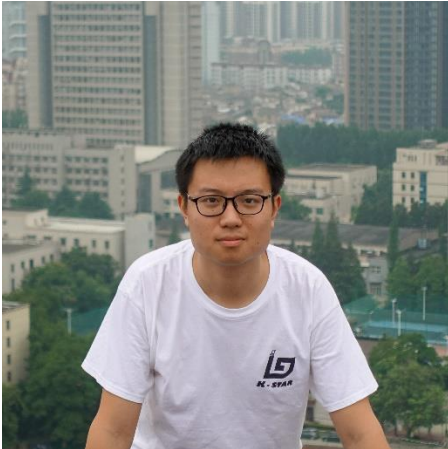




DISSERTATION DEFENSE



Xumiao Zhang

Characterizing and Improving Next-Generation Network Infrastructures and Applications

Monday, June 3, 2024

10:00am – 12:00pm

Virtual – [Zoom](#)

Passcode: 004917

ABSTRACT: The rapid evolution of network technologies and the increasing demand for fast, flexible, and reliable connectivity have led to the emergence of next-generation network infrastructures, including new mobile networks such as 5G, new network protocols such as QUIC, and even new communication paradigms such as LEO satellite networking. These infrastructures possess the potential to revolutionize a wide range of applications such as connected and autonomous vehicles. However, there is a lack of comprehensive investigation into their unique characteristics for enhancing network applications, as well as the adaptation needed for existing applications to harness their full capabilities. To address this challenge, in this dissertation, I demonstrate that systematic measurements and analyses aimed at unveiling the intricacies of emerging network infrastructures, along with the development and innovation of efficient network applications, hold the key to unlocking the full potential of the next-generation network ecosystem.

For network application innovations, leveraging emerging vehicular connectivity and advanced sensor perception capabilities, we explore cooperative sensing for connected and autonomous vehicles. Specifically, we design an edge-assisted multi-vehicle collaboration framework based on Voronoi diagrams. As for network infrastructure measurements and improvements, we first characterize 5G network performance, power consumption, and application QoE implications through large-scale real-world experiments. Then, we examine the QUIC transport protocol over high-speed Internet, reveal QUIC's performance issues after comparing it with the traditional TCP protocol stack, and conduct an in-depth root cause analysis. Lastly, to understand LEO satellite networks, we take Starlink as an example and compare it with existing cellular networks in various aspects. We also explore the potential of enabling multipath transport between LEO satellite and cellular networks.

CHAIR: Prof. Z. Morley Mao