Abstract:
Traditional spectrum allocation policies statically grant spectrum bands to licensed users (also called incumbents) for exclusive access. This prevents access to these licensed spectrum bands even when the incumbents are idle. The exponential increase in the use of wireless services in recent years has resulted in "spectrum scarcity." To address this, the Federal Communications Commission (FCC) has proposed Dynamic Spectrum Access (DSA), where unlicensed users (also called Secondary Users) opportunistically access licensed spectrum bands when they are idle. However, this may lead to the possibility of illegitimate spectrum access by malicious unlicensed users. Therefore, there is a need for the enforcement of spectrum access in wireless networks.

Much of the research and practice to date has focused on preventative (ex-ante) approaches to protect incumbent users. The focus of my Ph.D. research is on developing techniques for automating ex-post access right enforcement. This gives rise to the need for efficient DSA enforcement. With the utilization of a crowdsourced-based approach, my work aims to contribute to the broader evolution of spectrum sharing. By delving into the intricacies of DSA, my work provides insights that facilitate more adaptive, scalable, and robust approaches to spectrum utilization in modern wireless networks. With a focus on ex-post spectrum enforcement, my research addresses some fundamental requirements for efficient DSA enforcement: 1) Coverage of the geographical area of spectrum enforcement, 2) Accurate, reliable, and robust detection of spectrum access violations.

To this end, I explore and address the problem from three directions. Firstly, a spectrum enforcement framework is developed that utilizes a crowdsourced approach to attain high coverage in monitoring spectrum for efficient enforcement. Secondly, a novel spectrum sampling scheme is developed that allows accurate and robust detection of spectrum access violations over varying environmental and physical factors, for prolonged intervals of time. Thirdly, an efficient methodology for the recruitment of crowdsourced spectrum monitoring agents is developed to allow sustainable and scalable enforcement of spectrum access rights.