The success and wide proliferation of wireless and mobile services places extreme pressure on the limited available wireless bandwidth. As this pressure continues to increase with smartphones, new services and users, the available bandwidth will not be able to sustain it, severely limiting the promise of computing on the move. Dynamic Spectrum Access networks (DSANs or sometimes known as Cognitive Radio Networks) offer the potential of alleviating this problem. Unlike traditional wireless networks, DSANs are not restricted to operate over a fixed bandwidth in license-free frequency spectrum. DSANs dynamically utilize the unused bandwidth in licensed bands, such as the bandwidth allocated to cellular networks, without harming the primary licensed users.

While DSANs are capable of reusing an otherwise wasted bandwidth, translating the large bandwidth into application requirements, such as higher capacity and lower delays, is a complex problem. The networking protocols have to understand application requirements, monitor the unused spectrum, and dynamically adapt to schedule and route the traffic without affecting the primary licensed users.

In this paper, we propose a suite of measurement-based models and protocols that enable applications to realize the lower-layer resources in a DSAN. First, we propose a centralized network-monitoring engine. It dynamically computes the network topology graph and spectrum usage statistics. Based on this information, a stochastic model predicts the available capacity and delay estimates, and exposes them to the applications using simple Application Programming Interfaces (APIs). Second, we propose a routing protocol that uses the API to construct high-capacity or low-delay routes. We have deployed the system in a test bed with software-defined radios at Carnegie Mellon University, Qatar.

The proposed framework enables the design of practical and efficient higher-layer protocols. However, the more general problem of optimal resource allocation in DSAN requires solving other complex tasks, such as optimal spectrum assignment and scheduling. In the future, we plan to model and demonstrate practical solutions for these problems. We also plan to pursue distributed heuristics that adapt to mobility.