Over the past decade we have witnessed the explosive growth of wireless networks. Unlike a traditional wireless device that is basically a radio transceiver, today’s smart wireless devices are commonly equipped with powerful application processor, strong multi-modal multi-functional sensors, and high-capacity memory and storage. Accordingly, it becomes possible for a smart wireless device to utilize its powerful sensing and computing capability to enhance networking. Specifically, the device can sense the environment, extract relevant context information from the sensory data, and reconfigure and adapt to the context to achieve better networking performance. In this talk, we will discuss several techniques developed by Dr. Shu and his research group that fulfill the above vision. Considering that spectrum is a fundamental resource for wireless networking, our discussion will emphasize one particular context: the radio environment map (REM). Several statistical learning and stochastic optimization models have been developed to construct REM and use it for better medium access control (MAC) and QoS routing in the 2D (spectrum and time domains) and 3D (space, time, and spectrum domains) settings, respectively. Security and privacy challenges originated from the context computation and utilization will also be discussed.

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