Machine Learning Aided Spectrum Sensing and Energy Harvesting for Sustainable Internet-of-Things

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Large-scale deployment of the Internet-of-Things (IoT) is on the horizon and is expected to revolutionize many services such as healthcare, home automation, and transportation. In a recent report, Gartner forecasted that 20.4 billion connected things will be in use worldwide by 2020. This report indicates that there is a critical need for discovering available spectrum and supplying energy for a massive number of devices to be connected in near future.

Cognitive radio (CR) is a promising wireless communication technique that enables greater efficient use of the radio spectrum by sharing under-utilized spectrum and thereby allowing more concurrent wireless communications in a given spectrum band. The operation of CR, however, requires periodical sensing and continuous decision makings on the availability of spectrum, which results in a high energy consumption. The energy consumption is particularly significant in densely occupied environments, such as IoT, where CRs must spend most of their time searching for available spectrum. Dynamic spectrum access in such an environment places a unique demand on energy consumption that cannot be solved with low-power circuit design or energy-efficient communication protocols alone.

We propose to address the challenge by exploiting abundance of devices and applying machine learning techniques which hold promise for performance improvements in highly dense scenarios that are difficult to describe with tractable mathematical models. The spectrum sensing and energy harvesting performance can be improved by cooperation among devices (sensing units), where spectrum sensing and energy harvesting is integrated and optimized using machine learning techniques.

This project will provide opportunities for educating and training students at the intersection of physical-layer and network-layer system design and optimization, which has been rarely studied in the past. The expertise of visiting faculty and students and host faculty ideally complement each other in carrying out the proposed interdisciplinary research.