Open Thesis / Project

Detecting and Mitigating Coexistence Problems through RF Spectrum Analysis

Thesis Type

Master Project / Master Thesis

Motivation

With the rapid growth of the Internet of Things (IoT), an increasing number of wireless appliances is crowding the same unlicensed Industrial, Scientific, and Medical (ISM) frequency bands, causing severe cross-technology interference. The latter leads to loss of packets, increased delays, and to a reduced performance, especially for wireless IoT devices operating at low power. It is hence crucial for a low-power wireless IoT device to get an *understanding* of the RF spectrum usage in its surrounding and dynamically adapt its protocol configuration accordingly, so to maximize the dependability of its communications. Such an understanding includes, for example, which channels are highly congested, as well as which (or how many) devices are operating on a given frequency and their traffic pattern.

We are interested in finding an efficient and accurate way to obtain such an understanding of the RF spectrum usage. As collecting information using energy detection (i.e., by sampling the received signal strength at high frequency) is highly expensive for battery-powered IoT devices, we are also looking for possible schemes that off-load this task to more powerful and unconstrained devices. For example, wall-powered Wi-Fi devices such as Raspberry Pis can get an understanding of the RF spectrum usage and communicate this info to the surrounding low-power IoT devices using cross-technology communication (CTC) or other means.

Goals and Tasks

Within this context, the student can explore several directions and perform different tasks:

- Explore metrics that allow to characterize the RF spectrum usage (e.g., which channels are congested, how many devices are using these frequencies) in a compact and efficient way;
- Explore the use of ML techniques to detect and classify wireless coexistence issues in real-time;
- Explore how to make use of such a detailed RF spectrum usage characterization to increase coexistence across IoT devices;
- Build a demonstrator where a more powerful device (e.g., Raspberry Pi) monitors the RF spectrum usage and communicates this information to a low-power IoT device (e.g., using CTC).

Target Group

- Students of ICE/Telematics;
- Students of Computer Science;
- Students of Electrical Engineering.

Required Prior Knowledge

- Knowledge of networked embedded systems;
- Skills in Python and C programming;
- Experience with machine learning.

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