Demo Abstract: Robust Data Collection Despite Cross-Technology Interference in Urban Environments

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ABSTRACT

In this demo, we present Oppcast, a robust and energy-efficient data collection protocol which carefully exploits a combination of spatial and channel diversity to eliminate the need of performing expensive channel estimation in advance. By incorporating techniques like multi-channel opportunistic routing and fast channel hop, Oppcast achieves high reliability with up to 2.4 times energy efficiency in comparison to the state of the art low-power data collection protocols when tested in both large-scale testbed (Academic Institution) and various urban environments (Carpark, Residential Complex, Shopping Mall and Cafeteria).

1. INTRODUCTION

In urban environments, due to large-scale adoption of various technologies like WiFi, Bluetooth and extensive usage of common household appliances like a microwave and a cordless phone to name a few, 2.4 GHz ISM band is getting strikingly congested. This has a direct impact on the performance of ZigBee-based protocols, which share the same wireless spectrum and suffers from severe cross-technology interference (CTI). Performing periodic data collection in the presence of such highly dynamic CTI therefore, becomes quite challenging.

We often assume that there are at least 4 usable ZigBee channels (15, 20, 25, and 26) that are orthogonal to the most commonly used WiFi channels (1, 6, and 11) as shown in Figure 1(top). From our measurements, in urban environments, this assumption no longer holds true due to unplanned WiFi AP deployment [2]. Figure 1(bottom) illustrates the WiFi Analyzer's output from inside a shopping mall. Finding a CTI-free ZigBee channel can become quite expensive due to periodic channel estimation and sometimes may not be available at all.

To this end, we design Oppcast, a data collection protocol that carefully exploits spatial and channel diversity to provide: (1) reduced energy consumption because of the elimination of channel estimation, (2) improved robustness
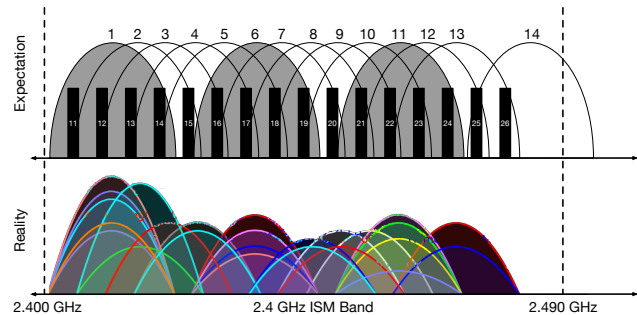
Figure 1: Depiction of the extent of WiFi interference in a shopping mall.

to CTI because of multi-channel communication, and (3) reduced latency because of the usage of opportunistic routing.

Preliminary evaluation of Oppcast against state-of-the-art data collection protocol ORPL [1] in various urban environments like a Car park, a residential complex, a shopping mall and a cafeteria shows that Oppcast not only achieves robustness to CTI prevalent in such settings but also provides up to 2.4 times energy efficiency.

2. DEMONSTRATION

We implement Oppcast on Contiki using its Rime stack to provide light-weight communication between the nodes. In the demonstration, we aim to illustrate the robustness of data collection application based on Oppcast. We will deploy a TelosB network, where each node would periodically send data to a Sink multiple hops away by exploiting multiple routes over multiple channels. Sink, which is connected to a laptop, will display the real-time protocol performance along with the CTI due to WiFi at the venue.

3. ACKNOWLEDGEMENT

4. REFERENCES

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