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Leveraging Multi-radio Communication for Mobile Wireless Sensor Networks

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Abstract

An important challenge in mobile sensor networks is to enable energy-efficient communication over a diversity of distances while being robust to wireless effects caused by node mobility. In this thesis, we argue that the pairing of two complementary radios with heterogeneous range characteristics enables greater range and interference diversity at lower energy cost than a single radio. We make three contributions towards the design of such multi-radio mobile sensor systems. First, we present the design of a novel reinforcement learning-based link layer algorithm that continually learns channel characteristics and dynamically decides when to switch between radios. Second, we describe a simple protocol that translates the benefits of the adaptive link layer into practice in an energy-efficient manner. Third, we present the design of Arthropod, a mote-class sensor platform that combines two such heterogeneous radios (XE1205 and CC2420) and our implementation of the Q-learning based switching protocol in TinyOS 2.0. Using experiments conducted in a variety of urban and forested environments, we show that our system achieves up to 52% energy gains over a single radio system while handling node mobility. Our results also show that our system can handle short, medium and long-term wireless interference in such environments.

First Advisor

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