TECHNISCHE HOCHSCHULE
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UNIVERSITY OF
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Mittuniversitetet
MID SWEDEN UNIVERSITY

Fachbereich Elektrotechnik und Technische Informatik
Department of Electrical Engineering and Computer Science

Studienarbeit Master
Lukas Martenvormfelde

A Jamming- and Interference-aware Channel Assignment Scheme for Wireless Sensor Networks

Abstract

An increasing number of connected wireless devices in industrial as well as consumer products leads to a high utilization of the unlicensed spectrum. Furthermore, wireless devices are exposed to physical layer attacks performed with high powered jamming systems. To overcome the issue of a crowded spectrum and therefore colliding wireless transmissions, more flexible and reliable Wireless Communication System (WCS) are a need for digitalization due to a lower wiring effort. Several research activities contributed approaches for Interference Detection and Identification (IDI) as well as dynamic resource allocation. However, the majority of the proposed algorithms requires additional hardware for spectrum sensing or the determination of the channel states.

In this work, a Received Signal Strength Indicator (RSSI) based sampling is performed on a low-cost IEEE 802.15.4 compliant Wireless Sensor Network (WSN) device. A spectrum estimation is performed to extract the bandwidth and the length of appearing bursts and assign new channels based on the results. Hence, the sampling and the calculation is performed on a battery driven device without additional hardware.

The experimental setting contains two nodes acting as a transmitter with periodic transmit intervals and a receiver performing a spectrum estimation. The next channel to use and an updated blacklist is shared through three redundant feedback messages per period. A jammer emits 20 MHz wide periodic pulses of Gaussian noise with a length of 10 ms. As real-time communication reliability metrics for the evaluation of the Channel Assignment Scheme (CAS), the (n, k)-Ratio is calculated and the consecutive errors are considered. The result of the experiment shows that the performance increases the (n, k)-Ratio to approximately 75% in comparison to 50% without the CAS. The number of consecutive errors drops significantly so that most of the errors appear as single errors.

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