

RESEARCH PROJECT

Energy Saving Concepts for Wireless Sensor Networks

Motivation and Background

Wireless sensor networks usually consist of small sensor nodes that are limited to low-power hardware and run off battery. A large portion of the overall energy consumption is caused by the wireless transmission and reception of data from neighboring sensor nodes, or central base stations or servers. Due to the nature of wireless communication systems, idle listening – a state where a node is ready for reception but no data is being transmitted – causes a huge power drain in the whole system. In order to reduce the overall energy consumption of the communication system, the medium access (MAC) needs to be optimized to lower the energy consumption while keeping negative effects on prime metrics of wireless communication systems (data rate, latency, reliability) at low levels. When looking at the literature, many approaches have investigated the challenges of energy saving mechanisms in context of wireless networks by adapting the behavior of the MAC [2, 4, 5, 3], or targeting even novel approaches employing Wake-Up Receivers or energy saving mechanisms on the physical layer [1]. To this point, many concepts of energy saving mechanisms of wireless sensor networks developed in the last decade also had their influence in modern IEEE 802.11 WLAN-based systems, e.g. WiFi 6 and IoT based systems.

Thus, a detailed overview energy saving concepts of wireless systems spanning from wireless sensor networks up to IoT systems is the main target of this Research project.

Research Project Goals

The goal of this research project is to create a literature overview of the different concepts for energy saving by medium access optimization. This is being done by writing a project report in the form of a seminar thesis. Besides the literature review, a brief software simulation is to be created to successfully finish the research project. In this simulation, the discrete event simulator OMNeT++¹ and the INET framework² are to be used to implement and evaluate various approaches described in the literature part. The goal of the implementation part of the research project is to get a basic understanding of how software simulations in the networking context are designed,

implemented, tested, conducted and evaluated. At the end of this research project, the student compares the concepts of energy saving mechanisms from the literature to the own simulation results and presents a detailed evaluation of the gathered results in a qualitative and quantitative way. After the research project, the student will have acquired a deep understanding of the inspected concepts and a basic working knowledge regarding network simulations using OMNeT++ and its INET framework.

Required knowledge (or willing to learn)

- C++ programming experience
- Usage of a statistic evaluation language (e.g., R)
- A basic understanding of wireless communication principles and technologies
- Scientific literature review, and writing

References

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- [3] A. Roy and N. Sarma. Energy saving in mac layer of wireless sensor networks: a survey. In *National Workshop in Design and Analysis of Algorithm (NWDAA)*, Tezpur University, India, volume 96, 2010.
- [4] L. Tang, Y. Sun, O. Gurewitz, and D. Johnson. PW-MAC: An energy-efficient predictive-wakeup MAC protocol for wireless sensor networks. In *30th IEEE Conference on Computer Communications (INFOCOM 2011)*, pages 1305–1313, Shanghai, China, 4 2011. IEEE.
- [5] W. Ye, J. Heidemann, and D. Estrin. An Energy-Efficient MAC Protocol for Wireless Sensor Networks. In *21st IEEE Conference on Computer Communications (INFOCOM 2002)*, pages 1567–1576, New York City, NY, 6 2002. IEEE.

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¹<https://omnetpp.org/>

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