

Abstract

Wireless Sensor Networks appear as a technology, which provides the basis for a broad field of applications, drawing interest in various areas. On the one hand, they appear to allow the next step in computer networks, building large collections of simple objects, exchanging information with respect to their environment or their own state. On the other hand, their ability to sense and communicate without a fixed physical infrastructure makes them an attractive technology to be used for measurement systems.

Although the interest in Wireless Sensor Network research is increasing, and new concepts and applications are being demonstrated, several fundamental issues remain unsolved. While many of these issues do not require to be solved for proof-of-concept designs, they are important issues to be addressed when referring to the long-term operation of these systems. One of these issues is the system's lifetime, which relates to the lifetime of the nodes, upon which the system is composed.

This thesis focuses on node lifetime extension based on energy management. While some constraints and results might hold true from a more general perspective, the main application target involves environmental measurement systems based on Wireless Sensor Networks. Lifetime extension possibilities, which are the result of application characteristics, by (i) reducing energy consumption and (ii) utilizing energy harvesting are to be presented. For energy consumption, we show how precise task scheduling due to node synchronization, combined with methods such as duty cycling and power domains, can optimize the overall energy use. With reference to the energy supply, the focus lies on solar-based solutions with special attention placed on their feasibility at locations with limited solar radiation. Further dimensioning of these systems is addressed.

It will be shown, that for the presented application scenarios, near-perpetual node lifetime can be obtained. This is achieved by focusing on efficient resource usage and by means of a carefully designed energy supply.