Chapter 11


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ABSTRACT

As the Wireless Sensor Network is a form of the realization of the Ambient Intelligence system vision where computation, control, and communication are embedded into the physical environment such that the resulting interaction paradigms is person-to-physical world paradigm, the Wireless Sensor Network covers a wide range of applications. Current and future application areas include habitat and environment monitoring, disaster control and operation, military applications, object tracking, video surveillance, traffic control, industrial surveillance and automation, as well as health care, and home automation. One of the main functionalities of Wireless Sensor Network applications is gathering sensory data about the physical environment regardless of the application field and the nature of gathered data and the required processing on it.

When developing a Wireless Sensor Network, a number of design factors have to be considered in the design process, such as, fault tolerance, scalability, production cost, operating environment, network topology, hardware constraints, transmission media, and power consumption; the key challenge a Wireless Sensor Network has to deal with is energy efficiency because sensor nodes typically are battery-

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powered, and it may not be possible to change or recharge batteries; so, the protocols and algorithms used should be energy-efficient.

But, as the energy-efficiency is critical for periodical data gathering applications in wireless sensor networks, it has the highest priority in algorithms design; also the latency, packet loss, and throughput are important factors and should be addressed. This chapter proposes a routing protocol inspired by an energy-efficient cluster-based routing protocol called Energy-Aware Routing Protocol (EAP). The new enhanced protocol that is called Low Loss Energy-Aware Routing Protocol (LLEAP) enhances the performance of EAP in terms of some quality of service parameters by adding a second iteration for constructing the tree structure for multi-hop communication among cluster heads, by modifying the used weights of the cluster heads and parent node selection, and finally by selecting suitable aggregation method to decrease losses and delay. Simulation results showed that LLEAP significantly outperforms EAP in terms of packet loss percentage by on average 93.4%.

INTRODUCTION

A Wireless Sensor Network (WSN) typically consists of a large number of low-cost, low-power, and multifunctional devices called sensor nodes and one or more sinks; sensor nodes are not just sensors, but sensors are one of their components. Sensor nodes consist of the components which make them eligible as network entities. These sensor nodes usually densely deployed in an ad hoc manner in a field of interest (this field is called a sensor field) to perform distributed sensing and information processing. Sensor nodes communicate over a short distance via a wireless medium and collaborate to accomplish a common task, for example, environment monitoring, battlefield surveillance, and industrial process control. A sink, on the other hand, does not generate any data by itself but collects data from sensor nodes. A sink can be regarded as a gateway between a sensor network and other networks such as the Internet, or an interface between a sensor network and the people who operate the sensor network (Wang, 2010, p. 9).

WSN routing especially won and still owns a large interest in the research field, particularly because the routing protocol may be different for different WSN applications while these applications are many and vary in their characteristics and requirements, and on top of that, the routing protocols used in traditional data networks whether wired or wireless (even Ad Hoc networks) are not suitable for use as they are for WSN applications to the WSN of differences, requirements, and constraints on the design. The key challenge WSN routing has to deal with is the energy efficiency and prolonging network lifetime.

Hierarchical communication among sensor nodes by clustering them is more scalable, energy-efficient, lower in latency, better in terms of network lifetime than flat communication. This chapter presents a routing protocol inspired by another energy-efficient hierarchical cluster-based routing protocol proposed already in literature; this protocol is called Energy-Aware routing Protocol (EAP). EAP meets several important requirements for a clustering algorithm. It was proved that EAP performance is better than Low-Energy Adaptive Clustering Hierarchy (LEACH) performance in terms of network lifetime. The new protocol that is called Low Loss Energy-Aware routing Protocol (LLEAP) enhances EAP in terms of packet loss percentage, throughput, and end to end delay.
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