

Inter-Intra Cluster Multihop-LEACH Routing In Self-Organizing Wireless Sensor Networks

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Abstract: Wireless Sensor Networks have emerged in the past decade as a result of recent advances in microelectronic system fabrication, wireless communications, integrated circuit technologies, microprocessor hardware and nano-technology, progress in ad-hoc networking routing protocols, distributed signal processing, pervasive computing, and embedded systems. Recent advances in Wireless Sensor Networks have led to many new protocols specifically designed for routing, since routing protocols differ depending on the application and network architecture. Efficient routing in a sensor network requires that the routing protocol must minimize energy dissipation and maximize network life time. In this paper we have implemented a cluster based routing protocol Multihop-LEACH which does inter cluster and intra cluster multi-hopping. The protocol is evaluated using TinyOs and TOSSIM simulator. Evaluation results reveal that Multihop-LEACH protocol utilizes less power and least delay. The connectivity, success rate and power utilization of Multihop-LEACH is further improved by increasing the probability of clustering.

Keywords: Multihop, Multihop-LEACH, TinyOS, NesC, TOSSIM Probability and Clustering.

1. Introduction

Sensor networks have emerged as a promising tool for monitoring the physical worlds, utilizing self-organizing networks of battery-powered wireless sensors that can sense, process and communicate. Wireless sensor networks [1] consist of small low power nodes with sensing, computational and wireless communications capabilities that can be deployed randomly or deterministically in an area from which the users wish to collect data. Typically, wireless sensor networks contain hundreds or thousands of sensor nodes that are generally identical. These sensor nodes have the ability to communicate either among each other or directly to a base station (BS). The sensor network is highly distributed and the nodes are lightweight. Intuitively, a greater number of sensors will enable sensing over a larger area. As the manufacturing of small, low-cost sensors become increasingly technically and economically feasible, a large number of these sensors can be networked to operate cooperatively unattended for a variety of applications like military applications, disaster management, habitat monitoring, health applications, home applications etc [21]. The features of sensor networks [2] are as depicted below.

- *Varying network size* – The size of a sensor network can vary from one to thousands of nodes.

- *Low cost* – For the deployment of sensor nodes in large numbers, a sensor node should be inexpensive.
- *Long lifetime network* – An important characteristic of a sensor network is to design and implement efficient protocols so that the network can last as long as possible.
- *Self-organization* – Sensor nodes should be able to organize and form a network automatically without any external configuration.
- *Query and re-tasking* – The user should be able to query for special events in a specific area, or remove obsolete tasks from specific sensors and assign them with new tasks. This saves a lot of energy when the tasks change frequently.
- *Cooperation/Data aggregation* – Sensor nodes should be able to work together and aggregate their data in a meaningful way. This could improve the network efficiency.
- *Application awareness* – A sensor network is not a general purpose network. It only serves specific applications.
- *Data centric* – Data collected by sensor nodes in an area may overlap, which may consume significant energy. To prevent this, a route should be found in a way that allows in-network consolidation of redundant data.

Recent advances in wireless sensor networks have led to many new protocols specifically designed for sensor networks. Most of the attention, however, has been given to the routing protocols since they might differ depending on the application and network architecture [3, 4]. To prolong the lifetime of the sensor nodes, designing efficient routing protocols is critical. Even though sensor networks are primarily designed for monitoring and reporting events, since they are application dependent, a single routing protocol cannot be efficient for sensor networks across all applications. Multihop routing technique is the first step towards minimizing energy consumption in sensor networks. Clustering and data aggregation are also important techniques in minimizing the energy consumption in sensor networks [12, 13, 14].

In this paper we describe and implement a cluster based multihop routing protocol Multihop-LEACH. Multihop-LEACH performs both inter cluster and intra cluster multi-hopping. The performance evaluation and comparison with considering all the characteristics that should be possessed by routing protocols reveals the important features that need to be taken into consideration while designing new routing