

Chapter 10

Energy Efficient Routing Protocols in Wireless Sensor Networks: A Survey

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ABSTRACT

This research presents a survey of energy efficient routing protocols in sensor network by categorizing into a main classification as architecture based routing. Architecture based routing is further classified into two main areas: flat or location based routing protocol, and hierarchical based routing protocols. Flat based routing is more suitable when a huge number of sensor nodes are deployed, and location based routing is employed when nodes are aware of their location. Hierarchical routing look into alternative approach by placing intermediate nodes in terms of cluster heads, gateway nodes, or mobile entities for efficient handling of energy. The survey is presented in order to highlight the advantage of hierarchical based routing, mainly the deployment of mobility routing. As not many surveys have been conducted in mobility based routing, this chapter can be helpful for looking into a new perspective and paradigm of energy efficient routing protocols.

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INTRODUCTION

Sensor networks are facing many challenging issues such as routing failure, routing holes, energy depletion and network failure. Among this energy depletion should be given careful attention as this factor contributes mainly to other issues mentioned above. When sensor nodes run out of energy, the nodes go into sleep mode or dies completely. And this yield to routing hole around the network which leads to network failure. So energy efficient operation in sensor network needs careful attention and further consideration in order to provide power efficient, increased lifetime of the network. There are many researches and contributions performed in terms of energy efficient sensor network routing protocol. But there are still factors to be considered in increasing the lifetime of sensor.

Sensor networks are deployed to create “smart environments” which are useful in monitoring conditions such as temperature, sound, movement, location, light and others (Youssef et al. 2002). Wireless sensor network (WSN) differs from traditional network in terms of energy constraint of battery-backed sensors. In most of the situation, sensor nodes operate based on powered batteries and has limited capabilities as well. The design of these sensor nodes and batteries need to be compromised based on the size and cost. The higher capacity batteries can last longer but increases the size of the sensor node and the cost as well. Smaller batteries might not last longer and reduces the lifetime of the node. Sensor battery lifetime is directly related to the lifetime of the node and therefore affects the lifetime of the entire sensor network as well.

Routing in WSN differs from traditional and mobile ad hoc routing in which the latter two do not have energy as constraint in terms of routing. Whereas in WSN, since sensor nodes are energy constraint, routing path should be carefully planned to avoid having the same node to be the routing agent. But one of the potential problems with current routing protocols is that it looks for

the lowest energy route and uses it for the entire communication. This leads to energy depletion at these nodes and reduces network life time (Sha et al. 2005). When considering extending the lifetime of the node and the network, energy efficiency of routing protocols is an issue (Gui & Mohapatra 2003). When energy at sensor node is depleted, the node becomes inactive or dies and this leads to routing holes in sensor network. Routing hole refers to the areas where data cannot be routed since there are no active nodes available. Most of the protocols proposed for energy efficient operation in sensor network looks into using existing architecture of fixed sensor nodes and base station. Although this architecture looks simple and efficient in terms of sensing and relaying data, there are many problems associated with it. Among those, this architecture uses multihop routing for conveying sensed data to the base station. In this case, the static base station uses more power for its receivers and more energy is utilized by other nodes to send data to the base station thus reduces network lifetime. More over when the base station is static, nodes closest to the sink and nodes which are connecting two parts of the network are utilized the most and runs out of energy first. This causes routing hole near the base station which would eventually cause network failure.

The unique characteristics of sensor network with battery-supported energy, less computing power, less prone to failure and collaborative information processing makes it different from traditional TCP/IP network. These characteristics are the basic factors for the need of a unique routing protocol in WSN to look into energy-efficiency as one of the important criteria. And most of the past research activities in WSN routing basically looks into one single criterion, i.e. energy-efficient routing, fault-tolerant routing, geographic routing etc. But there are four factors which are considered essential for good routing protocol: i) energy efficiency ii) load balancing iii) fault tolerance and iv) scalability. Based on these four important parameters, the survey in this paper is classified

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