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A survey on energy efficient coverage protocols in wireless sensor networks

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Abstract A Wireless Sensor Network (WSN) is used to monitor an area for events. Each node in the WSN has a sensing range and a communication range. The sensing coverage of a sensor node is the area determined by the sensing range of the sensor node. Sensing coverage of the network is the collective coverage of the sensor nodes in a WSN. Sufficient number of sensor nodes need to be deployed to ensure adequate coverage of a region. Further, since sensor nodes have limited battery life, it is also essential to reduce the energy consumption. This would help improve the network lifetime and thus the coverage lifetime. To reduce energy consumption in the WSN, some of the nodes with overlapping sensing areas could be turned off using a coverage optimization protocol. In this paper, we discuss various coverage optimization protocols. These protocols are broadly classified as *clustering* and *distributed* protocols. Further, these protocols are classified based on the type of sensing model used, node location information, and mechanism used to determine neighboring node information (based on probe or computational geometry). In this paper, we review the key coverage optimization protocols and present open research issues related to energy efficient coverage.

Contents

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1. Introduction

Wireless Sensor Networks (WSNs) have been widely considered as one of the most important technologies for the twenty-first century (Zheng and Jamalipour, 2009; Chong and Srikanta, 2003). A typical Wireless Sensor Network (WSN) (Zheng and Jamalipour, 2009; Chuan et al., 2012; Raghavendra et al., 2011; Akkaya and Younis, 2005) consists of a large number low cost, multi-functional sensor nodes typically operate on limited battery power and are deployed to monitor an area of interest. These sensor nodes are typically small in size with inbuilt micro-controllers and radio transceivers. Thus, sensor nodes have the ability to sense external events, process the sensed data and transmit it. WSNs are widely used for environmental condition monitoring, security surveillance of battle-fields, wildlife habitat monitoring, etc. (Mulligan and Ammari, 2010). A WSN has the following characteristics:

- Dense Node Deployment: Sensor nodes are usually densely deployed in an area to be monitored. The number of sensor nodes in a sensor network is usually higher than that of a MANET (Chlamtac et al., 2003; Hoebeke et al., 2004).
- Limited Energy Resources: Sensor nodes are usually powered with small batteries. In certain applications, they are deployed in a harsh or hostile environment, where it would be very difficult or even impossible to replace or recharge the node batteries.