Lifetime and Coverage Studies on Wireless Sensor Networks

Ashraf Hossain, Dept. of E&ECE, IIT Kharagpur, India

Abstract of the Thesis–

The nodes in a wireless sensor network (WSN) are generally energy constrained, as the battery of a node may not be recharged or replaced. The lifetime of such a network is limited by the energy dissipated by individual nodes during signal processing and communication with other nodes. The issues of modeling a sensor network and assessment of its lifetime have received considerable attention in recent years. Another important performance metric of WSN is network coverage. It depends on several factors including sensing model that has been used to design the network model.

The issues of lifetime and coverage have been addressed in the thesis. It has been observed that non-uniform energy drainage pattern affects network lifetime. Thus, equal energy consumption condition has been imposed. An exhaustive energy dissipation model is considered to study network lifetime and other performance metrics. Regular and random node placement schemes are extensively studied. It has been observed that our proposed scheme provides 2.4 and 1.6 times lifetime improvement with respect to other reported node placement schemes under comparable conditions. Equal energy consumption condition has been extended to a wireless image sensor network. The issue of network coverage and impact of node failure are investigated for three major sensing models, viz. Boolean, shadow-fading and Elfes sensing model. Temporal variation of network coverage is also studied. A strategy to obtain constant coverage is proposed. Our proposed strategy provides constant coverage for a period of time which is about 40 times when compared with uniform deployment of nodes with single hop and multi-hop communications.

Keywords: clustering, coverage, data gathering network, equal energy dissipation condition, lifetime, node failure, regular placement, random placement, sensing model, wireless sensor network.