“Sleep Scheduling In Wireless Sensor Networks”

By: Seyed Amir Yahyavi Firouz Abadi

Supervisor: Dr. Nasser Yazdani

Field: Information Technology

Date: 15 July 2008

Abstract of M.Sc. Thesis:

The main challenge in wireless sensor networks is to reduce the energy consumption of the methods that were previously used in wireless and ad-hoc networks. One of the most common methods to reduce the energy consumption of nodes is to put them to sleep when their workload is not heavy. Putting nodes to sleep may be done in various layers and unit of the sensor nodes and have different effects on how the network operates. Putting the transmitter unit can save a lot of energy but may have longer delay or increase the data loss. Turning off the sensing unit would also save a great deal of energy but may result in lower coverage, lower accuracy and higher response time. Since usually sensor networks are supposed to work many times more than a sensor nodes life in active mode we have no choice but to put sensor nodes into sleep. In such cases we have to find methods to reduce the problems that arise because of this fact. These methods try to improve the way network operates in different layers.

Maximum energy saving is possible through putting transmitter unit to sleep. MAC protocol manages the operation of this unit. Several MAC protocols have been designed specifically for WSNs. S-MAC is one of well known MAC protocols specifically designed for WSNs. In this MAC nodes use Sleep/Active periods to save energy. This approach increases the data transmission delay in network and makes it unusable for delay sensitive applications. Several methods that only rely on MAC layer data have been proposed to deal with this problem. Since MAC layer does not have enough information about the networks situation, Load, etc it is not able to adjust itself to the network’s current state. Therefore, we need information that is only available in higher layers. Several routing protocols have been proposed for multihop sensor networks that try to reduce the energy consumption. One of the common and data-centric approaches in these networks is Directed Diffusion. By using routing layer information we can better adjust the duty cycle of MAC protocol and change it according to the network’s state. Therefore we use Directed Diffusion’s information to adjust the activity of transmitter unit so that we can achieve an energy efficient model with acceptable delay and balanced load.

In the application layer by adjusting the activity in this layer we can reduce the energy consumption. If the nodes have the ability to control the sensing unit’s operation separately by scheduling its activity we can achieve energy savings. One of the main applications of WSNs is surveillance and target tracking. Several methods to provide full coverage over an area have been proposed. Since the number of deployed nodes is usually orders of magnitude larger than the required number of nodes to provide the requested coverage we can put some of them to sleep and in order to provide the requested coverage we can switch between various nodes. Several deterministic and probabilistic approaches have been proposed to provide 1-coverage and k-coverage. Probabilistic approaches usually have lower overhead since they needs less control messages between neighbor nodes. In this layer by using a probabilistic approach for different node distributions (Random Uniform, Poisson, Grid) we provide the required coverage. By dynamically calculating the required wakeup probability to provide k-coverage in each cycle we achieve very high energy savings.