Chapter 6
Power Conservation Techniques in Wireless Sensor Networks

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ABSTRACT
This chapter discusses power conservation problems in Wireless Sensor Networks (WSNs). The problem arises from the fact that WSNs have limited energy since sensors are powered with small batteries (due to the sensor size constraints). Currently, some energy-efficiency methods focus on reducing energy consumption by designing sensor hardware. Other methods enable sensors to communicate with each other in an efficient manner by developing new communication protocols. Some communication protocols need to have extra information such as sensor locations for determining the best possible relays to deliver data to a Base Station. In this chapter we will first provide a survey on current power conservation methods. We will then discuss the efficiency and effectiveness of these methods, and propose possible solutions. Finally, we conclude the chapter with concluding remarks and open issues.

INTRODUCTION
Due to the recent advancements in the wireless networks, and the manufacturing of small, costless and energy-efficient devices, WSNs have been developing in a rapid speed. WSNs consist of a large number of energy-limited sensors that are used to monitor some area. Since WSNs are comprised of a large number of collaborating sensors (usually in the order of thousands), the cost of these sensors needs to be minimized. These sensors usually operate in areas where it is difficult for humans to work in. For example, WSNs are used to monitor a battle field, monitor the temperature fluctuations in the south and north poles, and work for extended periods in high temperature deserts. One of the future applications for WSNs is to be deployed in space or on the surface of planets.

Due to the size and cost constraints, the sensors are powered with small batteries. These batteries do not hold much energy in them. Also, since the sensors operate in usually inaccessible territories,
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Figure 1. A typical WSN

it is not possible to change the sensors’ batteries. Therefore, power conservation is important to reduce energy consumption in the WSN environment. The main goal for energy conservation is to enable sensors work for the longest possible time (i.e. network life time) while maintaining the quality of service (QoS). The QoS in the WSN environment refers to the network ability to cover 100% of the area that’s being monitored.

Figure 1 shows a typical WSN. Usually WSNs have several hundred sensors and a Base Station. The function of the sensors is to collect data and send it to the Base Station. Another function for the sensors is to serve as a bridge between other sensors and the Base Station. The reason for the need of relays is because the communication range for a sensor is very limited due to energy constraints. In addition, the required energy to transmit data grows with the increase of the transmission range. In a WSN, all of the sensors’ data will be sent to a Base Station. The Base Station collects the information, organizes them, deletes any redundant information, and put the information in a readable format for users to read. Usually the Base Station has higher processing capability than the scattered sensors. It also has larger size and more stored energy, and may have a power link that provides with constant power supply.

Figure 2. Sensors with their transmission ranges