

# Chapter 4

## Routing Protocols in Wireless Sensor Networks

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### ABSTRACT

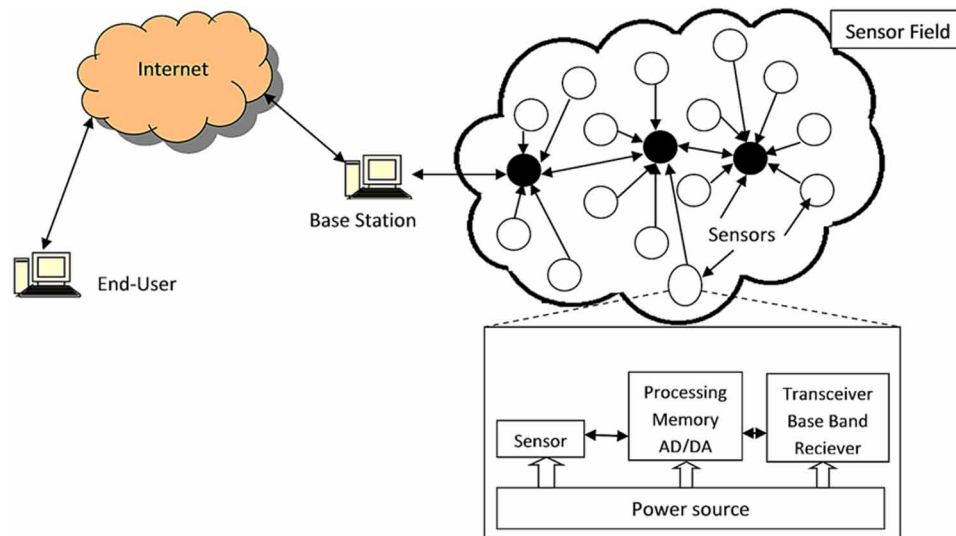
*In Wireless Sensor Network (WSN), the routing protocols have been given attention because most of the routing protocols are application and architecture dependent. This chapter presents routing protocols for wireless sensor networks and also classifies routing in WSN. Chapter gives five main classifications of routing protocols in WSN which are data-centric, hierarchical, location-based, network flow and QoS aware and opportunistic routing protocols. The focus has been given on advancement of routing in WSN in form of opportunistic routing, in which the sensor nodes utilize broadcasting nature of wireless links and the data packets can be transmitted through different paths. The routing protocols for WSN are described and discussed under the appropriate classification. A table of comparison of routing protocols on the basis of power usage, data aggregation, scalability, query basis, overhead, data delivery model and QoS parameters has been presented.*

### INTRODUCTION

The recent advancements in the micro-electro-mechanical systems (MEMS) technology, communication techniques in wireless networks and nanotechnology give arise to develop small sensor nodes that are low-cost multifunctional energy constrained devices (Akkaya & Younis, 2005; Akyildiz, Su, Sankarasubramaniam, & Cayirci, 2002). These nodes can communicate over radio frequencies in small distances. The sensors constitute sensing, data processing and communicating hardware and software components. *Wireless Sensor networks* (WSN) are the dense collection of such sensors. The WSNs gather and communicate the physical or chemical data to monitor and control physical or chemical environments from remote stations with accuracy.

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Figure 1. Wireless sensor network example



In most of the applications the position of the sensors need not to be engineered or pre-determined and this allows the distribution of the sensor nodes randomly. The WSN left unattended in most of the applications for long time. Hence, the protocols designed for WSN must contain the self-organizing capabilities. Rather than sending only raw data the sensor nodes should also be capable of carrying out some simple computations on raw data and transmit only the useful data towards the sink/base station.

Networking the unattended densely scattered sensor nodes has significant impact on many applications like disaster management, security, battle field surveillance (Dargie & Poellabauer, 2010). Routing WSN is very challenging task because WSNs are having different characteristics than conventional networks. First of all, as the sensor nodes are randomly deployed, global addressing is not possible. Hence, the user cannot apply classical IP-based protocols to WSNs. Second, the sensor nodes are constrained with respect to energy, transmission power, processing capacity, and storage capacity and therefore require resource management. Third, in contrast to classical communication in networks, the communications in WSN always require the flow of data from multiple sensor nodes (sources) towards the sink/base stations (Figure 1). Fourth, the data gathered from different regions in WSN have significant redundancy because multiple sensor nodes can generate the same data within particular area of deployment. Due to these types of differences, to solve the problem of data routing in WSN many algorithms has been proposed till date. These algorithms consider almost every characteristic of WSN. The sensor nodes organize themselves to form different topologies for communication which are discussed in the following section along with communication framework.

The organization of chapter is as follows. Rest of this section will briefly summarize the communication in WSN and classification of routing protocols in WSN. In the Section 2, various design issues for routing protocols in WSNs are covered. Section 3 summarizes all types of routing protocols available under different classifications like Data centric, hierarchical, location based, Network flow and QoS, and opportunistic routing. Section 4 concludes the chapter with comparison tables of the studied routing algorithms and points out the good approach for routing in WSN.

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