Chapter 11
Wireless Sensor Networks:
Concepts, Analysis, Routing, and Applications

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ABSTRACT

Wireless sensor networks (WSNs) can be classified among the blazing domains of research in the recent era. WSNs have enormous day-to-day life real-time applications due their low priced, self-computing, powerful, autonomous small sensor nodes which have a small storage capacity, restricted non-removable non-rechargeable battery, and a restricted computational capacity. The applicability of WSNs are in almost all domains, like observing environmental conditions, human healthcare tracking systems, position tracking and monitoring, industry automation, process tracking and controlling, tracking and monitoring objects, mammal, human being, and control, and many more. This chapter briefly explores the basic concepts, components, network architecture, design issues, challenges, routing protocols, application domains, implemented applications, etc. in the field of WSNs. It also focuses on the performance evaluation parameters to check, analyze, diagnose, examine, and determine the performance of WSNs. At the end, the chapter concludes with the scope of research in the field of wireless sensor networks.

INTRODUCTION

Nowadays, Wireless Sensor Networks (WSNs) (Buratti et al., 2009), (Yick et al., 2008), become more trendy, rising and one of the blazing research areas because of its broad variety of application in large areas. These types of networks (Akyildiz et al., 2007), (Puccinelli & Haenggi, 2005) are mainly composed of a very small, economical, low powered, non-rechargeable, non-removable onboard battery driven, autonomous, supportive, distributed sensor nodes that are designed for an application specific task. These types of nodes are deployed densely in big number in a region of application, as shown in

Figure 1, from where the important data is to be gathered and sent to the sink node or base station (BS) which is generally located away from this region (Akyildiz et al., 2002), (Akyildiz et al., 2002). The data collected from these types of sensor nodes can be further processed and analyzed. In such types of networks (Tilak, 2002), there is no fixed network infrastructure, that's why the sensor nodes must support and cooperate to accomplish communication, global control and information aggregation.

Generally, a sensor node (Akyildiz & Vuran, 2010) normally consists of four modules: a sensing unit for data acquirement from the region of interest, a small computational unit to process the sensed data, a communication unit to transmit the sensed data and a power unit consisting of a non- rechargeable, non-removable limited onboard battery. It may also have some additional components like mobilzer, a GPS system, power generator etc., which can be integrated in the basic model of sensor node depending on the type of applications. Figure 2 shows hardware structure of such type of node. The components of a sensor are described below.

- **Power Unit:** It is the main driving force of the sensor node. It usually consists of a non-removable, non-rechargeable limited energy supply battery. Other energy sources can also be used for power supply in special cases. As the power supply is limited and cannot be remove or recharge, it must be used in efficient way by the each and every component of the sensor.
- **Sensing Unit:** Depending on the type of application, this unit is designed to acquire desired information from the physical surrounding environment, such as sound, temperature, light, humidity etc. This unit is normally comprised of two sub modules: the actual sensor unit and a unit to convert analog data to digital (ADC). Generally, in most of the sensors the data produced by the sensors is in analog form, to convert these analog data into digital form an ADC unit is used. The final processed data by sensing unit is then provided as an input to the processing unit.
- **Processing Unit:** The processing unit is the controlling unit of the node which is responsible for the processing of the sensed information, like run related algorithms and handle the procedures that allow the node to perform sensing operations and work together with other nodes for wireless

Figure 1. Sample Structures of Wireless Sensor Networks
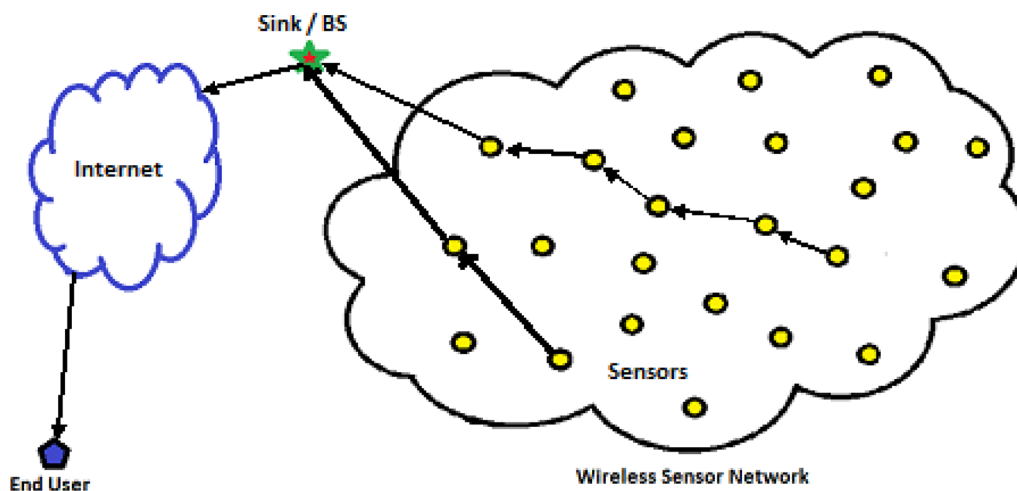
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