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A Detail Review on Wireless Sensor Network

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ABSTRACT: Wireless sensor networks are harshly restricted by storage capacity, energy and computing power. So it is essential to design effective and energy aware protocol in order to enhance the network lifetime. In this paper, a review on routing protocol in WSNs is carried out which are classified as data-centric, hierarchical and location based depending on the network structure. Then some of the multipath routing protocols which are widely used in WSNs to improve network performance are also discussed. Advantages and disadvantages of each routing algorithm are discussed thereafter. Furthermore, this paper compares and summarizes the performances of routing protocols.
Keywords*: DSN, MANET, GPS, WSN.*

I. INTRODUCTION

A Wireless Sensor Network is a special kind of wireless network consisting of small and spatially distributed autonomous devices (nodes) which can cooperatively sense physical phenomena around them [5]. A sensor network is defined as a composition of a large number of low cost, low power multi-functional sensor nodes which are highly distributed either inside the system or very close to it. Nodes which are very small in size consist of sensing, data processing and communicating components. The position of these tiny nodes need not be absolute; this not only gives random placement but also means that protocols of sensor networks and its algorithms must possess self organizing abilities in inaccessible areas. Distributed or dispersed sensor networks (DSNs) have recently emerged as an important research area.

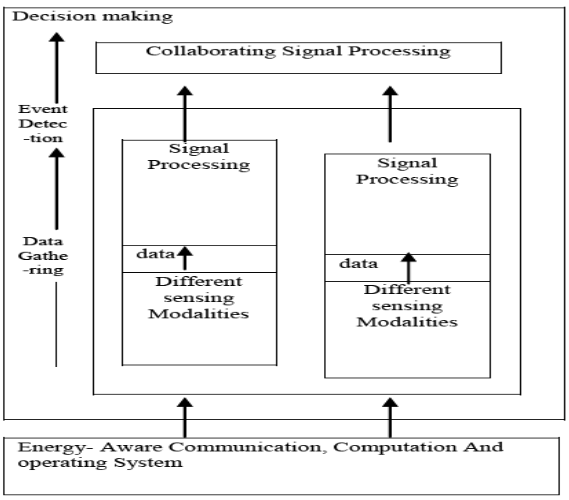

Figure 1: Wireless Sensor Network

This development has been spurred by advances in sensor technology and computer networking. It is economically feasible to implement DSNs, but there are several technical challenges that must be overcome before DSNs can be used for today's increasingly complex information gathering tasks. These tasks, across a wide spectrum of both civilian and military applications, include environment monitoring, scene reconstruction, motion tracking, motion detection, battlefield surveillance, remote sensing, global awareness, etc. They are usually time-critical, cover a large geographical area, and require reliable delivery of accurate information for their completion. It also processes the collected data and effectively route them to the nearest sinks or gateway node. It consists of a large number of densely deployed sensor nodes [1]. Each node in the sensor network may consist of one or more sensors, a low power radio, portable power supply, and possibly localization hardware, such as a GPS (Global Positioning System) unit or a ranging device. These nodes incorporate wireless transceivers so that communication and networking are enabled. Additionally, the network possesses self-organizing capability. Ideally, individual nodes should be battery powered with a long lifetime and should cost very little. A key feature of such networks is that their nodes are unmetered and unattended. Consequently, they have limited and non-replenish able energy resources. Therefore, energy efficiency is an important design consideration for these networks. In addition to one or more sensors, each node in a wireless sensor network is typically equipped with a radio transceiver or other wireless communications device, a small microcontroller, and an energy source, usually a battery. The size a single sensor node can vary from shoebox-sized nodes down to devices the size of grain of dust. The cost of sensor nodes is similarly variable, ranging from hundreds of dollars to a few cents, depending on the size of the sensor network and the complexity required of individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and bandwidth.

II. CLASSIFICATION OF SENSORS

The sensors are classified into three categories.

Passive, Omni Directional Sensors: Passive sensors sense the data without actually manipulating the environment by active probing. They are self powered i.e. energy is needed only to amplify their analog signal. There is no notion of "direction" involved in these measurements.

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Passive, narrow-beam sensors: These sensors are passive but they have well-defined notion of direction of measurement. Typical example is 'camera'.

Active Sensors: This group of sensors actively probes the environment, for example, a solar or radar sensor or some type of seismic sensor, which generate shock waves by small explosions.

III. ROUTING CHALLENGES IN WIRELESS SENSOR NETWORKS

Due to reduced computing, radio and battery resources of sensors, routing protocols in wireless sensor network are expected to fulfill the following requirement:

a) Data delivery model: Data delivery model overcomes the problem of fault tolerance domain by providing the alternative path to save its data packets from nodes or link failures [6]**.** It severely affect the routing protocol in wireless sensor network, especially with regard to use the limited energy of the node, security purpose [7], energy consumption and route immobility.

b) Scalability: A system is said to be scalable if its effectiveness increases when the hardware is put-on and proportional to the capacity added [8]. Routing schemes make efforts with the vast collection of motes in WSNs which should be scalable enough to talk back to the events take Place in the environment.

c) Resilience: Sometimes, due to environment problem or battery consumption sensors erratically stop working [9]. This problem is overcome by finding the alternate path when current-in use nodes stop operating.

d) Production cost: The cost of single node is enough to justify the overall cost of the sensor network. So the cost of each sensor node should be kept low.

e) Operating environment: Sensor network can be setup inside large machinery, at the base of the ocean, in a biologically or chemically contaminated field, in the battle field behind enemy line, in big building or warehouse etc.

f) Power consumption: Requirement such as long life time of sensor networks and restricted
storage capacity of sensor nodes has directed to search a new scope to alleviate power
consumption. Sidra Aslam discussed several schemes such as power aware protocol, cross-layer optimization, and harvesting technologies which help in reducing power consumption constraint in WSNs [10]. In multi-hop sensor networks, the multi-functioning of some nodes such as data sender and data router can cause topology change due to power failure which require new path for data transfer and restructure the network.

g) Data aggression/fusion: The main goal of data aggregation algorithms is to gather and aggregate data from different sources by using different functions such as suppression, min, max and average to achieve energy efficient and traffic optimization in routing protocols so that network lifetime is enhanced [11].

IV. WIRELESS SENSOR NETWORKS ARCHITECTURE

There are a number of different topologies for radio Communication networks. A brief discussion of the network topologies that apply to wireless sensor networks are outlined below.

A. ***Star Network (Single Point-to-Multipoint):*** A star network (Figure 1) is a communications topology where a single base station can send and/or receive a message to a number of remote nodes. The remote nodes can only send or receive a message from the single base station; they are not permitted to send messages to each other. The advantage of this type of network for wireless sensor networks is in its simplicity and the ability to keep the remote node's power consumption to a minimum. It also allows for low latency communications between the remote node and the base station. The disadvantage of such a network is that the base station must be within radio transmission range of all the individual nodes and is not as robust as other networks due to its dependency on a single node to manage the network.

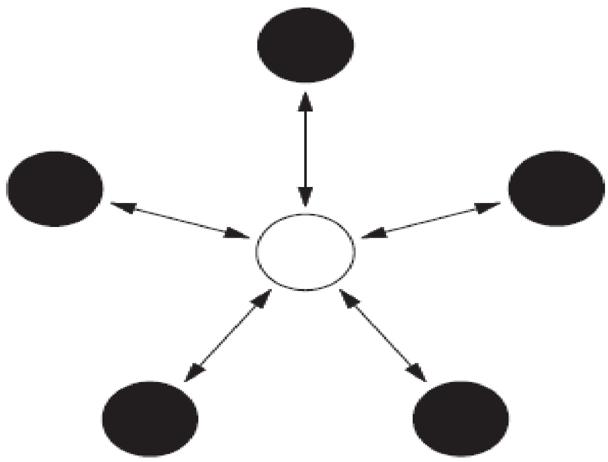

Figure 2: Star Network

B. Mesh Network: A mesh network allows for any node in the network to transmit to any other node in the network that is within its radio transmission range. This allows for what is known as multi-hop communications; that is, if a node wants to send a message to another node that is out of radio communications range, it can use an intermediate node to forward the message to the desired node. This network topology has the advantage of redundancy and scalability.

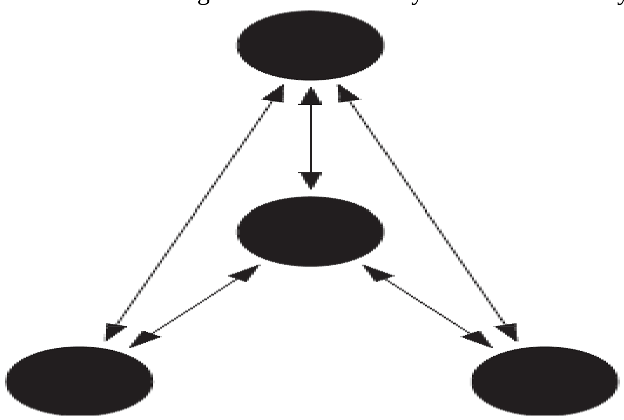

Figure 3: Mesh Network

If an individual node fails, a remote node still can communicate to any other node in its range, which in turn, can forward the message to the desired location. In addition, the range of the network is not necessarily limited by the range in between single nodes; it can simply be extended by adding more nodes to the system. The disadvantage of this type of network is in power consumption for the nodes that implement the multichip communications are generally higher than for the nodes that don't have this capability, often limiting the battery life. Additionally, as the number of communication hops to a destination increases, the time to deliver the message also increases, especially if low power operation of the nodes is a requirement.

C. Hybrid Star – Mesh Network: A hybrid between the star and mesh network provides for a robust and versatile communications network, while maintaining the ability to keep the wireless sensor nodes power consumption to a minimum. In this network topology, the lowest power sensor nodes are not enabled with the ability to forward messages. This allows for minimal power consumption to be maintained. However, other nodes on the network are enabled with multi-hop capability, allowing them to forward messages from the low power nodes to other nodes on the network. Generally, the nodes with the multi-hop capability are higher power, and if possible, are often plugged into the electrical mains line.

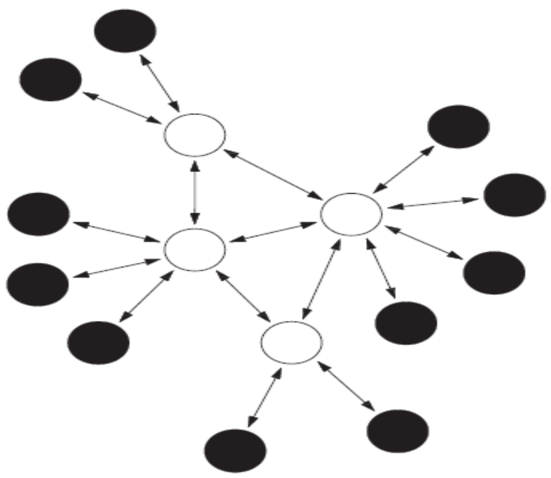

Figure 4: Hybrid Star-Mesh Network

V. FUTURE DEVELOPMENTS

The most general and versatile deployments of wireless sensing networks demand that batteries be deployed. Future work is being performed on systems that exploit piezoelectric materials to harvest ambient strain energy for energy storage in capacitors and/or rechargeable batteries. By combining smart, energy saving electronics with advanced thin film battery chemistries that permit infinite recharge cycles, these Systems could provide a long term, maintenance free, wireless monitoring solution

V. CONCLUSION

Wireless sensor networks are enabling applications that previously were not practical. As new standards based networks are released and low power systems are continually developed, we will start to see the widespread deployment of wireless sensor networks. Sensor nodes can be imagined as small computers, extremely basic in terms of their interfaces and their components. In computer science and telecommunications, wireless sensor networks are an active research area with numerous workshops and conferences arranged each year. All of this sensor network research is producing a new technology which is already appearing in many practical

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