Star Topology as Central Topology in a Hybrid Model

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***Abstract*— In the past decade wireless sensor network have been an interesting and important research area. Configuration and maintenance of wireless sensor networks are complicated by random deployment of sensor nodes. Sensor nodes gather data about the physical environment around them. After processing of data it is necessary to communicate with other sensor nodes and ultimately to the user. There are some basic topologies such as mesh, star, ring, bus used for communication. In this paper I advocate a model which uses a star topology over a mesh topology for communication within a sensor field as well as communication between sensor fields.**

***Keywords*— Sensor field, Sensor nodes, Topology, Physical environment, Communication**

I. INTRODUCTION

Recent advancement in wireless communications and electronics have enabled the development of low cost, low power, multifunctional sensor nodes that are small in size and communicate in short distance. A sensor network can be divided into sensor fields for rapid communication of data, easy fault detection and most importantly addition of new sensor fields to accommodate further deployment of sensor nodes.

This article is divided into two parts where the first part discusses about the data communication over a single sensor field using traditional individual wireless network topologies. The second part discusses about my proposed model and its analysis.

II. WIRELESS SENSOR NETWORK TOPOLOGIES

The deployment and development of wireless sensor network have made an enhanced application of basic network topologies. In this section a brief idea of sensor field and basic wireless sensor network topologies is given.

A. Sensor Node

Sensor Node is a basic unit in a sensor network with on-board sensors, processors, memory, wireless modem and power supply. Some of the other features of sensor nodes are as follows:

- Sensor nodes are .low power, low cost, multifunctional electronic device.
- Sensor nodes are densely populated
- Sensor nodes are small in size and communicate in small distances.
- The topology of a sensor network changes very frequently.

B. Sensor Field

Sensor nodes are deployed over a particular physical environment. However it is necessary to define an area over which the physical environment is analysed. The analysis is done to achieve a behavioural pattern, if possible. The behavioural pattern is analysed by communication of data between nodes deployed within the area in consideration The area over which the behavioural pattern of the physical environment is analysed is known as sensor field.

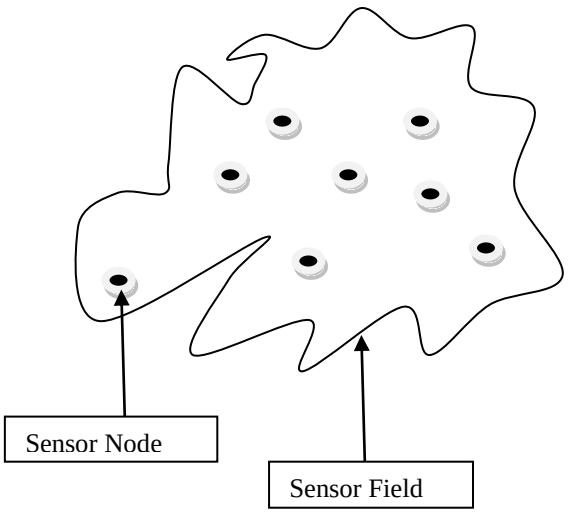

Figure 1: Sensor Field

C. Basic Wireless Sensor Network Topologies

The figure given below shows six network topologies generally used for communication between nodes.

1) Bus-In the bus topology shown in figure 2 the data messages will be broadcasted on the bus to all the nodes from the coordinator node. When the node receives it checks the destination address in the message header and then decides whether the message is for itself or some other node. In this topology each node simple listens for the data messages and is not responsible for retransmitting any messages if any message is lost, thus the being a passive topology.

2) Ring - In the ring topology shown in Figure 2 all sensor nodes perform the same function and there is no coordinator node. Messages generally travel around the ring in a single direction. But if any link of the ring is cut, the entire communication is broken.

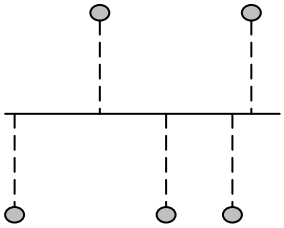

Figure 2: Bus

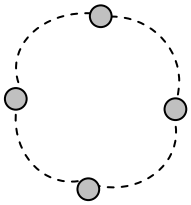

Figure 3: Ring

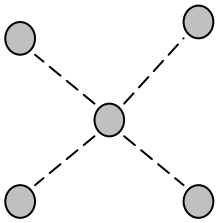

Figure 4: Star

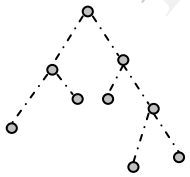

Figure 5: Tree

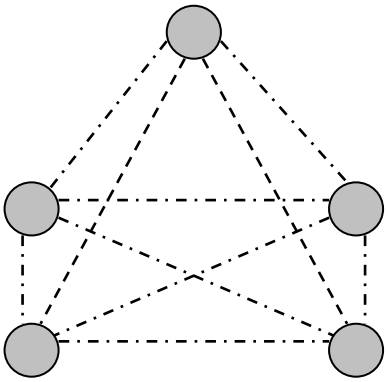

Figure 6: Mesh

3) Star-Many wireless sensor network use the star topology. A star network features a central connection point called a "hub node". Devices typically connect to the hub. A failure in any pair of star network-hub node connection will only take down one node communication network access and not the entire network. However If the central node fails the entire network also fails. In such a situation another node has to be considered as hub node and new connection pairs are established.

4) Tree-Tree networks use a central hub called a root node as the main communications router. One level down from the root node in the hierarchy is a central hub. This lower level then forms a star network. The tree network can be considered a hybrid of both the Star and Peer to Peer networking topologies.

5) Mesh- A network setup where each sensor node is interconnected with one another, allowing for most transmissions to be distributed, even if one of the connections goes down. This topology is not commonly used for most computer networks as it is difficult and expensive to have redundant connection to every computer. However, this topology is commonly used for wireless networks.

III. PROPOSED MODEL

In the previous section the various data transmission topologies that are followed within a wireless sensor field are described. In such a situation we can consider any one node to be the gateway node and communicate with the outside server to analyse the geological recordings obtained within the sensor field. In such a scenario if the gateway node goes down the information obtained from the sensor field cannot be transmitted to the outside world. Moreover the basic data transmission topologies do not cater to the needs of analysing patterns of a geographical area consisting of various sensor fields.

The proposed model deals with multiple sensor fields. The gateway nodes of each sensor field acts as a prime sensor node for the corresponding sensor field. Let P_1 be the prime sensor node for S_1 sensor field, P_2 for S_2 and so on until the n^{th} sensor field. In this model the sensor node acquire data and transmits the data among them including the prime node by following any of the basic topological models. The proposed model extends the concept of star topology to each sensor field. A central server node may be deployed so that each p_i's connect with the central server node to transmit its information. Whenever any p_i fails the other P_i's continue to communicate with the central server node so that the process of data acquisition and analysis continues. If it is necessary to cover larger geographical area additional sensor nodes are deployed within new sensor field created. A sensor node is selected as the prime node, say P_{i+1} and a connection link is established between the central server node and P_{i+1}.The central server node after analysing the geological pattern of the whole area in contention and transmits it to the outer world for further analysis. The star topology provides an efficient mode of data transmission within a wireless sensor network.

IV. CONCLUSION

The proposed model may be considered as a hybrid model with star topology as the central topology for data transmission between various sensor fields. There are other hybrid models which keeps the mesh topology as central model. Comparative analysis in terms of efficiency in data transmission in various hybrid models can be considered for future work.

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