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Enhancing Life-Time of Wireless Sensor Networks Using Improved GSTEB Routing Protocol

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Abstract *— Wireless sensor network (WSN) is a system composed of a large number of low-cost micro-sensors. This network is used to collect and send various kinds of messages to a base station (BS). WSN consists of low-cost nodes with limited battery power, and the battery replacement is not easy with thousands of physically embedded nodes, which means energy efficient routing protocol should be employed to offer a long network life time. The lifetime of Wireless Sensor Networks (WSN) is crucial, so we need not only to minimize total energy consumption but also to balance WSN load. Researchers have proposed many protocols such as LEACH, HEED, PEGASIS, TBC, PEDAP and GSTEB. In this paper, we propose an improved General Self-Organized Tree-Based Energy-Balance routing protocol which builds number of clusters in network and in each cluster GSTEB implemented and encryption is used for security purpose. Simulation results show that improved GSTEB has a better performance than GSTEB thus prolonging the lifetime of WSN.*

Keywords*-Energy balance, Network life time, routing protocol and wireless sensor network*

I. INTRODUCTION

Wireless sensor network (WSN) is a popular area for research now days, due to vast potential usage of sensor networks in different areas. With the advances in Micro-Electro-Mechanical Systems (MEMS)-based sensor technology, low-power digital electronics and low-power wireless communication it is now possible to produce wireless sensor nodes in quantity at low cost[1][2][3]. Although these sensor nodes are not as powerful or accurate as their expensive macro-sensor counter parts, we are able to build a high quality, fault-tolerant sensor network by making thousands of sensor nodes work together. Through the cooperation of wireless sensor nodes, WSN collects large amounts of information and sends them to the Base Station (BS). A sensor network is a comprised of sensing, processing, communication ability which helps to observe, instrument, react to events and phenomena in a specified environment. This kind of network enables to connect the physical world to environment. By networking tiny sensor nodes, it becomes easy to obtain the data about physical phenomena which was very much difficult with conventional ways. Wireless sensor network typically consist of tens to thousands of nodes. These nodes collect process and cooperatively pass this collected information to a central location. WSNs have unique characteristics such as low duty cycle, power constraints and limited battery life, redundant data acquisition, heterogeneity of sensor nodes, mobility of nodes, and dynamic network topology, etc. Applications of WSNs exists in variety of fields including environmental applications, medical monitoring, home security, surveillance, military applications, air traffic control, industrial and manufacturing automation, process control, inventory management, distributed robotics, disaster prediction, environment monitoring etc. surveillance, military applications, air traffic control, industrial and manufacturing automation, process control, inventory management, distributed robotics, disaster prediction, environment monitoring etc.

II NETWORK AND RADIO MODEL

In our work, we assume that the system model has the following properties

• N sensor node distributes in square field giving coordinates to each and there is only one BS deployed far away from the area.
• Sensor nodes are stationary and energy constrained. Once deployed, they will keep operating until their energy is exhausted.
• BS is stationary, but BS is not energy constrained.
• All sensor nodes have power control capabilities each node can change the power level and communicate with BS directly.
• Sensor nodes are location-aware. A sensor node can get its location information through other mechanisms such as GPS or position algorithms.

• Each node has its unique identifier (ID).

2.1 Energy Model Analysis

The energy consumption of transmitting a k-bit packet to a distance d and receiving that packet is:

Transmitting $ETx(k,d) = Eelec*k + \epsilon amp*k*d^2$

Receiving $ERx(k) = Eelec*k$

Where Eelec is the electronics energy i.e. energy dissipated to run the electronics circuits, which depends upon factors such as digital coding, modulation, filtering and spreading of the signal, whereas amplifier energy ϵamp depends upon the distance to the receiver and the acceptable bit error rate.

III IMPROVED GENERAL SELF ORGANIZED TREE-BASED ENERGY BALANCE ROUTING PROTOCOL

In Initial Phase, BS assigns a root node and broadcasts its ID and its coordinates to all sensor nodes. Then in Tree Constructing Phase, the network computes the path either by transmitting the path information from BS to sensor nodes or by having the same tree structure being dynamically and individually built by each node[4]. Sensor nodes are randomly distributed in the square field and there is only one BS deployed far away from the area. Sensor nodes are stationary and energy constrained. Once deployed, they will keep operating until their energy is exhausted. The proposed algorithm CGSTEB consists of the phases which are similar to existing GSTEB in addition we will be using Clustering and Encryption.

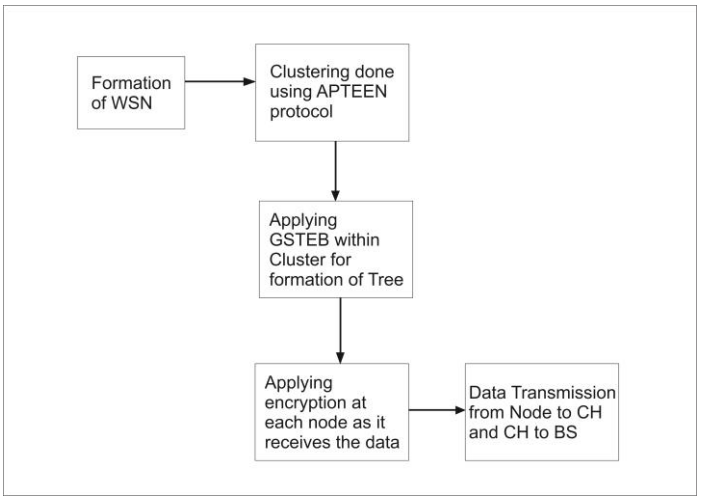

Figure1. Network architecture of CGSTEB

A. CLUSTER FORMATION

The network parameters are initialized and the nodes are formed into group of Clusters using concept of APTEEN. Depending on the size of the network and number of sensor nodes, divided into n numbers of clusters while each node select its cluster head on basis of energy level and distance[5][6].

Main features of such architecture are:

• All the nodes need to transmit only to their immediate cluster-head, thus saving energy.

• Only the cluster head needs to perform additional computations on the data such as aggregation, etc. So, energy is conserved.

• The cluster members of a cluster are mostly adjacent to each other and sense similar data and are aggregated by the CH.

• CHs at increasing levels in the hierarchy need to transmit data over relatively larger distances. To distribute this consumption evenly, all nodes take turns becoming the CH [7].

• Since only the CHs need to know how to route the data towards its higher level CH or the BS, it reduces its routing complexity.

B. FORMATION OF TREE

Formation of tree using GSTEB, Data is being transmitted from sensor node to CH, If CH is away from BS then to avoid wastage of energy CH transmit data to the another CH which is closed to BS. During transmission of data for security purpose we use encryption at every node, where data is being encrypted at energy node which are participating in data transmission, finally data received by BS and decrypted at BS using node ID of participated nodes.

• Initial Phase
• Tree Constructing Phase
•Self-Organized Data Collecting and Transmission Phase
•Information Exchanging Phase using Encryption

C. ENCRYPTION

As data is being transferred from node to node, every time it is encrypted. Encryption Key is nothing but Node ID.XOR operation is performed at each receiving node using message bits and Node ID. At base station decryption occurs again by using Node Id which were participant of data transmission process.

IV SIMULATION RESULTS

Simulation parameters of the project are mentioned in Table 1.

Table 1.Simulation Parameter

1	Simulation Area	500*500
2	No of Nodes	100
3	Radio Propagation Model	Two ray ground
4	Channel Type	Channel/ Wireless channel
5	Antenna Model	Antenna/Omni antenna
6	Interface Queue Type	Queue/Drop Tail/PriQueue
7	Topology	Flat grid

A. NETWORK THROUGHPUT

It is the amount of data moved successfully from one place to another in a given time period, and typically measured in bits per second (bps). Hence number of transmitting byte increases throughput increases and vice versa Fig. shows the performance of the GSTEB and CGSTEB with Enc. The graph is of number of nodes node versus Throughput. The graphs shows throughput of CGSTEB is better than GSTEB. Table2 shows values of throughput for different scenarios.

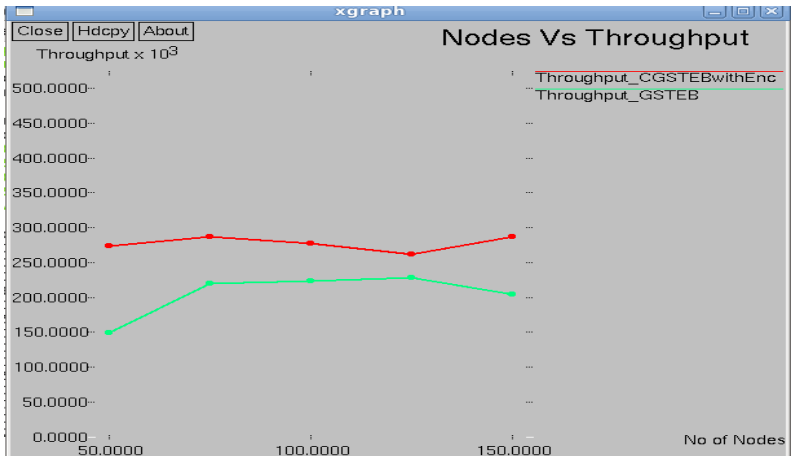

Figure 2.Throughputs of GSTEB and CGSTEBwithEnc

Table 2: Throughput

Number of nodes	Throughput_CGSTEBwithEnc	Throughput _GSTEB
50	274080	148800
75	287360	220160
100	277440	223040
125	261760	228480
150	287040	204320

B. PACKET DELIVERY RATIO

Packet delivery ratio is the ratio of the number of delivered data packet to the destination. This illustrates the level of delivered data to the destination.∑ Number of packet receive / ∑ Number of packet send. The greater value of packet delivery ratio means the better performance of the protocol. We are calculating percent value of it. Fig.3 shows the PDR values for different scenarios. Table 4 gives us various values of PDR it also shows the values of CGSTEB are better than GSTEB

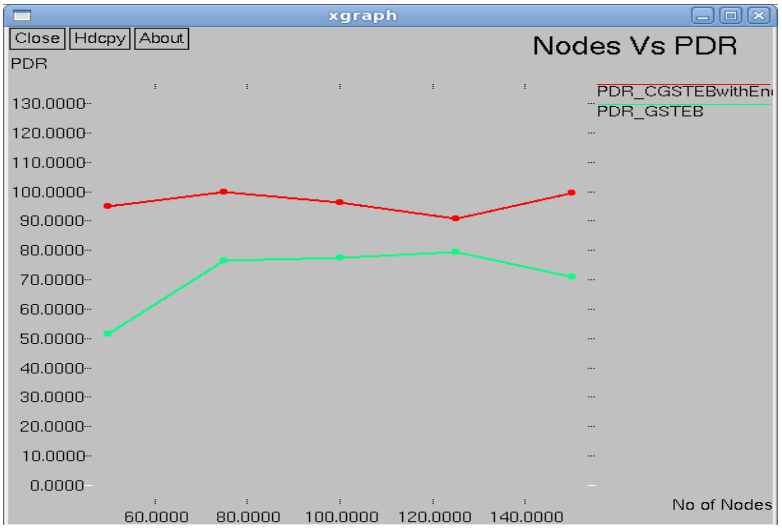

Figure 3. PDR of GSTEB and CGSTEBwithEnc

Table 3: Packet Delivery Ratio

Number of nodes	PDR_CGSTEBwithEnc	PDR_GSTEB
50	95.1138	51.638
75	99.7224	76.402
100	96.2798	77.4014
125	90.8384	79.2893
150	99.6113	70.9051

C. Delay

Network delay is an important design and performance characteristic of a computer network or telecommunications network. The delay of a network specifies how long it takes for a bit of data to travel across the network from one node or endpoint to another. It is typically measured in multiples or fractions of seconds. It also includes the delay caused by route discovery process and the queue in data packet transmission. Only the data packets that successfully delivered to destinations that counted. Table5 and Fig4 shows that GSTEB has more delay than CGSTEB.

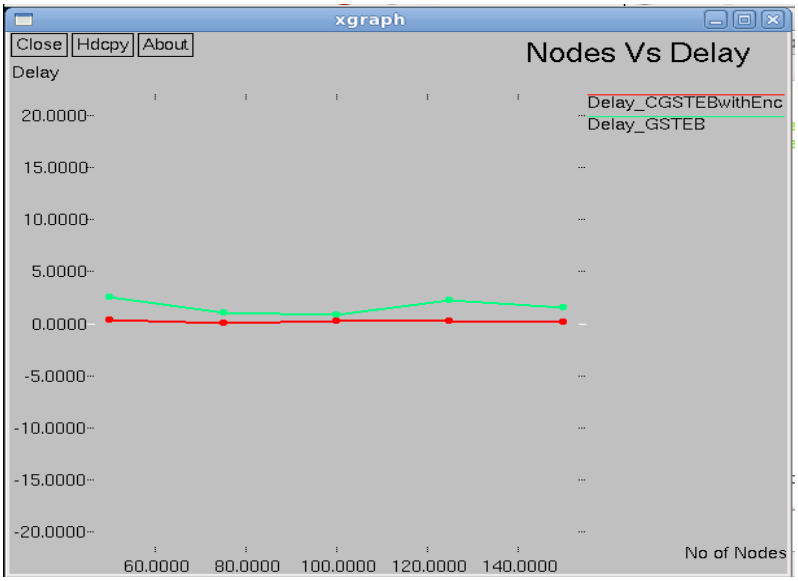

Figure 4. Delay of GSTEB and CGSTEBwithEnc

Table 4: Delay

Number of nodes	Delay_CGSTEBwithEnc	Delay_GSTEB
50	0.358381	2.55226
75	0.0328641	1.0571
100	0.289855	0.886027
125	0.221324	2.26456
150	0.181667	1.57796

V CONCLUSION

A wireless sensor network is a group of small sensor nodes which communicate through radio interface. These sensor nodes are composed of sensing, computation, communication and power as four basic working units. There are various types of restrictions on Wireless sensor networks, but limited energy, communication capability, storage and bandwidth are the main resource constraints. When we try to reduce energy consumption it leads to energy imbalance and leads to partition network which will degrade network performance and thus reduce network performance. Number of protocols proposed to design to get efficient energy balanced routing. In our project we have used existing protocols to make one improved protocol so that disadvantages of existing protocol can be overcome by it. If we compare the various parameter like Throughput, PDR, Delay, Control overheads etc. Values of CGSTEB are better GSTEB. We have work for stationary nodes also having fixed coordinates in future we can try to develop or study the performance for mobile Nodes.

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