An Evolutionary Optimization Technique For Energy And Throughput In WSN Using GSTEB Protocol

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Abstract **- It is a crucial challenge of providing high data rates with minimum energy consumption for future generation of WSNs in order to improve the network lifetime. These two issues can be combinely literature only by few researchers. Various protocols are used to extend lifetime of the wireless sensor networks (WSN) and sensor nodes are used effectively to transfer information to the base station. Protocols such as LEACH, LEACH-C and HEED are used to extend the life existence time of the system. In this paper we develop an optimization framework for throughput and energy consumption using GSTEB protocol. Although different protocols has been proposed earlier to enhance the throughput and energy efficiency more yet in the mean time a lot of upgrade must be achieved. GSTEB has shown fairly significant results over the on hand WSN protocols. Simulation results demonstrates that GSTEB overhauls the system performance than other protocols by adjusting the throughput and energy consumption thus broadenning the existence time of the system.**

Keywords- Energy Balance, Energy Consumption ,Network Lifetime, Network Simulator, Self-Organized Routing Protocol Wireless Sensor Network

I. INTRODUCTION

The importance of WSN emerges from their capacity of detailed monitoring of sensor nodes in remote and difficult to reach areas where it is not possible to provide traditional wired network structure or periodically provide battery backup to the nodes. WSN provides An extensive variety of applications including disaster prevention and military observations.

In last few years, researchers have been proposed by an unique class of improvised networks popularly known as Wireless Sensor Network arising from the restrained ability of low powered battery run nodes to operate for a longer time period. Nowadays most of the active research in computer science and telecommunication is the region of WSN. Architecture of WSN is shown in Fig.1.

Three major things WSN do –

i. Sense the data
ii. Aggregate the data
iii. Route the data to the gateway or base station or sink

The entire WSN is actually build of more number of low energy wireless devices popularly known as sensor nodes, path connecting edges and base station or sink. Particular distinctiveness of WSN is the restricted power as well as bandwidth assets, elevated compactness of nodule exploitation, cheap and unpredictable sensor nodes that responsible for the size and costs of the sensor nodes. These sensor nodes communicate and collect the data which is further send to the sink as required. The purpose of target sensor node is to send the required data for a specific region.

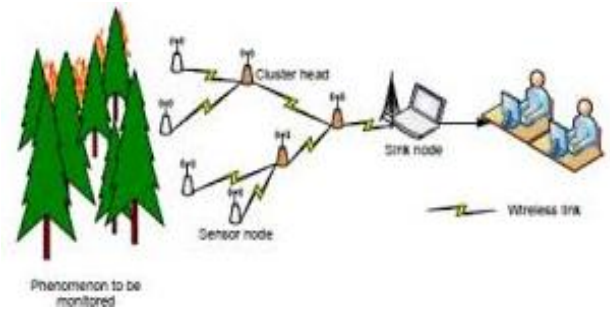

Fig.1. Architecture of WSN

By satellite communication, sink send all the information to the client who makes use of internet. Wireless Sensor Networks are widely used in various real time applications such as wireless road applications, fitness analysis, wireless smoke sensors, power Control Sensor Network, Smart Grid-net, Smart city center networks etc. The data starts from unlike sensor nodes amassed mutually in the sink node during transmission. Wireless Sensor Network comprises of several number of sensor nodes that are being employed in an environment to monitor the parameters like Temperature, Humidity, Pressure, Traffic etc.

 DOI : 10.18231/2454-9150.2018.1333

Sensor networks are employed in wide range of applications like environmental, military, home security [1] etc. Instead of using WSNs in various applications it has many restrictions like limited supply of energy, limited computational power and bandwidth of the wireless links[2].The major constraint is energy consumption. Numerous protocols are proposed for upgrading the throughput, energy consumption and lifetime of the network for example, LEACH, HEED, PEGASIS and PEDAP. The above mentioned protocols employs various methods for improving the lifetime of the network. In this paper we propose a GSTEB protocol. A General Self Organized Tree Based Energy-Balance routing protocol is utilized to get extended lifetime of the network. In each round,a root node of base station is being alloted by the base station and its ID is communicated and it facilitates with all sensor nodes .

PEDAP [8] is a tree-based steering protocol that makes every one of the nodes to create a minimum spanning tree, which costs least energy for information transmitting. It additionally has another adaptation called PEDAP-PA which somewhat increases energy for information transmiting yet balances energy consumptions per node. PEDAP has a similar system presumptions as PEGASIS and it uses information fusion. In any case, both PEDAP and PEDAP-PA are protocols that need BS to create the framework which will leads to more energy loss. This is on account of if system needs BS to form the topography, BS ought to send more amount of data to the sensor nodes, includes time of the Time Division Multiple Ac-cess (TDMA) slot, information about their child nodes and their parent nodes. This sort of data exchange will make a great deal of energy to be squandered or will cause a long delay.

II. SIGNIFICANCE OF WIRELESS SENSOR NETWORK

Wireless sensor network refers to a group of spatially dispersed and dedicated sensors for monitoring and recording the physical conditions of the environment and organizing the collected data at a central location.

- Data Fusion and Dynamic Inference of Network
- Information Integration of Sensor Networks and Web-Based Services
- Location and Time Services
- New Applications of Sensor Network:
- Environmental Monitoring, Healthcare, Home Automation
- QoS Issues in WSN-Based Integrated Networks
- Reliability of Sensor Network and Failure Analysis
- Routing Protocols for Cross Networks
- Sensor Tasking, Control and Actuation
- Network and Transport Layer Protocols for Cross Networks

III. OVERVIEW OF ROUTING PROTOCOLS

In WSN Hierarchical routing algorithms are used to enhance energy efficiency, throughput and hence it prolong the network lifetime. Routing protocols can be classified based on the architecture of network and its application. Generally routing protocols for WSNs are categorized as [2] [3]

- Hierarchical-based routing protocol
- Flat-based routing protocol
- Mobility based protocols
- Location-based routing protocol
- Heterogeneity-based Protocols
- Multipath based protocols
- QOS-based protocols

Low Energy Adaptive Clustering Hierarchy (LEACH) is one of the oldest hierarchical routing protocol. LEACH is a clustering- based protocol that reduces the energy dissipation in WSNs. It consist of distributed clustering and utilizes randomize rotation of CHs to distribute the uniform energy load in the network [4][5] . The phase of LEACH is split into two phases: set-up and steady phase. In set-up phase cluster is formed, CH is choosed and TDMA schedule is assigned for cluster members. In steady phase transmission of data takes place based on the TDMA schedule [6].

HEED protocol is an enhanced method of LEACH protocol. It is used for developing energy-efficient routing protocol, in which higher level nodes have more residual energy. In HEED, selection of cluster uses two metrics; they are node degree or density to reach balancing of power.

It chooses the CH intermittently relies upon two parameters : essential grouping parameter to choose an underlying arrangement of CHs and secondary parameter to "break ties" among them auxiliary bunching parameters are the function of cluster properties, such as cluster size and whether or not variable power levels are allowable for intercluster communication. Power Efficient Gathering on Information Systems (PEGASIS) is a chain based algorithm. In this method the chain is constructed using a greedy algorithm. Each node collects data from the downstream node and sends it to the higher node through the chain. The PEGASIS protocol shows a better performance than the LEACH protocol [7][8].

Routing protocols	Type	Data Transmission model	Power Consumption	Scalability
LEACH	Hierarchical	Cluster head	High	Good
LEACH-C	Hierarchical	Cluster head	Medium	Good
PEGASIS	Hierarchical	Cluster head	Medium	Good
GSTEB	Hierarchical	Tree based	Low	Good

 DOI : 10.18231/2454-9150.2018.1333

Table 1 : Classification of Hierarchical Routing Protocols in WSN

IV. PROPOSED METHODOLOGY GSTEB

The main objective of GSTEB is to accomplish a more extended network lifetime for different applications and enhance the features of administration parameter. GSTEB protocol is the improvement in the LEACH protocol which selects the cluster head based on energy level of the sensor nodes. The GSTEB work will divide into four stages.

1. Initial stage
2. Tree constructing stage
3. Self-organized data collecting and transmitting stage
4. Information exchange stage

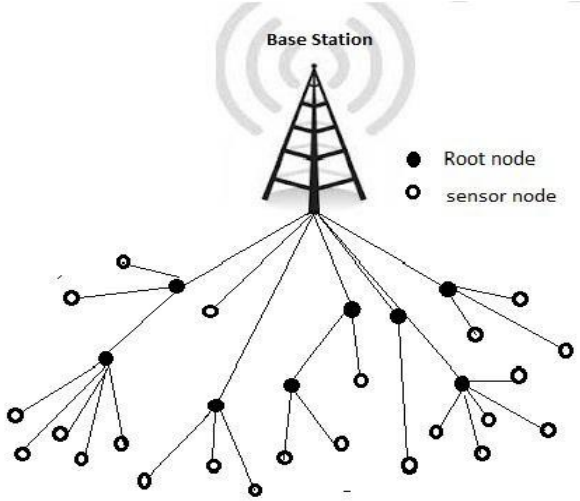

Fig. 2 Architecture of GSTEB protocol

3.1 : INITIAL STAGE PHASE:

At first , base station transmits a packet to every nodes to indicate them of beginning. All nodes send a packet which contains all its neighbors' information during its time slot. At that point its neighbors nodes which get this packet and store the data for future use. After this Phase, GSTEB works in rounds. In each round, the routing tree might be reconstructed and each sensor node produces information packet that should be sent to base station. A round gets completed when information from all the sensor nodes are received by the Base Station.

3.2 : TREE CONSTRUCTING PHASE:

A root node is assigned by Base station. It sends root ID and root coordinates to every sensor nodes. At each round, a node wihich is having more residual energy is chosen as root node. The root gets the information about all sensors nodes and sends the fused information to base station. Each node selects a parent in its neighbors using energy level. The formulae for calculating energy level is given below

EL (i) = [Residual energy(i)/α]

EL is a parameter for load balance, i is the ID of each node, α is a constant which reflects minimum energy unit. The distance between the sensor node and the root nodes must be larger than its parent node and the root nodes, each node selelcts the parent node from its neighbors. Each node will know all information about the neighboring nodes and its child nodes. If any particular node which does not having child node, it considered itself as a leaf node at which the information transmission starts.

3.3 : SELF-ORGANIZED DATA COLLECTION AND TRANSMITTING PHASE

After the formation of routing tree, each sensor node aggregates the data to create an data packet which should be transmitted to base station. After a node gathering information from its child nodes, it act as a leaf node and send the combined information during its time period. The primary segment is used to check if there is correspondence interference for a parent node. In this segment, each leaf node sends a signal which contains its ID to its parent node at the mean time. There are three conceivable outcomes to happen and they split all the parent nodes into three kinds. First possibility is, if there is no need of leaf node to transmit information to the parent node in this particular time period, it does not receives any information. The second possibility is, if only one leaf node has to broadcast data to the parent node, it receives a beacon signal. The third possibility is, if in excess of one leaf node should has to transmit information to the parent node in order to identify the collision .

The activity of the second segment relies upon the three circumstances. During the second segment, the leaf nodes which can transmit their informations are affirmed. For the first probability, the parent node turns to sleep mode until next time schedule starts. In the third Segment, the permitted leaf nodes send their information to their parent nodes, while other leaf nodes goes to sleep mode The parent nodes are selected based on the consumption of energy

3.4 : INFORMATION EXCHANGING PHASE:

In this Phase, every node needs to produce and transmit information packet in each round, before the network ceases to exist. The dying of any sensor node can roll out changes to the topography. So the nodes which are going to die should indicate to other nodes .The process is also splitted into various time slots and in each time slot ,the nodes whose energy is going to be destroyed will determine the arbitrary delay to makes any particular node to broadcast in this time slot. When the delay is ended, these nodes will endeavour to transmit a packet to the whole network. While every single other nodes are search for the channel, they will get this packet and perform an ID check.

On the off chance no such packet is received in the time slot, the network will initiate the next round. After finishing all the rounds in a time slot re-elective clustering is utilized. Re-elective clustering is the way of choosing the CH after each time slot depends upon the remaining

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energy level of every nodes in the network. The above technique is utilize in order to decrease loss of data transmitted over the CH because after completion of every time slot, the energy level of all the nodes includes cluster head is decreased only by less amount. So, the CH is choosed based on the residual energy level so that data can be transferred securely. Hence the energy consumption is minimized and lifetime of the network can be improved.

V. COMPARATIVE ANALYSIS AND SIMULATED RESULTS

For efficiency purpose simulation is done using NS2 (Network Simulator 2). NS2 is a series of discrete event network simulator. NS2 supports simulation of TCP, routing and multicast protocols for wired and wireless networks. Network simulator 2.35 (NS2) can compare the performance analysis of LEACH, LEACH-C and GSTEB. A network model is designed for 40 nodes. These nodes Energy, throughput, delay ratio and packet loss is examined and compared using NS2. Energy consumption, Packet dropping ratio and Throughput are used to evaluate the performance of LEACH-C and GSTEB.

4.1: ENERGY CONSUMPTION:

It indicates how much amount of energy survives in each node, after the transmission of all the packets over a time. Fig.3. shows the comparison results of remaining energy in LEACH-C and GSTEB. In this, GSTEB consumes lower energy when compared to LEACH-C because of distance increases from BS to sensor nodes.

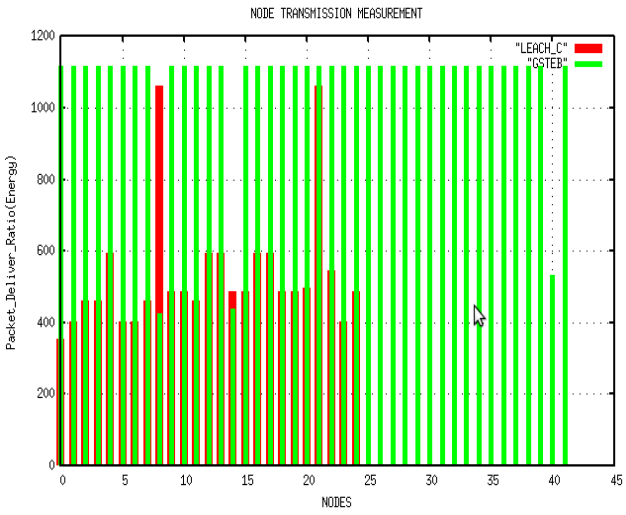

Fig. 3 : Packet Delivery Ratio (Energy) VS No. Of Nodes

4.2 : THROUGHPUT:

Throughput is defined as a total number of packets delivered over the total simulation time. Fig.4 shows the comparison of throughput for GSTEB and LEACH-C. In this, GSTEB provides higher throughput compared to LEACH-C. If time increases LEACH-C will have lower throughput.

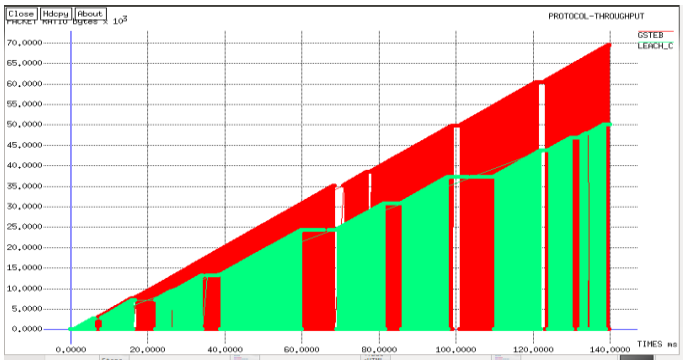

Fig. 4 : Simulation Time VS Loss Rate

4.3 : PACKET DROPPING RATIO:

Packet dropping ratio indicates how much amount of packet drops, after the transmission of all the packets. Fig.5. shows that GSTEB is dropped the packets after 140ms. It provides no packet drops before 30ms. But LEACH-C dropping of packets more compared to GSTEB. The packet droppings occur more when nodes are far away from the BS.

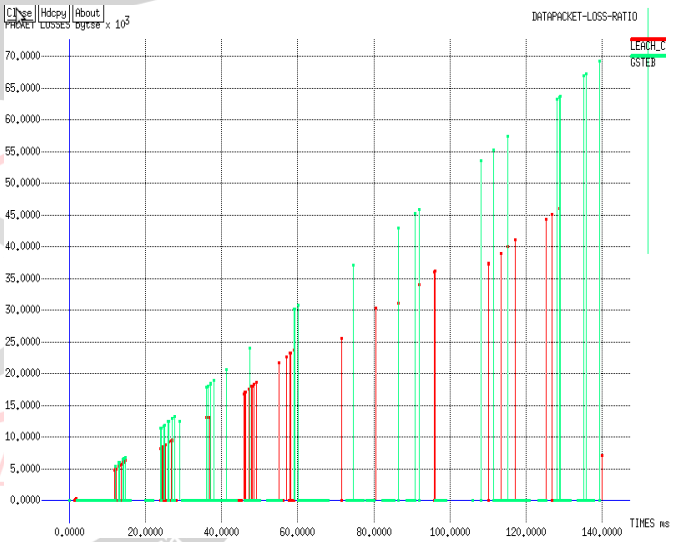

Fig. 5 : Simulation Time VS Packet Delivery Ratio

VI. CONCLUSION

Wireless Sensor Networks consists of many low powered sensor nodes. Although they are used in many applications they have many constraints, such as Inadequate power, limited processing power, limited range, energy supply[13] etc. An important constraint is energy consumption. The simulations show that when the data collected by sensors is strongly correlative, GSTEB outperforms LEACH, PE-GASIS, TREEPSI [9] and TBC. From the results obtained, it is analyzed that GSTEB provides better performance interms of throughput, energy consumption and packet dropping ratio.

The simulation results of energy consumption, packet dropping ratio and throughput in comparison of the LEACH-C and GSTEB protocol it shows that the performance and energy conservation is better when compared to clustering based LEACH-C protocols. But

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GSTEB had the disadvantage of high packet dropping ratio if time increases.In Future Work, GSTEB will be modified with clustering technique, to get a better performance.

VII. ACKNOWLEDGEMENT

I would like to express my special gratitude and thanks to my guide Dr.V.Padmathilagam for her valuable guidance and support.

Then Iwish to express my sincere thanks to my Co-guide Dr.J.Samuel Manoharan for his guidance and suggestions. And also i extend my thanks to my family & friends who supported me to complete this paper.

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