# Performance Evaluation of LEACH, PEGASIS and IEEPB Routing Protocols in Wireless Sensor Networks

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*Abstract*— Sensor webs consist of nodes and have limited battery power. Wireless Sensor Network is deployed to collect useful information from the field. Wireless Sensor Networks have characteristics of low energy consumption, low cost, distributed and self-organization have brought a revolution to the information perception. WSN can be split into two groups that are hierarchical routing and flat routing. It is an ad-hoc network which consists of small Sensor Nodes that possess definite quantity of sensing, computing and transmitting power. Power Efficient Gathering in Sensor Information Systems (PEGASIS) is a near optimal, chain based, hierarchical routing protocol that outperforms Low Energy Adaptive Clustering Hierarchy (LEACH) protocol. Energy Efficient PEGASIS Based (EEPB) protocol and Improved Energy Efficient PEGASIS Based (IEEPB) are two adaptations of PEGASIS protocol.

*Keywords Wireless Sensor Networks, LEACH, PEGASIS, EEPB, IEEPB.*

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## I. INTRODUCTION

Wireless Sensor Networks reside of thousands of Sensor Nodes that encompasses of sensing, processing, transmission, mobilizer, position finding system and power units with some optional components. Sensor networks have a wide variety of applications .The sensor networks can be used in military environment, Home networks, nuclear and explosive material, Disaster management, Medical and health care, Industrial fields, Habitat monitoring, radiological. For example, in a disaster relief operation, sensor nodes are dropped from an aircraft over a wildfire, each node then measures temperature and an overall temperature map can be derived.

Figure 1 shows the schematic diagram of sensor node components in which sensor nodes are shown in small circles. Each sensor node comprises processing, mobilizer, transmission, sensing, position finding system, and power units. Sensor nodes are usually scattered in a sensor field, which is an area where the sensor nodes are deployed.[1]

Each of these scattered sensor nodes has the capability to collect and route data either to other sensors or back to an external base station(s). A base station may be a fixed node or a mobile node capable of connecting the sensor network to an existing communications infrastructure or to the internet where the user can access data.

Low Energy Adaptive Clustering Hierarchy (LEACH) and Power Efficient Gathering in Sensor Information Systems (PEGASIS) are two typical HRPs. Power Efficient Gathering in Sensor Information Systems (PEGASIS), is a near optimal chain based routing protocol for extending the lifetime of the network that outperforms LEACH protocol. In PEGASIS protocol each node only communicates with the nearest node and takes turns while transmitting the data to the BS, hence saving the amount of energy consumed in each round.

After chain formation PEGASIS elects a leader from the chain in terms of residual energy every round to be the one who collects data from neighbours to be transmitted to the base station. As a result, the average energy spent by each node per round is reduced. Unlike LEACH, PEGASIS avoids cluster formation and uses only one node in a chain to transmit to the base station instead of multiple nodes. This approach reduces the overhead and lowers the bandwidth requirements from the BS. Figure 2 shows that only one cluster head leader node forwards the data to the base station. [2]

the nearest node *j* and connects with it to join the chain.

g. Repeat the same steps to connect node *i*+1, *i*+2….and continue this till all sensor nodes have joined the chain.


Figure 2: PEGASIS

**ii. *Leader Selection Phase***

IEEPB chooses the leader by weighting method taking into consideration residual energy of nodes and the distance from node to base station. The steps are as follows:

a) Estimate distance between node and base station. It can be calculated as:

b) PEGASIS protocol has its main applications in characterizing and monitoring the quality of environment. Various other protocols are developed on the basis of PEGASIS protocol such as PDCH, PEGASIS-ANT, H-PEGASIS, EEPB, IEEPB.

$D_{bs}=D_{to(bs)}$

$^4/D$

$^4_{Av}$

## II. DESCRIPTION OF EEPB AND IEEPB PROTOCOL

*A. Energy Efficient PEGASIS Based Protocol (EEPB)*

EEPB protocol is an enhanced version of PEGASIS protocol that considers the average distance between each node from the formed chain. If the distance from the closest node to its upstream is longer than the distance which is calculated from the average distance of the formed chain, the closest node is the "far node". If the closest node unites the chain, it will result in the emergence of Long Link. In this scenario the "far node" will search a nearer node on formed chain. EEPB reduces the long link between the neighbouring nodes by using the distance threshold which is predefined by the user.

*B. Improved Energy Efficient PEGASIS Based Protocol (IEEPB)*

IEEPB is an improved chain based routing algorithm over EEPB. It contains 3 stages:

i. Chain construction phase
ii. Leader selection phase
iii. Data transmission phase

**i. *Chain Construction Phase***

a) Initializing the network parameters.

b) Determining the number of nodes, initial energy, base station location. Then chain construction starts.

c) BS broadcasts the whole network a hello message to obtain basic network information such as ID of nodes alive and distance from each node to BS.

d) Set the node which is farthest from BS as end node, it joins the chain first and is named as node 1.

e) Each node gets information of information of distance between itself and surrounding nodes which have not joined the chain, it finds the nearest node names it as *i* where i represent the *i*- th node that has joined.

f) Node *i* finds the information between itself and *i*- 1 nodes which are there in the chain, then it finds

Where $D_{avg}$ represents the average distance between sensor node and BS

b) Calculate energy portion $E_p$ as follows:

$$E_p=E_{init}/E_i$$

Where $E_i$ is the residual energy of node *i* for round *n*
Where $E_{init}$ is the initial energy of node *i*

c) Calculate weight of each node by using the formula:

$$W= w_1E_p+w_2D_{bs}$$

Where $w_1$ and $w_2$ are coefficients of weight factors such as

$$w_1+w_2=1$$

d) Compare different weights of each node and the node with minimum weight are selected as the leader in this round.

**iii. *Data Transmission Phase***

Once the chain formation phase and CH selection phase are accomplished, each node transmits its data to the adjacent node. The adjacent node then fuses its data with the data of previous node and sends it further. Once the data reaches CH, it sends data of all nodes to next CH. One round of communication terminates when BS receives all the data from last CH.[2]

## III. SIMULATION RESULTS

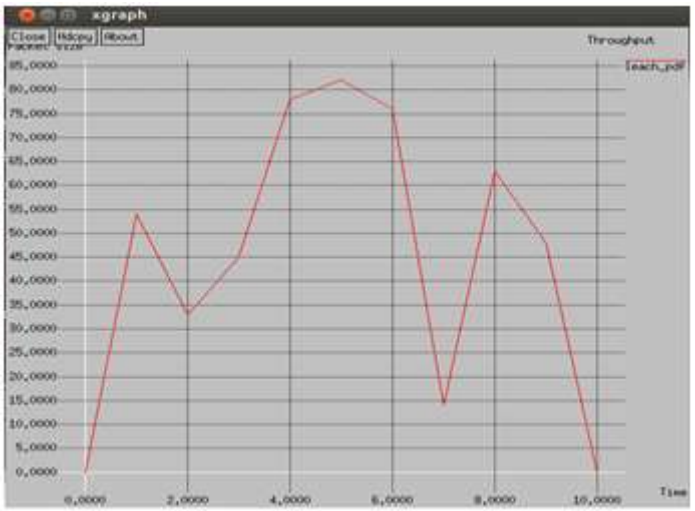


Figure 3: Graph Showing Throughput


Figure 3 shows Throughput i.e. number of packets sent in a particular time interval. It can be seen that maximum packet has been sent in time interval 4 to 6 seconds.

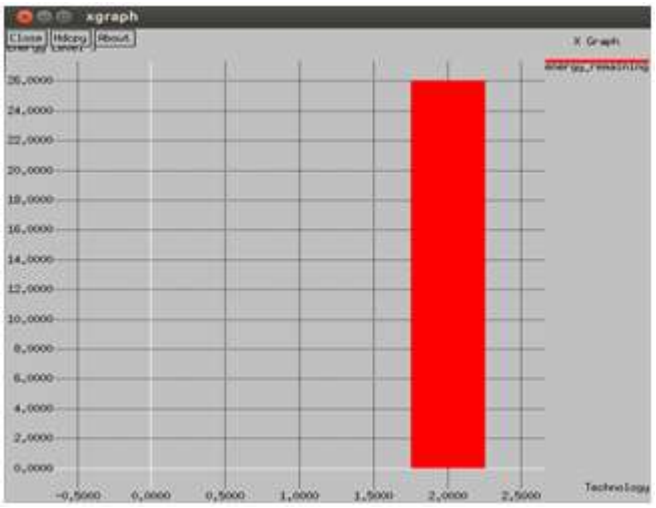


Figure 4: Graph Showing Energy Remaining

Figure 4 shows Energy remaining after completion of simulation. It can be seen that the energy left after simulation is 26 Joules.

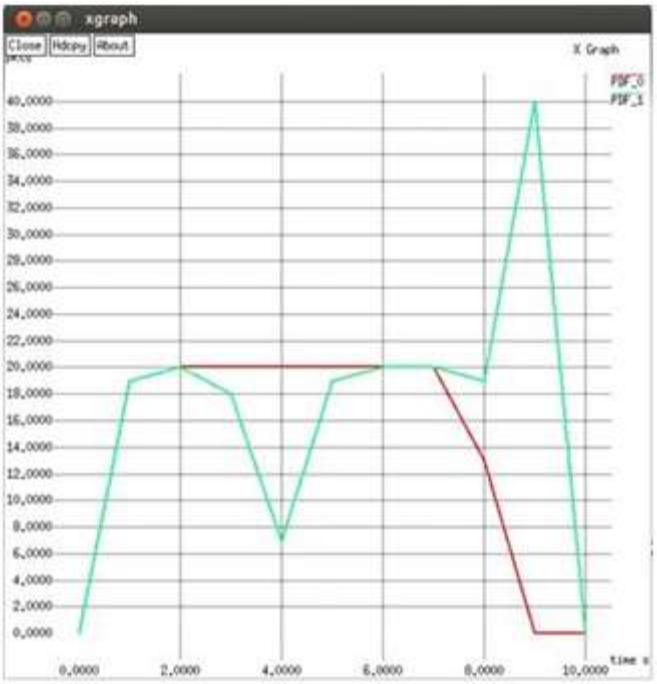


Figure 5 shows packet delivery ratio is more in IEEPB than PEGASIS protocol

Figure 6: Network Lifetime

Figure 6 shows Network Lifetime of PEGASIS and IEEPB routing protocols. It can be seen that IEEPB has longer Network Lifetime as compared to PEGASIS protocol.

## IV. CONCLUSION AND FUTURE WORK

In this paper IEEPB and LEACH Protocol has been explained in detailed. Unlike PEGASIS, IEEPB builds chain by considering residual energy and distance between the nodes. IEEPB outperforms PEGASIS in terms of packet delivery ratio, energy efficiency network lifetime. In future, IEEPB protocol can be compared with other PEGASIS variants and performance can be evaluated.

## REFERENCES

[1] Laili Almazaydeh, Eman Abdelfattah, Manal Al- Bzoor, Amer Al- Rahayfeh "Performance Evaluation Of Routing Protocols In Wireless Sensor Networks" IJCSIT Volume 2, April 2010.
[2] Feng Sen, Qi Bing, Tang Liangrui "An Improved Energy Efficient PEGASIS Based Protocol in Wireless Sensor Networks" IEEE 2011
[3] Meenu, Vandana "Modified PEGASIS in WSN to Increase Network Lifetime" IJCA Volume 52, August 2012
[4] Stephanie Lindsey, Cauligi.S. Raghavendra "PEGASIS: Power Efficient Gathering in Sensor Information Systems