AN IMPLEMENTATION OF ENERGY EFFICIENCY BY IMPROVED PEGASIS PROTOCOL IN WSN

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Abstract: *Wireless Sensor Network is an ad hoc network. Each sensor is defined with limited energy. Wireless sensor node deployed into the network to monitor the physical or environmental condition such as temperature, sound, vibration at different location. Each node collected the information than transmit to the base station. The data is transfer over the network each sensor consume some energy in receiving data, sending data. The lifetime of the network depend how much energy spent in each transmission. The protocol play important roll, which can minimize the delay while offering high energy efficiency and long span of network lifetime. One of such protocol is IPEGASIS, it is based on the chain structure, every chain have only one cluster head[2], it is in charge with every note's receiving and sending messages who belong to this chain, the cluster head consumes large energy and the times of every round increasing. In IPEGASIS, it take the advantage of sending data to it the closet neighbor, it save the battery for WSN and increase the lifetime of the network. The proposed work is about to select the next neighboring node reliably. For this it will combine few parameters such as Distance, Residual Energy and Response time. The proposed system will increase the overall communication and increase the network life.*

Keywords: WSN, energy, node, IPEGASIS *Routing Protocols, NS-2.35.*

1. INTRODUCTION

Wireless Sensor Networks [1], with the characteristics of low energy consumption, low cost, distributed and self-organization, have brought a revolution to the information perception. The wireless sensor network is composed of hundreds of thousands of the sensor nodes that can sense conditions of surrounding environment such as illumination, humidity, and temperature. Each sensor node collects data such as illumination, humidity, and temperature of the area. Each sensor node is deployed and transmits data to base station. The wireless sensor network can be applied to variable fields. For example, the wireless sensor network can be used to monitor at the hostile environments for the use of military applications, to detect forest fires for prevention of disasters, or to study the phenomenon of the typhoon for a variety of academic purposes. These sensor nodes can self-organize to form a network and can communicate with each other using their wireless interfaces. Energy efficient self-organization and initialization protocols are developed in [3], [4]. Each node has transmitted power control and an omnidirectional antenna, and therefore can adjust the area of coverage with its wireless transmission. Typically, sensor nodes collect audio, seismic, and other types of data and collaborate to perform a high-level task in a sensor web. For example, a sensor network can be used for detecting the presence of potential threats in a military conflict. Most of battery energy is consumed by receiving and transmitting data. If all sensor nodes transmit data directly to the BS, the furthest node from BS will die early. On the other hand, among sensor nodes transmitting data through multiple hops, node closest to the BS tends to die early, leaving some network areas completely unmonitored and causing network partition. In order to maximize the lifetime of WSN, it is necessary for communication protocols to prolong sensor nodes' lifetime by minimizing transmission energy consumption, sending data via paths that can avoid sensor nodes with low energy and minimizing the total transmission power.

2. WIRELESS SENSOR NETWORK

Figure.1 shows a typical schematic of a wireless sensor network (WSN). After the initial deployment (typically ad hoc), sensor nodes are responsible for self-organizing an appropriate network infrastructure, often with multi-hop connections between sensor nodes [5]. The onboard sensors then start collecting acoustic, seismic, infrared or magnetic information about the environment, using either continuous or event driven working modes. Location and positioning information can also be obtained through the global positioning system (GPS) or local positioning algorithms. This information can be gathered from across the network and appropriately processed to construct a global view of the monitoring phenomena or objects. The basic philosophy behind WSNs is that, while the capability of each individual sensor node is limited, the aggregate power of the entire network is sufficient for the required mission.

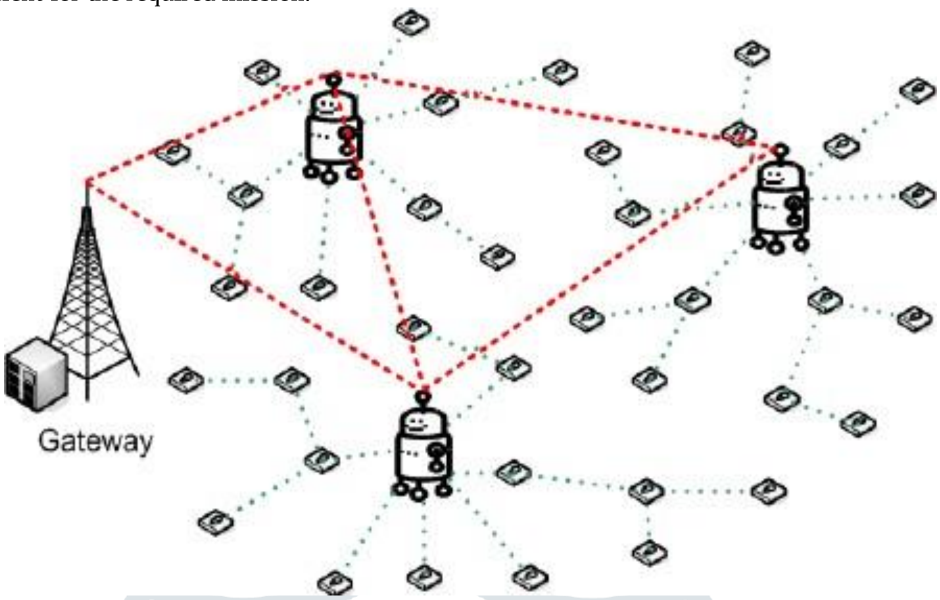


Figure: 2.1 WSN Architecture

3. PROPOSED PROTOCOL

IPEGASIS protocol is an extension of PEGASIS protocol designed for increasing the lifetime of the sensor network. PEGASIS protocol causes transmission of redundant data since one node from the chain is selected as the head node or leader node regardless of the location of base station or sink node. The extension of PEGASIS protocol base d on clustering mechanism solves this problem. The main purpose of this scheme is to enhance its performance and to increase the lifetime of the whole network.

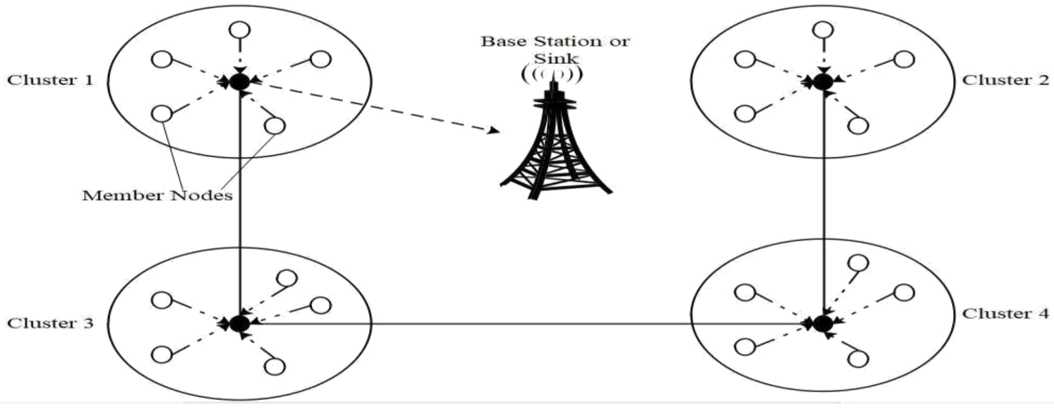
In order to balance energy consumption in PEGASIS, we propose modified algorithm for chain formation i.e. IPEGASIS. In IPEGASIS (Improved Power Efficient Gathering in Sensor Information System), if cluster head nodes received a message for chain formation, each head node computes a hierarchical tree using strip tree geometry algorithm and then transmits this message to the next head node selected based on in -order tree traversal algorithm until all the cluster head nodes are included in the chain. After chain formation, one head node -like in PEGASIS using the greedy algorithm is randomly selected as the leader to transmit fused data to the sink in each round. By token passing, each head node transmits fused data toward the leader node along the chain. The leader node transmits data received from its neighbours to the sink.

Figure: 3.1 IPEGASIS Protocol

4. NETWORK SIMULATION

Generally network simulators try to model the real world networks. The principle idea is that if a system can be modelled, then future of the model can be changed and the corresponding results can be analyzed. Following features are provided by simulator.

- Easy network topology setup
- Protocols and application implementation
- UDP
- FTP, Telnet, Web, CBR, VBR
- Routing protocols
- Queue management protocols



- Configurability
- Extensibility

Table 4.1 Simulation Parameters

Simulation Tools	NS-2.35
IEEE Scenario	802.15.4 (WSN)
Propagation	Two Ray Ground
No. of Nodes	20, 40, 60, 80, 100 Nodes
Channel	Wireless Channel
Traffic Type	TCP
Antenna	Omni Directional Antenna
MAC Type	IEEE 802.15.4
Routing Protocol	PEGASIS and IPEGASIS
Queue Limit	50 Packets
Queue Type	Droptail, CMU Priqueue
Simulation Time	100 seconds

5. IMPLEMENTATION AND RESULTS

In this work, the random way point static model is used for the simulation of WSN routing protocols. The source-estimation pairs are spread randomly over the network where the point to point link is established between them. In this work UDP agent with CBR traffic is used with 40 packet size and 10kbps rate used for the transmission. The simulation configuration for static nodes consists of many network components and simulation parameters that are shown in the table in detail.

- **PACKET DELIVERY RATIO**

This is the fraction of the data packets generated by the sources to those delivered to the destination. Figure and table shows the PDR of PEGASIS and IPEGASIS routing protocol for 20 nodes, 40 nodes, 60 nodes, 80 nodes and 100 nodes.

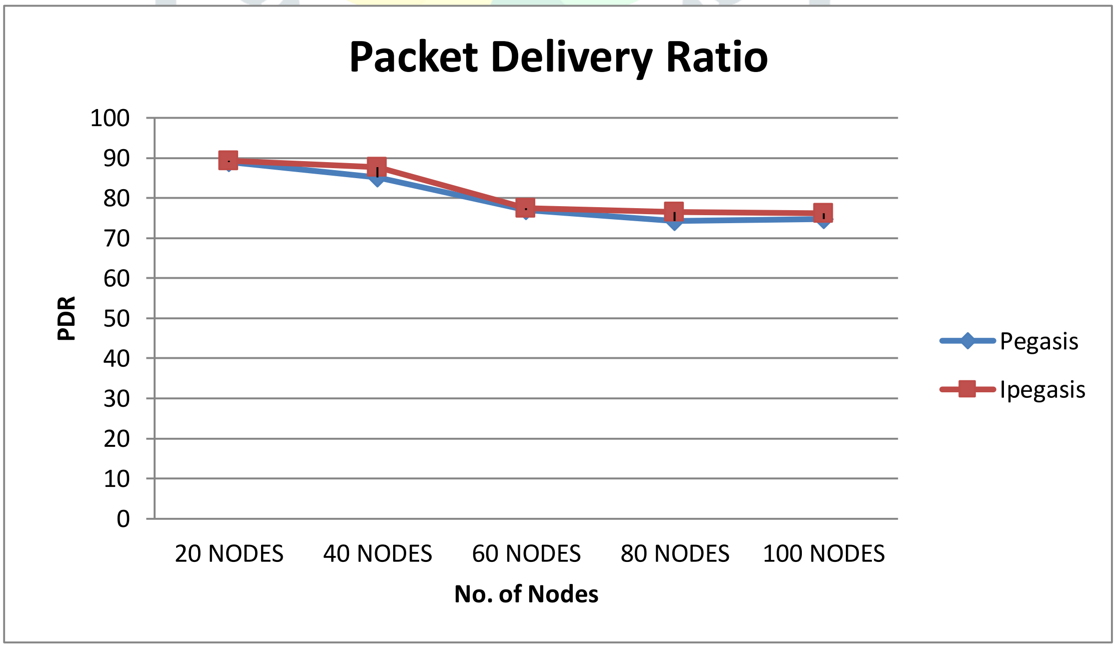


Figure: 5.1 Packet Delivery Ratios

Table: 5.1 Packet Delivery Ratios

No. Of Nodes	PEGASIS (%)	IPEGASIS (%)
20	88.95	89.37
40	85.09	87.63
60	76.96	77.53
80	74.27	76.56
100	74.82	76.19

- **THROUGHPUT**

Throughput is the median value of successful delivery of the packets over the network. This data is delivered over a physical or logical link, or pass through a certain network node. The Throughput is calculated in kilobits per second (Kbps), or data packets per second or data packets per time slot. Figure and table shows the Overall Throughput of PEGASIS and IPEGASIS routing protocol for 20 nodes, 40 nodes, 60 nodes, 80 nodes and 100 nodes.

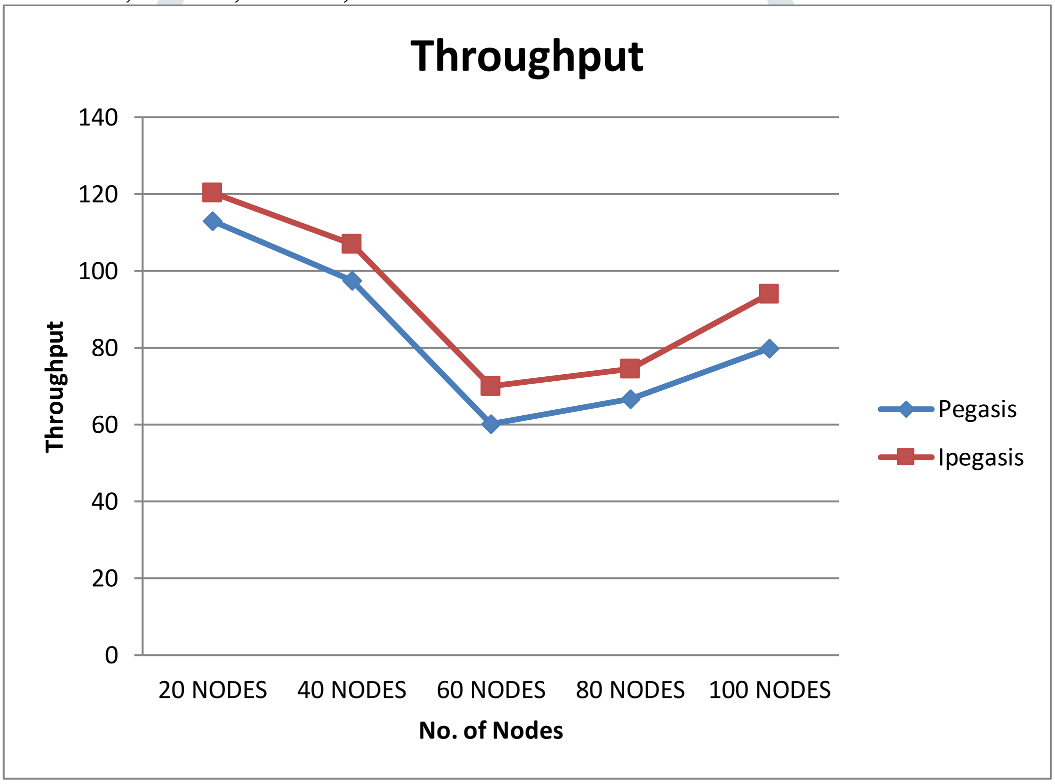


Figure: 5.2 Throughputs

Table: 5.2 Throughputs

No. Of Nodes	PEGASIS (kbps)	IPEGASIS (kbps)
20	113.07	120.42
40	97.47	107.06
60	60.23	70.02
80	66.67	74.49
100	79.81	93.96

- **END TO END DELAY**

End-to-End delay is the time taken for a packet to be transmitted across a network from source to the destination. This includes all the delays caused during route acquisition, buffering and processing at intermediate nodes. Figure and table shows the End-to-End Delay for PEGASIS and IPEGASIS routing protocol. IPEGASIS protocol has less End -to-End Delay compared with PEGASIS protocol for 60 nodes and 80 nodes scenario. However, for other node densities it shows high End -to-End delay because in IPEGASIS all the sensor nodes send their data only to their cluster head in their given time slot which causes more delay in the network.

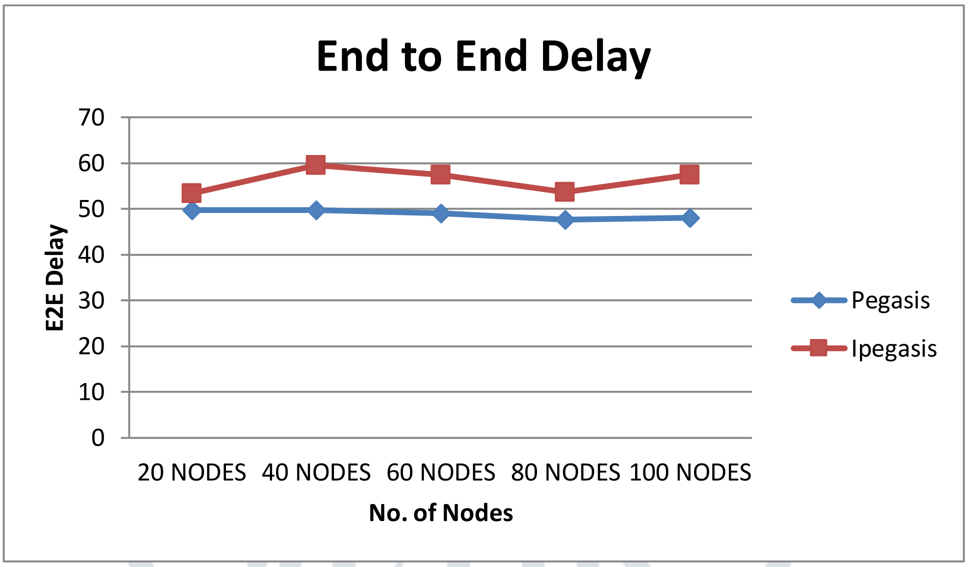


Figure: 5.3 End to End Delays

Table: 5.3 End to End Delays

No. Of Nodes	PEGASIS (m sec)	IPEGASIS (m sec)
20	49.7359	53.4449
40	49.8118	59.5893
60	49.081	57.5207
80	47.7038	53.6384
100	48.1203	57.4381

- **RESIDUAL ENERGY**

The estimation of Residual Energy shows how effectively the network preserves the energy for increasing the life time of network. The Figure5 and table show the energy consumption of network in terms of joule or percentage for 20 nodes, 40 nodes, 60 nodes, 80 nodes and 100 nodes. PEGASIS protocol shows less Residual Energy than IPEGASIS protocol because it reduces the number of hops as compared to PEGASIS protocols which also reduces the energy consumption and increases the lifetime of the whole network. IPEGASIS protocol uses fixed cluster head so it also minimizes the energy required in selecting cluster head for each round.

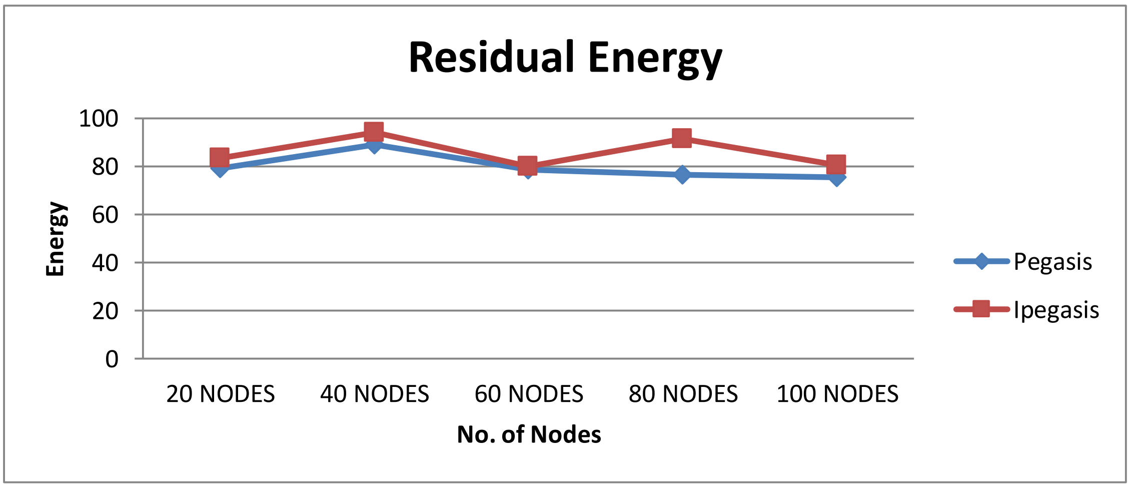


Figure: 5.4 Residual Energy

Table: 5.4 Residual Energy

No. Of Nodes	PEGASIS (Joule or %)	IPEGASIS (Joule or %)
20	79.182044	83.518403
40	88.866187	93.95059
60	78.728219	79.857744
80	76.43818	91.404471
100	75.525364	80.557015

6. CONCLUSION

In this work we analysed parameter like Residual Energy, Packet Delivery Ratio, Overall Throughput and End -to-End Delay and concluded that the IPEGASIS routing protocol gives improved results over PEGASIS routing protocol for each topology i.e. 20 nodes, 40 nodes, 60 nodes, 80 nodes and 100 nodes with the simulation time of 100 seconds for Two Ray Ground propagation in IEEE 802.15.4 scenario for Omni Directional Antenna.

The performance metrics are investigated for PEGASIS and IPEGASIS routing protocol by taking position of nodes is fixed. Taking Residual Energy as parameter and analysing the results we conclude that IPEGASIS protocol shows 6.65% improved performance compared to PEGASIS protocol. IPEGASIS protocol shows 1.9% improvement than PEGASIS for Packet Delivery Ratio. IPEGASIS protocol also shows 10.9 % improvement in Throughput than PEGASIS protocol. As our main focus is for reducing the energy consumption of the network we can neglect the delay caused.

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