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Energy Efficient Routing Protocol with Greedy Algorithm for WSN Scenarios

Ashlesha Sonane[1], Mayur Rathi[2]

Research Scholar, Department of CSE, LNCTS (RIT), Indore, MP, India[1]

Assistant Professor, Department of CSE, LNCTS (RIT), Indore, MP, India[2]

ABSTRACT: Nodes in Mobile Ad Hoc Networks (MANETs) are limited battery powered. That's why energy efficient routing has become an important optimization criterion in MANETs. The conventional routing protocols do not consider energy of the nodes while selecting routes which leads to early exhaustion of nodes and partitioning of the network. This paper attempts to provide an energy aware routing algorithm. The proposed algorithm finds the transmission energy between the nodes relative to the distance and the performance of the algorithm is analyzed between two metrics Total Transmission energy of a route and Maximum Number of Hops. The proposed algorithm shows efficient energy utilization and increased network lifetime with total transmission energy metric.

KEYWORDS: Energy efficient algorithm; Manets; total transmission energy; maximum number of hops; network lifetime

I. INTRODUCTION

Wireless sensor networks (WSNs) generated an increasing interest from industrial and research perspectives. A WSN can be generally described as a network of nodes that cooperatively sense and may control the environment enabling interaction between persons, computers and the surrounding environment. Wireless communication technologies which have revolutionized the way of our lives, this revolution have also resulted in the development of wireless sensor networks. A Wireless Sensor Network (WSN) is poised of a large number of small sensor nodes having controlled estimation quantity, restricted retention slot, finite power source, and short-range radio communication device [1]. It has a base-station, which does the tasks of calculation and decision-making, and can be correlated with the functionalities of server. The nodes communicate wireless and often self-regulated after being spread out in an ad-hoc fashion. Sensor nodes are able to autonomously form a network through which sensor readings can be originated. Since the sensor nodes have some judgment, data can be processed as it out flow wound up the network.

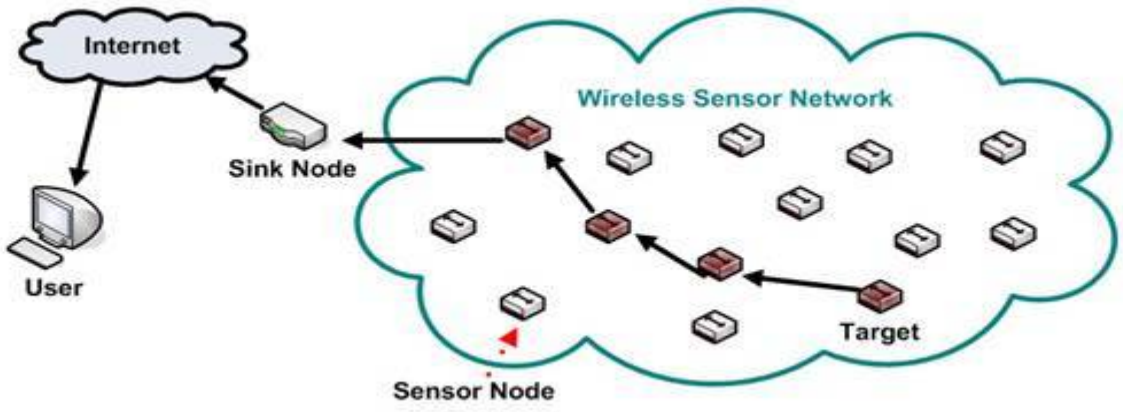

Figure -1Wireless Sensor Network [2]

The classification of routing protocols in WSN might differ depending on the application are

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- Operation based Routing Protocol.
- Network Structure based Protocol for routing.

Depending on the network structure we can divide routing protocols in Flat Based Routing, Hierarchical (Cluster-based) Routing and Location Based Routing. Hierarchical Routing is the well-known technique with special advantages analogous to scalability and valuable transmission. PEGASIS, TEEN and APTEEN use hierarchical Routing technique. In hierarchical architecture, higher energy nodes can be used to process and send information, while low-energy nodes can be utilize to achieve the sensing in the adjacency of target. Hierarchical routing is a proficient way to lower energy consumption within a cluster, achieving aggregation of data and fusion in order to decrease the number of transmitted messages to the sink node. Examples are: Low Energy Adaptive Clustering Hierarchy (LEACH), Power Efficient Gathering in Sensor Information Systems (PEGASIS), Stable Election Protocol (SEP) etc [5].

The main feature of PEGASIS is for each node to receive from and transmit to close neighbors and take turns being the leader for communicate to the BS. This approach will circulate the load of energy uniformly amidst the sensor nodes in wireless sensor network. At the beginning place the nodes randomly in the play field, and therefore, the node is at a random location. The sensor nodes will be organized to form a chain, which can either be accomplices by the sensor nodes themselves using a greedy algorithm starting from some node. Alternatively, the BS can gauge this chain and broadcast it to all the sensor nodes [6].

The benefits and drawbacks of wireless sensor networks can be summarized as follows:

- **Benefits:**
  - Network setups can be done without fixed infrastructure.
  - Ideal for the non-reachable places such as across the rural areas, hill areas etc.
  - Flexible if there is ad hoc situation when additional workstation is required.
  - Implementation cost is cheap.
- **Drawbacks:**
  - Less secure because hackers can enter the access point and get all information.
  - Lower speed compared to a wired network.
  - More complex to configure than a wired network.
  - Easily affected by surroundings (walls, microwave, large distances due to attenuation in signal etc.).

II. WIRELESS SENSOR NETWORKS APPLICATIONS

WSN applications can be restricted into two categories:

- Monitoring.
- Tracking.

Monitoring utilization include indoor/outdoor monitoring of environment, Health related monitoring, power and inventory location monitoring and structural monitoring.

Tracking utilization covers tracking of objects, animals, human and vehicles.

III. ROUTING IN WSN

a. PEGASIS Protocol (Power Efficient Gathering in Sensor Information System)

In wireless sensor network, Data handling is accomplished by data dissemination and data gathering. A routing protocol is a protocol that determines how routers (Sensor nodes) convey with each other, propagating information that permits them to preferred routes between any two nodes on the network. The prime route being done by applied routing algorithms. Each router has awareness only of the networks attached to it directly. A routing protocol proportion this information first between existing neighbors, and then throughout the network. This way, routers achieve knowledge of the topography of the network.

In data-gathering application, all data from all nodes need to be collected and transmitted to the base station (BS) by a leader node, where the end-user can approach the data. A simple approach to accomplishing this data gathering assignment is for entire nodes to transmit its data directly to the BS. The goal of algorithm which implement data gathering is maximize the numbers of rounds of communication before the nodes die and the networks becomes ruined. This means minimum energy should be consumed and the transmission should occur with minimum delays, which are

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incompatible requirement. Hence, the energy x delay metrics used to compare algorithms, since this it measures speedy and energy-decisive data gathering. A PEGASIS protocol that implement data gatherings are discussed below in detail.
Objective of PEGASIS:- PEGASIS is a data gathering protocol based on the assumption that all sensor nodes know the location of every other node, that is, the topology information is available to all nodes. Also any node has required transmission range to reach the BS in one hop, when it is selected as a leader. The objective of PEGASIS is as follows:

- Minimize the distance over which each node transmits.
- Minimize the broadcasting overhead.
- Reduce the number of messages that required to be dispatched to base station.
- Distributed the energy consumption equally across all nodes.

Working of PEGASIS protocol:- According to PEGASIS protocol, all the nodes have information about all other nodes and each has the capability of transmitting data to the base station directly. PEGASIS assumes that all the sensor nodes have the equal levelled of energy and they are possible to drown at the same time. Since all nodes are immobile and have global knowledge of the network, the chain can be formed easily by using greedy algorithm. Chain creation is started at a node far from BS. All nodes transmit and receive data from only one convenient node of its neighbours. To locate the closest neighbour node, each node uses the signal strength to measure the distance from the neighbours and then adjusts the signal strength so the only one node cab is heard. Node passes token through the chain to leader from both sides. Each node fuses the received data with their own data at the time of constructing the chain. In each round, a randomly elect node (chain leader) from the chain will transmit their aggregated data to the base station (BS). The chain subsists of those nodes that are nearest to one another and form a route to the base station (BS). The aggregated data is transmitting to the base station (BS) by the chain leader.
PEGASIS is a near optimal chain-based routing protocol. The basic purpose of this protocol is the extension of the WSN lifetime. In PEGASIS protocol all the WSN nodes communicate only with their closest neighbours and continue communicating in their turns until the aggregated data reaches the BS. This method of communication reduces the power consumption required to transmit data per round. PEGASIS protocol starts forming a chain using Greedy algorithm then randomly selects a leader for the formed chain after that data transmutation takes place.

IV. IMPLEMENTATION AND RESULTS

Network size is considered as 2000m X 2000m and the numbers of nodes are 25, 50, 75, 100 and 150 nodes which are static in the sensor field. Parameters for this simulation are as follows:

Simulation TOOL	Network Simulator-2.35
IEEE Scenario	WSN(IEEE 802.15.4)
Network Interface	Physical/Wireless Physical
Link Layer	LL
No. Of Nodes	25, 50, 75, 100, 125 nodes
Traffic Type	TCP
Antenna	Omni Directional Antenna
MAC Layer	IEEE 802.15.4
Routing Protocols	AODV,DSR, PEGASIS
Queue Limit	50
Simulation Area(in metre)	2000*2000
Queue type	CMUPriqueue, Drop-tail
Channel	Wireless Channel
Simulation Time	100 sec.

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V. PERFORMANCE METRICS

The following metrics are used in this work for comparing the performance of AODV, DSDV, AOMDV and PEGASIS routing protocols.

a. **Packet Delivery Ratio (PDR):-** Packet Delivery Ratio is the proportion of the ratio of the number of data packets received by the destination node to the number of data packets sent by the source node.

PDR can be calculated in terms of percentage. Packet delivery ratio demonist the total number of data packets that reached successfully at the terminal node. The main reason for this packet drops may arise by the cause of congestion, overflow in queue and hardware problems etc. Packet drop has network performance by consuming time and more bandwidth to retransmit a packet. Higher packet delivery ratio shows higher protocol performance.

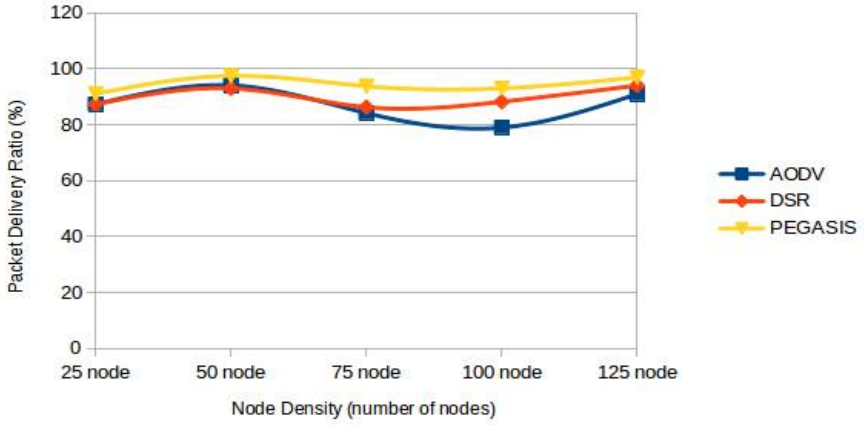

Figure:-2 Packet Delivery ratio for AODV, DSR and PEGASIS Routing protocol

b. **Throughput:-** Throughput is the average rate of successful message transmitted over a communication channel.

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$$\text{Throughput (bytes/sec)} = \frac{\text{Total number of received packets at destination}}{\text{Total simulation time}}$$

Throughput is calculated in bytes/sec or bits/second (bps). These metrics are not completely independent. Throughput is the amount of data transferred successfully on a communication network or network link over the period of time

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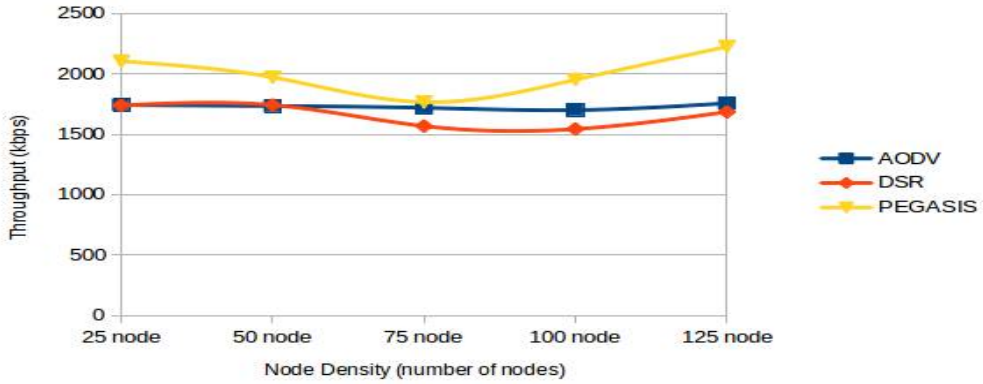

Figure:-3 Throughput for AODV, DSR and PEGASIS Routing protocol

c. **End to End Delay** :- It can be presented as the time a packet takes to transit from source to destination. This includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, and propagation and transfer times.

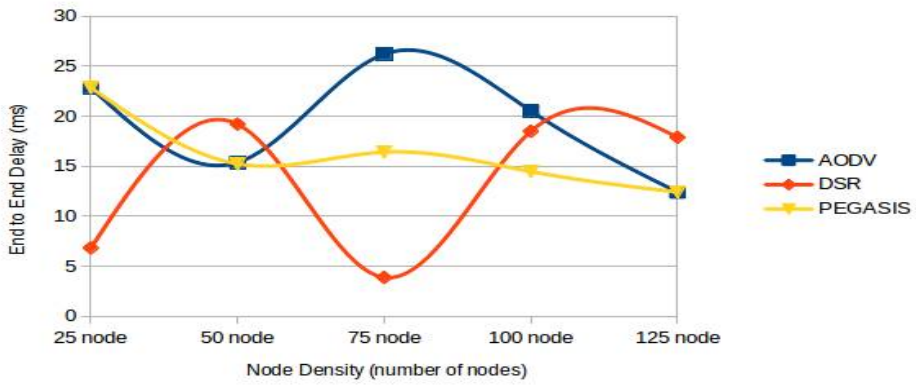

Figure:-4 End to End Delay for AODV, DSR and PEGASIS Routing protocol

d. **Residual Energy:-** It is the remaining amount of energy or power after completing the whole communication process**.**

Residual Energy = Initial Energy of Node – Energy Consumed during Communication.

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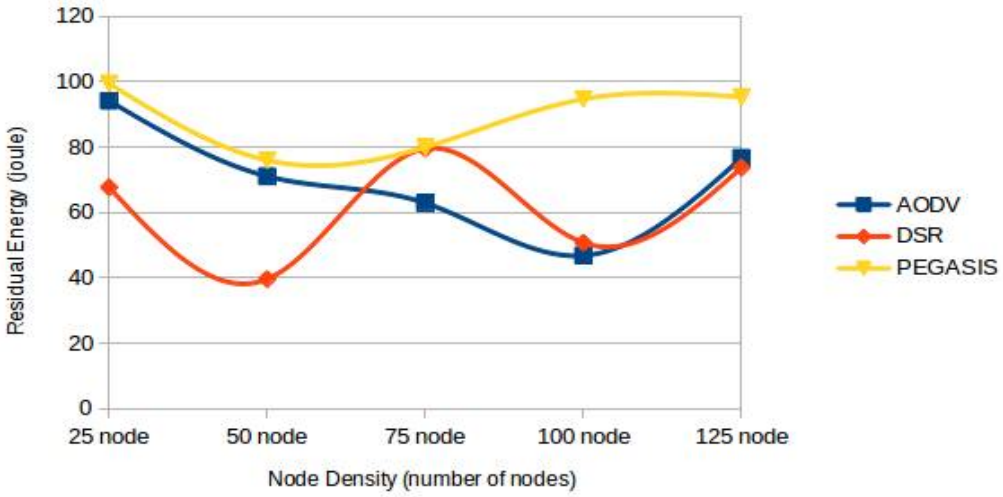

Figure:-5 Residual Energy for AODV, DSR and PEGASIS Routing protocol

VI. CONCLUSION

In this work which is implemented an energy efficient PEGASIS hierarchical routing technique in which various node density based scenarios are formation with optimization of our proposed hierarchical routing technique in transmitting data to the leader was analyzed and emphasized and analysis shows that energy efficiency of WSNs can be further improved by using the greedy-based routing technique. The concept of greedy-based routing technique can be effectively used to designed energy efficient routing protocol in WSN. With energy awareness PEGASIS protocol being our core interest in this work, our proposed greedy-based routing technique, which uses the greedy algorithm to send data to the leader proof to offer more reduced energy consumption and also increase the lifetime of the WSN. From the analysis of our simulation results, we found out that PEGASIS protocol offers a better solution to energy efficiency usage in a WSN when compared to other routing protocol such as AODV and DSR.

The overall performance of the PEGASIS protocol is analyzed through network simulator (NS-2.35). We have used three routing protocols AODV, DSR and PEGASIS for this work. After the implementation and compilation results with various performance matrices has been analyzed. All the protocols behaves like their properties in the same way as we know PEGASIS is an energy efficient routing protocol, which can been seen by detailed analysis of Residual Energy of all the protocols.

Finally, the result indicates that PEGASIS protocol provide better result than other protocol.

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