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PEGASIS: Chain Based Energy Efficient Routing Protocol to Intensify the life-span of Wireless Sensor Network

Yogesh k Yadav[1], Prof. Sujeet Mishra[2]
Pursuing M.Tech[1], Asst. Professor[2]
Sanghvi institute of Management and Science, Indore, Madhya Pradesh, India
jackyash2007@gmail.com[1], Sujeetmishra84@gmail.com[2]

Abstract: *Wireless sensor network (WSN) is an important and protesting analysis sphere. The routing protocols become distinguish and protect a good route between source and destination nodes in these static networks. Numerous routing protocols have been recommended for mobile ad hoc networks, and none can be perceived as the finest under all conditions. This work consist a systematic comparative evaluation of AODV, DSDV, AOMDV and PEGASIS. This work containing evaluates the static network on a range of WSN's with between 10, 15 and 20 nodes, which are static nodes. The network comparison metrics is Residual Energy.*

1. Introduction

Wireless sensor networks (WSNs) are increasingly being envisioned for collecting data, such as physical or environmental properties, from a geographical region of interest. WSNs are composed of a large number of low cost sensor nodes, which are typically capable of sensing, computing, and communication. The applications of WSNs can be found in diverse areas such as military (e.g., battlefield surveillance), environmental protection (e.g., habitat monitoring), healthcare (e.g. tele-monitoring of human physiological data), and home automation [1]. It has a base-station, which does the tasks of calculation and decision-making, and can be correlated with the functionalities of server or in some cases as a gateway in a computer network. The nodes communicate wireless and often self-organize after being deployed 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.

Many researchers have been carried out for sensor networks but the network protocols for sensor networks still need further extensive and intensive explorations. Most of existing routing protocols focus on one major technical issue whether it is data-centric approach or power efficient approach. In a typical monitoring application, after deploying sensor nodes in the field, users would like to query the data over a specific area for a certain time to monitor the status of environment. Then sensor nodes periodically send data back to the sink. In this kind of application the purpose of routing protocol is to minimize total energy consumption so that the lifetime of sensor networks as the whole can be prolonged as much as possible. Chain–based routing protocols have been proposed to reduce the total energy consumption for data gathering. In PEGASIS uses a greedy algorithm for constructing the routing chain. These chain constructions through greedy algorithms use centralized approaches for constructing the chain and elect the leader node for transmitting data back to the sink by taking turn. PEGASIS reduces the total communication energy consumption compared to AODV, AOMDV, and DSDV. PEGASIS organizes all nodes into the chain using greedy algorithm by adding the next closest node to the chain starting from the node farthest from the sink. It assigns one leader node to transmit data to the sink. Other nodes just transmit data to neighbor node along the chain and aggregate data before continuing sending data along the chain toward the leader node. It achieves better lifetime.

In this paper we present an improved protocol called PEGASIS (Power-Efficient Gathering in Sensor Information Systems), which is near optimal for this data gathering application in sensor networks. The key idea in PEGASIS is to form a chain among the sensor nodes so that each node will receive from and transmit to a close neighbor. Gathered data moves from node to node, get fused, and eventually a designated node transmits to the BS. Nodes take turns transmitting to the BS so that the average energy spent by each node per round is reduced. Building a chain to minimize the total length is similar to the traveling salesman problem, which is known to be intractable. However, with the radio communication energy parameters, a simple chain built with a greedy approach performs quite well. The PEGASIS protocol achieves between 100 to 300% improvement when 1%, 20%, 50% and 100% of nodes node die compared to the other cluster protocols. nodes could transmit progressively reduced signal strengths to find a close neighbor to exchange data. This would require the nodes to consume some energy when trying to find local neighbors.

2. WSN Routing Protocol

Routing is an important and challenging issue in dynamic multi-hop networks. Thus, many routing protocols algorithms have been proposed in recent years. A routing protocol is used to discover routes between nodes allowing communication within the network. The main goal of such a routing protocol is to establish a correct and efficient route between a pair of nodes, so that messages can reach their destination in a timely manner. During the last two decades, many mobile ad hoc network routing protocols have been proposed because of their importance in dynamic networks [2]. It is not possible to consider a particular algorithm or class as the best for all scenarios. Each protocol has its own advantages and disadvantages and may only be suited for certain situations . Due to a variety of challenges, designing a mobile ad hoc network routing protocol is a tough task. Firstly, in mobile ad hoc networks, the topology changes frequently because of node move ableness. Secondly packet extricates may appears frequently because of the variable and unpredictable capacity of wireless channels. Moreover, the transmission nature of the wireless medium introduces the hidden terminal and exposed extreme obstacles, mobile nodes have restrained power, limited bandwidth resources and require effective routing schemes.

AODV:- A routing protocol which builds on the DSDV algorithm is called Ad Hoc On-Demand Distance Vector. AODV is an amendment on DSDV, considering it typically diminishes the number of required broadcasts by devising routes on a insistence basis, as opposed to cultivating a complete list of routes as in the DSDV algorithm. The authors of AODV allocate it as a pure on devise route procurement system, since nodes that are not on a selected path do not cultivate routing information or participate in routing table changes. When a source node desires to send a message to some terminus node and does not already have a authentic route to that terminus node, it initiates a path discovery process to position the other node. It transmits a route request (RREQ) packet to its neighbors, which then forward the request to their nearer node, and so on. Either the destination or an intermediate node with a “fresh enough” route to the destination is located. The propagation of broadcast RREQs across network AODV take advantages of destination sequence numbers to ensure all routes are loop-free and contain the most recent route information. Transmission of own sequence number by node itself, as well as a broadcast ID. The transmission ID is incremented for every RREQ the node begins and together with the node’s IP address, uniquely identifies an RREQ. [3]

DSDV:- The full form of the DSSV protocol is Destination-Sequenced Distance-Vector Routing protocol . It based on the classical Bellman-Ford routing mechanism and described by a table-driven algorithm. The renovation made to the Bellman-Ford algorithm includes flexibility from loops in routing tables. Each node in the network maintains a routing table in which all of the possible terminus inner network and the number of hops to each destination are recorded. Each entry is notable with a sequence number nominated by the destination node. The sequence numbers enable the mobile nodes to distinguish decayed routes from new ones, thereby averting the formation of routing loops. Routing table updates are periodically transmitted all through the network in order to cultivate table consistency. To help alleviate the potentially huge amount of network traffic such type of updates that can create, route updates can employ two possible types of packets. The first is accepted as a full dump, That type of packet carries all available routing information and can require multiple network protocol data units (NPDUs).[4]

AOMDV:- AOMDV is a Ad-hoc On-demand Multi path Distance Vector Routing protocol. it is an extension to the AODV protocol for reckoning numerous loop-free and link disjoint paths. The routing access for each destination contains a list of the next-hops along with the analogous hop counts. All the next hops have the same sequence number. That helps in keeping path of a route. For each destination, a node cultivates the point out hop count, which is characterized as the maximum hop count for all the paths, which utilized for send route advertisements of terminus node. Every duplicate route advertisement received by a node specifies an alternate path to the terminus node. Loop freedom is assured for a node by accepting alternate paths to terminus node if it has a less hop count than the point out hop count for that terminus node. Because the maximum hop count is used, they point out hop count accordingly does not change for the same sequence number. When a route broadcast is received for a terminus node with a greater sequence number, the next-hop list and they point out hop count are reinitialized. [5]

AOMDV can be used to find node-disarticulate or link-disarticulate routes. To find node-disarticulate routes, each node does not immediately reject duplicate RREQs. Each RREQs appearing via a distinct neighbor of the source defines a node-disarticulate path. This is because nodes cannot be broadcast duplicate RREQs, so any two RREQs appearing at an intermediate node via a distinct neighbor of the source could not have traversed the same node. In an attempt to get multiple link-disarticulate routes, the destination replies to duplicate RREQs, the destination only response to RREQs appearing via unique neighbors. After the first hop, the RREPs pursue the reverse paths, which are node disarticulate and thus link-disarticulate. The trajectories of each RREP may intersect at an intermediate node, but each takes a distinct reverse path to the source to ensure link disarticulateing. The advantage of using AOMDV is that it allows intermediate nodes to reply to RREQs, while still selecting disarticulate paths. But, AOMDV has more message overheads during route discovery due to increased flooding and since it is a multipath routing protocol, the destination replies to the multiple RREQs those results are in longer overhead.[6]

PEGASIS:- 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 neighbors 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.[7]

The influential aspects of this protocol are as follows:

- PEGASIS avoids cluster formation and uses only one node in a chain to transmit to the BS instead of multiple nodes.
- PEGASIS increase the lifetime of each node by using collaborative techniques and decreases the data transmission.
- PEGASIS reduces the power required to transmit data per round as the power draining is spread uniformly over all nodes.
- Due to the dissimilar network sizes and topologies decreases the upstairs of dynamic cluster creation. PEGASIS has ability to overtake cluster formation like LEACH.
- The energy load is isolated equally in network.[8]

3. 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.

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1. **Formation of Chain**

To construct the chain PEGASIS protocol starts from the furthest node from the base station (BS) and uses Greedy algorithm to design a chain formation. The main idea here is that each sensor node communicates only with its closest two neighbours in order to minimize the power consumption.

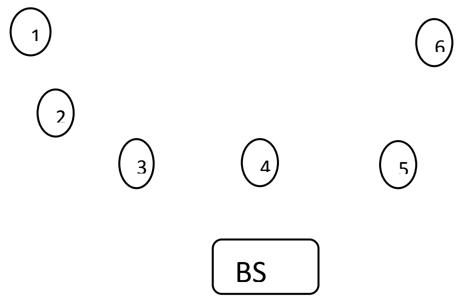

Figure-1 Chain formation using Greedy algorithm in PEGASIS

In Fig. node 1 lies the furthest from the base station so the chain construction starts from node 1 which is connected to node 2, node 1 is connected to node 2, and so on till node 6.

2. Selection of Leader

At the beginning of each round, a chain leader is selected randomly. This way of selection is easy and fast since no extra computation is performed. Moreover, the random selection has the benefit that as it is more likely for nodes to die at random locations thus providing robust network. After the leader has been selected it passes a token message to initiate a data gathering process. Passing a token also consumes energy however; the cost of passing a token is very small since the size of the token message is very small.

3. Data Transmission

Gathering the data in each round, each node receives data from one neighbour, fuses its own data with it, and transmits it to the other neighbour on the chain until the whole chain data reaches the chain leader. Finally, the chain leader sends this data to the BS.

4. Simulation

In our work we have performed 4 simulations First scenario is with a normalized AODV protocol. Second is for DSDV Protocol then with the AOMDV Protocol implementation and at last with PEGASIS protocol on a standard WSN environment. We have taken 10node, 15node and 20node for our implementation to be done.

1. Simulation Setup

We assume 10, 15, 20 sensor nodes are randomly scattered into the sensing field with dimensions 1500 m × 1500 m.

All sensor nodes periodically sense the environment and transmit the data to the next neighbors. Table summarizes parameters used in our simulation.

2. Simulation Parameters

Parameters	**Values**
Simulator	NS-2.35
Mobility Model	Random Way Point
Antenna type	Omni directional
Area of Map	1500*1500
PHY/MAC	IEEE 802.15.4
Routing Protocol	AODV,DSDV,AOMDV, PEGASIS
Network Traffic	TCP
Simulation Time	100sec
Antenna type	Omni directional

5. Simulation Results and Analysis

Packet Delivery Ratio:- The ratio of the number of delivered data packet to the destination, this illustrates the level of delivered data to the destination.

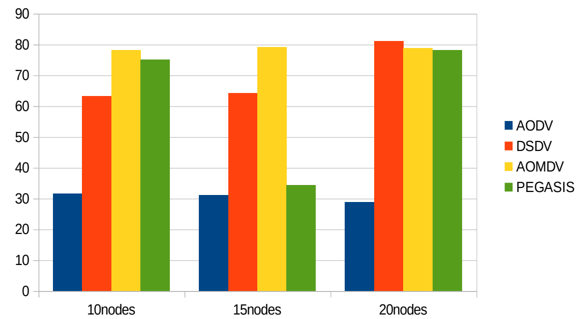

Figure1- PDR Comparisons for AODV, DSDV, AOMDV AND PEGASIS

Figure1 shows the packet delivery ratio of the four routing protocols and calculated for different number of nodes, the variation of packet delivery ratio with the number of nodes.

Throughput:- The rate at which the packet delivered successfully is called throughput of the network.

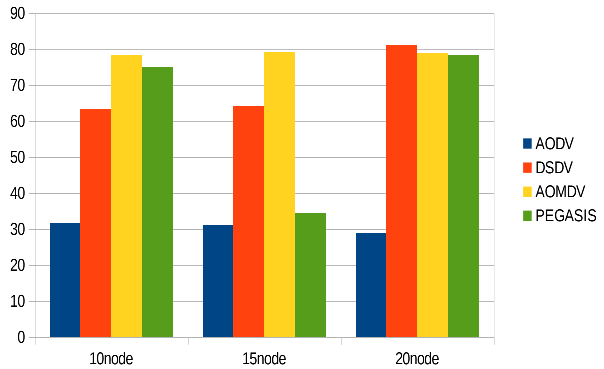

Figure2- average throughput Comparisons for AODV, DSDV, AOMDV AND PEGASIS

Figure shows the throughput of the four routing protocols and calculated for different number of nodes, the variation of throughput with the number of nodes.

Residual Energy:- It is the remaining amount of energy or power after the complete communication process has been done.

Residual Energy = (Initial Energy of Node – Energy Consumed during Communication)

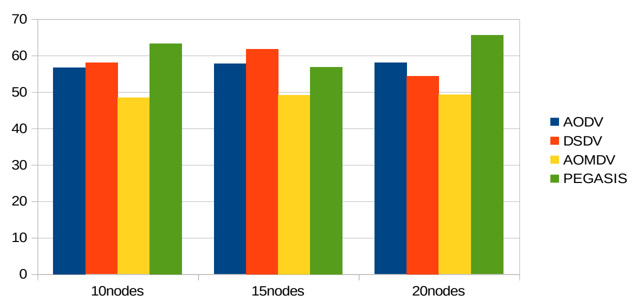

Figure3- Residual Energy Comparisons for AODV, DSDV, AOMDV AND PEGASIS

The variation of residual energy in Pegasis protocol found higher than other comprisable protocols.

6. Conclusion

Our goal for implementing and comparing various routing protocol was to reach towards a protocol which is higher energy decisive. For Reaching towards our goal we have used four routing protocols AODV, DSDV, AOMDV and PEGASIS for our work. In this work use of a popular open source simulation tool NS-2 with varying no of nodes 10, 15 and 20. After the implementation and compilation results residual energy has been analyzed and it is clear that PEGASIS is an energy efficient routing protocol which can been seen by detailed analysis of Residual Energy of all the protocols.

Reference

[1] Karkuzhali S, Kumaran G and Dr. Manju A ," Communication and Interference Aware Query Scheduling in a Wireless Sensor Networks", IJARCSSE. Volume 5, Issue 4, 2015

[2] YING-HONG WANG AND CHIH-CHIEH CHUANG "Ad Hoc On-Demand Backup Node Setup Routing Protocol " JOURNAL OF INFORMATION SCIENCE AND ENGINEERING 20, 821-843 (2004)

[3] Champa devi, himanshu saini and Vivek kumar"Performance Analysis of DSDV,AODV AND DSR Routing Protocol In MANET s" IJARCE Vol. 2, No. 5 ,May 2015 E - ISSN: 2348 - 5523

[4] T. Rajath and R. Nagendra "Sensor Deployment and Scheduling in Wireless Sensor Networks ", International Journal of Advent Research in Computer and Electronics (IJARCE) Vol. 2, No. 5 , May 2015 E - ISSN: 2348 – 5523

[5] Pooja, Sandeep jaglan and Reema gupta, "Comparative Analysis of AODV & AOMDV Reactive Protocols" , Volume 4, Issue 8, August 2014 IJARCSSE.

[6] Eman Abdelfattah,"Mobile Ad-Hoc Routing Protocols: Evaluation of Performance" Aug 18, 2008

[7] Samia A. Ali and Shreen K. Refaay, "Chain-Chain Based Routing Protocol", IJCSI International Journal of Computer Science Issues, Vol. 8, Issue 3, No. 2, May 2011.

[8] Tarun Gulati and sunita Rani, "An improved pegasis protocol to enhance energy utilization in WSN", International Manuscript ID: ISSN2249054X-V2I3M7-052012 VOLUME 2 ISSUE 3 May 2012.