A Review: Power efficient Gathering in Sensor Information System (PEGASIS) protocol for WSN

Patwant Singh[1], Satbir Singh[2]

[1] *M.Tech Student, Electronics & Communication, GNDU REC Gurdaspur,India*
[2] *Assistant Professor, Electronics & Communication, GNDU REC Gurdaspur,India*

Abstract -*Wireless sensor network is a network consisting of various number of small nodes deployed in the remote areas to perform the task of sensing, computation and data forwarding. These sensor nodes keep on getting drained in the energy whenever the data transmission phase comes into action. To achieve a longer lifetime these nodes are dealt with various routing techniques which makes the communication between nodes and Base Station much more economical in terms of energy consumption. Among various routing techniques, Hierarchical routing has been the much effective one, here in this paper, a review of chain based topology being termed as PEGASIS (Power efficient Gathering in Sensor Information System) has been reviewed. PEGASIS protocol is very much significant in small area network. After studying various variants of PEGASIS, the research gap is being brought under the spotlight in order to enhance network lifetime. Although LEACH has put on a great impact on network by exploiting the clustering topology, But PEGASIS doesn't any include cluster formation in the network, in fact data is passed through forming a chain till it reached to the Base Station.*

Key Words: PEGASIS (Power efficient Gathering in Sensor Information System), Wireless Sensor Network, LEACH

1. INTRODUCTION

Advancement in wireless communication has made possible the development of wireless sensor networks comprising of devices called sensor nodes. Sensor nodes are low power, small size & cheap devices, capable of sensing, wireless communication and computation. As soon as the sensors are deployed in the network they configure themselves and connect with each other for data collection and thereby forwarding the data to the Base Station.

Application of sensor network is in wide domain, as these sensors measure all kinds of ambient conditions in the environment surrounding them for example temperature, sounds light or the presence of other subjects, disaster management. In the recent years WSNs has emerged as an important technology for monitoring physical environment [1].

These WSNs finds its applicability in wide range of applications such as Military surveillance, environment monitoring, space exploration, disaster relief, health care monitoring, weather monitoring. Deployment of a sensor network in these applications can be in random fashion (e.g., dropped from an airplane in a disaster management application) or manual (e.g., fire alarm sensors in a facility or sensors planted underground for precision agriculture) [2]. Creating a network of these sensors can assist rescue operations by locating survivors, identifying risky areas, and making the rescue team more aware of the overall situation in a disaster area [3].

The rest of paper is being discussed like, section 2 covers the routing protocols in WSN, Section 3 gives the introduction to the PEGASIS protocol, Section 4 gives the study or the literature review of the different variants of PEGASIS protocol, Section 5 will put a light on conclusion and future scope along with the references.

2. ROUTING PROTOCOLS IN WSN

Routing is one the important aspect which handles the data transmission among the nodes and between the nodes and Base Station. The classification of routing protocol is performed in the following manner.

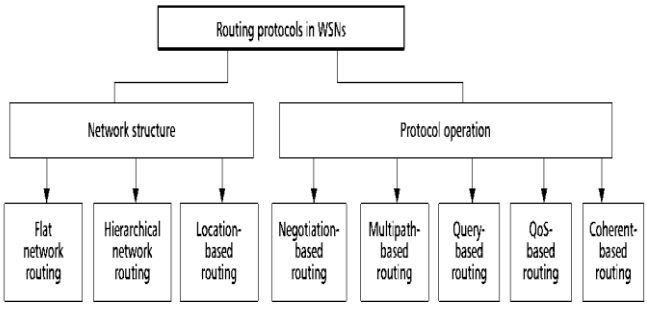

Fig-1 Routing protocols in WSNs

The explanation about these protocols can be studied from the [4]. The review work in this paper focus on the Hierarchical Network Routing protocols, specifically on the PEGASIS protocol.

3. POWER EFFICIENT GATHERING IN SENSOR INFORMATION SYSTEM (PEGASIS) PROTOCOL

Wireless sensor nodes sense data and send it directly to the base station or they perform a clustering procedure as in LEACH [5]. LEACH is known for cluster formation which contains cluster members sensing the data and the cluster head which gathers the data collected in a fused manner (all the data is sent as a single packet) to the base station. This procedure has gained in conserving a lot of energy that would otherwise be wasted. PEGASIS is an extension to LEACH [6].

The key idea in using PEGASIS is that it uses all the nodes to transmit or receive with its closest neighbor nodes. This is achieved by the formation of a chain as shown in the Figure 2.3 below. All the nodes which collect the data fuse it with the data received by the neighbor node and transmit it to the next-nearest neighbor. In this way all the nodes receive and fuse their data, and pass it to the next neighbor in a chain format till they all reach the base station. Every node in the network takes turns as a leader of the chain and the one responsible to transmit the whole fused data collected by the chain of nodes to the base station.

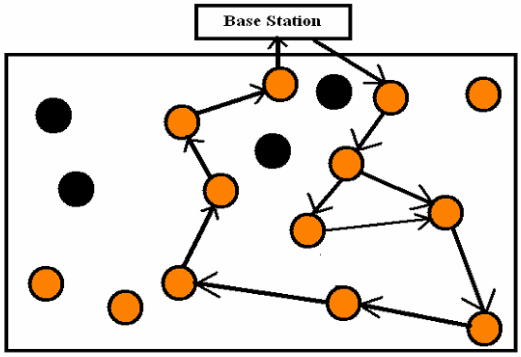

Fig-2 PEGASIS Chain Based Protocol [6]

The significant advantages of this protocol are:

1) PEGASIS is greedy chain protocol which leads to reduce the overhead caused due to many cluster heads.
2) When a sensor node dies, chain is reconstructed to bypass the dead node. So the initial topology is not affected.
3) Head node receives all the aggregated data and transmits further to the base station.

There are few disadvantages of this protocol such as:

1) PEGASIS assumes that each sensor node is capable of communicating with the BS directly. In practical cases, sensor nodes use multi-hop communication to reach the BS.
2) PEGASIS assumes that all sensor nodes have the equal level of energy and are likely to die at the same time.
3) PEGASIS introduces excessive delay for distant nodes on the chain.
4) The single leader can become a bottleneck Application Field:
5) This protocol is most appropriate for surveillance application such as motion detection and knowing its characteristics.

4. RELATED WORK ON THE PEGASIS PROTOCOL

Since the day PEGASIS came into existence the network lifetime has been getting consistent improvement with the various optimization techniques being adopted for the leader node selection or for the selection of routing path. Various works has been done on making the PEGASIS successful enough to satisfy the demand of the ongoing research applications which are compatible in employing the chain based topology in the network.

YU Yong-chang and WEI Gang [7], [2008].In this paper, authors proposed an algorithm to build chain by adopting a threshold distance to decrease the formation of long link. It selects the leader by considering both the residual energy of nodes and the distance between node and base station and adjusts the reselection frequency of leader according to remaining nodes in the network. The results show that the proposed method has better performance than PEGASIS.

Feng Sen, et al. [8], [2011].In this paper, authors proposed an algorithm to build chain, and uses weighting method when selecting the leader node, that is assigning each node a weight so as to represent its appropriate level of being a leader which considers residual energy of nodes and distance between a node and base station (BS) as key parameters. The results show that the proposed method has a better performance than EEPB on balancing energy consumption and prolonging lifetime of Wireless Sensor Networks (WSN).

Hasan Al-Hasan, et al. [9], [2011].In this paper, authors proposed a hierarchical routing protocol for stationary wireless sensor networks. The proposed method used a new chain construction algorithm and chain leader election method that plays a very critical role in the energy saving. The results show that this protocol solved the main problems in PEGASIS and also increased both the lifetime and the throughput of the wireless sensor network.

Mr. Ravinder Kumar and Dr. P. S. Mundra [10], [2012].In this paper authors proposed an efficient hierarchical chain based routing protocol which was not

suitable for large sensor networks with power and time constraints. He used the concept of Beam Star topology to divide the whole sensing field into a number of smaller areas, so that it can create multiple shorter chains to reduce the data propagation delay and redundant transmission path, thus significantly improved the data delivery of the packets as compare to the Chiron and routing was done between cluster head (CH) to cluster head and network is divided into two parts so that the chain leader of the same covering angle will transmits the data to the next chain leader but in the same covering angle in the sequential manner. Since the number of sensor elements were reduced so sensing time and power dissipation reduced and data delivery was improved.

Wang Linping in [11] has proposed an enhanced algorithm of PEGASIS which balances the load on each node and improves the network lifetime. In PEGASIS, there is only one cluster head in each chain whereas in PDCH i.e. PEGASIS Double Cluster Head, there are double cluster heads which avoids the long chain problem existing in PEGASIS. Simulations have been performed to compute the rounds of communication and the percentage of dead nodes in each round of communication. In the future work, PDCH can perform better as compared to EEPB and PEGASIS for raising the system distributed and parallel processing.

Zibouda [12], 2012 has proposed a new protocol i.e. PEGASIS-MH in order to minimize the consumption of energy and to enhance the life time of sensor network. PEGASIS-MH protocol is developed for multi-hopping within the sensing field. In case of single hop, cluster heads that are located away from Base station are prone to depletion of energy as they utilize strong signals in order to reach BS. Therefore, multi-hop routing concept is utilized between the cluster heads to overcome the drawback which was there in single hop routing concept. The simulation has been done using NS-2 simulator and the results show that the PEGASIS-MH is far better as compared to other protocols such as LEACH, PEGASIS and Hierarchical PEGASIS in terms of lifetime and energy efficiency. For QoS, fault tolerance integration will be the future work.

Vibha Nehra and Ajay K. Sharma [13], [2013].In this paper, authors proposed an algorithm by using average distance among the sensor nodes as the criteria for chaining and thereby providing better performance in terms of energy dissipation and amount of information sent to BS. The chaining speed of proposed method is faster than PEGASIS. This algorithm avoids the formation of LL and provides a stable and balanced lifetime to the network. The s results proved that purposed algorithm outperforms PEGASIS by achieving higher energy efficiency extending lifetime of network.

R. Sittalatchoumy and L. Sivakumar [14], [2014].In this paper, authors proposed a modified version of PEGASIS to reduce the energy consumption in Wireless sensor Networks. Two possible routing algorithms were implemented. The proposed method outperforms PEGASIS and EEPB by eliminating the overhead of dynamic cluster formation, minimizing the distance non-cluster heads must transmit, limiting the number of transmissions and receives among all nodes, and using only one transmission to the BS per round. Distributing the energy load among the nodes increased the lifetime and quality of the network. Results show that proposed method performs better than PEGASIS and EEPB.

Madhuri Gupta [15] [2014] has proposed a variant approach for chain formation in the wireless sensor network which is a modified version of chain based PEGASIS protocol. In this paper, the process of forming chain is modified in order to obtain a chain with multiple degree nodes. This approach considered degree of connectivity and remaining energy of each node. It achieved the target of the improvement in energy consumption and prolong the lifetime of the network. Simulations results achieved 50% better results in average energy consumption by the network under defined scenario. It reduced the node death rate as energy dissipation get reduced by 50% for the defined specification.

5. CONCLUSION AND FUTURE SCOPE

PEGASIS protocol has suffered from various limitations but due to the incorporation of different techniques including optimizations techniques like Honey Bee Optimization, Genetic Algorithm, Particle Swarm Optimization etc., various efficient way to selection of leader node whether on the basis of residual energy or considering the distance to the Base Station, it is being able to achieve its applicability in the real time applications of today's scenario. EEPB where worked on the leader node selection on the weight basis to be assigned to the distance factor or to the energy factor, IEEPB mitigated the long link chain formation in the network. PDCH-PEGASIS ensured the avoidance of long link with the introduction of double cluster head in the network. The study done in this paper explores the PEGASIS protocol in various aspects. Future scope in the PEGASIS lies in working towards the QoS parameters like throughput and delay. PEGASIS can also be implied in the heterogeneous scenario which is one another area seeking its applicability.

REFERENCES

1. Akyildiz, I.F.,W. Su, Y. Sankarasubramaniam, E. Cayirci, "A Survey on Sensor Networks", IEEE Communications Magazine, Vol.40, pp.102-114, August 2002.
2. Jamal N, Al-Karaki, Ahmed E Kamal, "Routing techniques in wireless sensor networks: a survey," IEEE journal on Wireless Communication, Vol.11, No.6, pp.6-28, 2004.
3. Kazem Sohrabym Daniel Minoli, Taieb Znati, "Wireless Sensor Networks, Technology, Protocols and Applications" , A JohnWiley & Sons, Inc., Publication, 2007.
4. Seema Bandyopadhyay and Edward J., Coyle, "An Energy Efficient Hierarchical Clustering Algorithm for Wireless Sensor Networks". IEEE Conference INFOCOM, pp. 189-200, 2003.
5. Wendi B. Heinzelman, Anantha P. Chandrakasan, Hari Balakrishnan, "An Application-Specific Protocol Architecture for Wireless Microsensor Networks", Proceedings of IEEE Transactions on Wireless Communications, Vol.1, No.4, October 2002.
6. Stephanie Lindsey and Cauligi S. Raghavendra," PEGASIS: Power-Efficient GAthering in Sensor Information Systems," IEEE Aerospace Conference Proceeding, pp.1125-1130, 2002.
7. YU Yong-chang, WEI Gang, "An Improved PEGASIS Algorithm in Wireless Sensor Network," Acta Electronica Sinica, vol.36, pp.1309-1313, July 2008.
8. Feng Sen, Qi Bing, Tang Liangrui "An Improved Energy-Efficient PEGASIS-Based Protocol in Wireless Sensor Networks," International Conference on Fuzzy Systems and Knowledge Discovery (FSKD), 2011.
9. Hasan Al-Hasan, Mohammad Qatawneh, Azzam Sleit, Wesam Almobaideen," EAPHRN: Energy-Aware PEGASIS-Based Hierarchal Routing Protocol for Wireless Sensor Networks," Journal of American Science, pp.753-758 ,2011.
10. Ravinder Kumar, P. S. Mundra," Improved Data Gathering Protocol for WSN," International Journal of Electronics and Computer Science Engineering, vol.1, no.3, pp.1208-1213, 2012.
11. Wang Linping, Cai Zhen, "Improved Algorithm of PEGASIS protocol introducing double cluster heads in Wireless Sensor Network", Proceedings of IEEE International Conference on Computer, Mechatronics, Control and Electronic Engineering, pp. 148-151, 2010.
12. Zibouda Aliouat, Makhlouf Aliouat, "Effective Energy Management in Routing Protocol for Wireless Sensor Networks", IEEE International Conference on New Technologies, Mobility and Security, pp.1-5, 2012.
13. Vibha Nehra, Ajay Kumar Sharma, "PEGASIS-E: Power Efficient Gathering in Sensor Information System Extended," Global Journal of Computer Science and Technology, Vol.13, No.15, pp.1-5, 2013.
14. R. Sittalatchoumy, L. Sivakumar," Performance Enhancement of Energy Efficient Protocols for application in WSN," Journal of Theoretical and Applied Information Technology, Vol. 60 No.1, 2014.
15. Madhuri Gupta, Laxmi Saraswat, "Energy Aware Data Collection in Wireless Sensor Network Using Chain Based PEGASIS," IEEE International Conference on Recent Advances and Innovations in Engineering (ICRAIE-2014), pp.1-5, May 09-11, 2014.

