DATA GATHERING AND AGGREGATION METHOD FOR SENSING AND INDICATING THE PH OF FLOWING STREAM

[1]Akanksha Bhagi, [2]Pawan Kumar
[1]Student, [2]Faculty
[1]Indira Gandhi Delhi Technical University for Women,Delhi,India

Abstract*—Lately, the advantages of setting up adhoc networks are realized. Most of these are established in remote areas. The major issue that such networks face are related to energy that such a remote sensing node has. In this paper, we attempt to establish and compare two data gathering and aggregation methods, Maxima-Minima Method and Interval Method on basis of time take for delivery and energy consumed. In Maxima-Minima Method, the data is shared with the base station according to set threshold value. In Interval Method, data packets are shared after every small specified interval.

***Index Terms*—Wireless Sensor Network, Data Gathering, Data Aggregation, Data Scheduling.**

I. INTRODUCTION

Wireless Sensor Networks are physically deployed, distributed collection of nodes [1]. These nodes gather data, process, acquire and send it to either the cluster head or base station for further processing [2]. Most of these networks are deployed in geographies which are hard to reach or military sensitive. It becomes imperative that they are reliable since the applications which they cater to are so designed. WSN nodes face the biggest challenge of energy management. Since they are expected to share data periodically or continuously, the nodes which are energy constrained tend to run of battery. A dead node, even though won't affect the network stability, hampers the very application it is employed.

Data aggregation is a process of combining several data packets received form the nodes at intermediate nodes and transmitting it to the base station (BS) for further processing. Issues like data confidentiality and integrity, security issues, reliability along with energy become important in such a process in wireless sensor networks. Several data aggregation protocols like LEACH (Low Energy Adaptive Clustering Hierarchy) [3], TAG (Tiny Aggregation) [4], PRDA (Polynomial Regression Based Secure Data Aggregation) [5], PEGASIS (Power Efficient Gathering in Sensor Information System) [6] are already well established and in use. In this paper, we establish two separate techniques which describe how this aggregated data is shared with the base station.

The cluster head in an organized network shares the data with the base station using techniques like TDMA [7], CDMA [8], CSMA/CA [9] etc with the base station. These techniques have their own disadvantages. For example, TDMA is heavily affected by deployment strategies and complex to implement in multi-hop scenario. CSMA on the other hand has maximum efficiency when the data traffic is low. CDMA has involves digital signals hence causes energy utilization.

II. DATA GATHERING AND SCHEDULING METHODS

In this paper, we have used two different methods, and compared them with existing methods. The first method, is known as Maxima-Minima Method, while the second method is called the Interval Method. In Maxima-Minima Method, the upper and lower limit of the combined aggregated data packet which is sent from the cluster head (CH) to the base station is fixed. The data is received by the cluster head is accumulated till the minimum packet size is achieved. It is then, immediately sent to the base station. If, in case, a burst is received, and the accumulated packet size is more than the maximum threshold value, the packet is broken down into several different packets, each of which is less than or equal to the maximum packet size as described. It is then shared as per FIFO algorithm. Thus at all times, the packet size varies between minimum and maximum values. In the other method, the Interval Method, the cluster head periodically shares data with the base station, irrespective of the size of the data packet formed at after aggregation. This period is fixed and independent of any surrounding parameters.

III. PROPOSED WORK

In our paper, we have assumed that each cluster head has a fixed bandwidth available at all times to send the data to the base station, thus there is no collision at the base station. It is a single hop system. In our algorithm, we have taken into consideration that there are no nodal failures. It is assumed that the cluster head is selected using LEACH protocol. Each node only shares the data packet once. The node has initial energy of 0.5 Joules. The energy consumed in receiving or transmitting bits is fixed at 0.5 nJ/bit and existing energy equations are used [10].The threshold probability used by the node to determine if it's a cluster head in each round [11].

In Maxima-Minima Method, we have deployed 100 nodes in a grid in 10x10 area. The base station is depicted using a red circle, as in figure 1. Each cluster is divided into 25 nodes. There cluster head is represented using red triangle. The minimum threshold value is set to 2 bits while the maximum value is set to 8 bits. As the data is shared with the cluster head, it forms a single packet which is shared with the base station through designated channel. If the data reaches the minimum threshold, it is right away shared with the base station. If however, the data is packet so formed is bigger than maximum threshold limit, it breaks down the packet till the packet size is less than or equal to the maximum threshold limit. It then shares the data using FIFO method.

In Interval Method, there are 100 nodes deployed in grid in the same conditions. The base station is depicted using a red circle, as in figure 2. Each cluster is divided into 25 nodes with no overlapping. There cluster head is represented using red triangle. The interval for sharing the data is fixed at 30 millisecond. After every such interval, the data packet is shared with the base station.

Similar deployment conditions are used in Hexagonal Cell Based topology. The cluster head is represented using blue dot and the base station is represented using blue triangle.

IV. SIMULATION RESULTS

In our paper, we have used MATLAB to simulate the results. For grid based deployment, it can be observed in figure 5 & figure 6, there is not much energy difference and energy consumed with respect to time in either case is nearly the same. However as in Table 1, it can be noticed that the time is saved in Interval Method as opposed to Maxima-Minima Method.

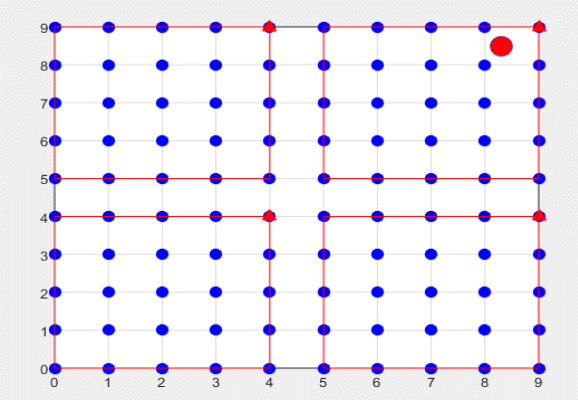

Figure 1: Maxima-Minima Method Grid Deployment

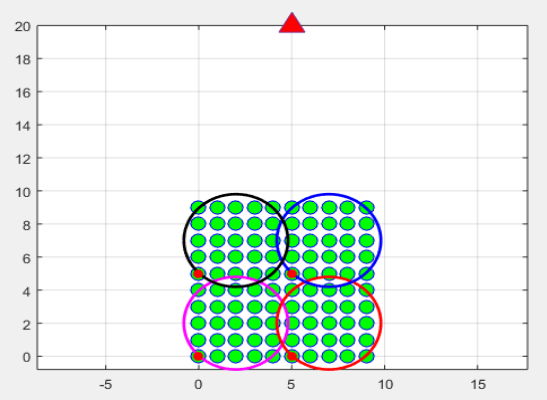

Figure 2: Interval Method Grid Deployment

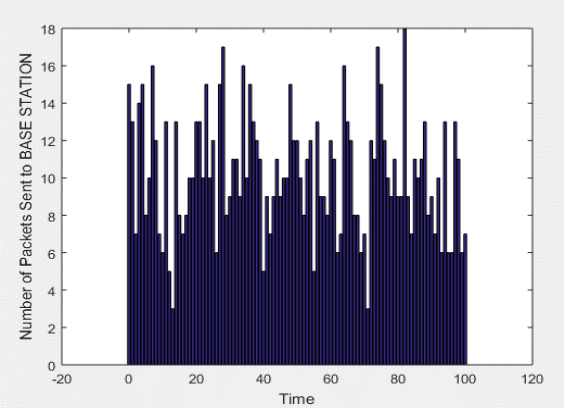

Figure 3: Packets sent to the BS in Maxima-Minima Method in Grid

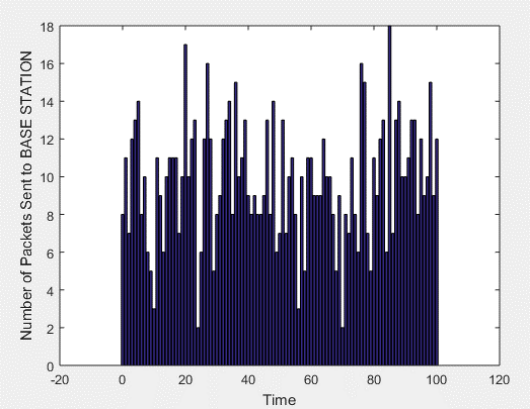

Figure 4: Packets sent to the BS in Interval Method in Grid

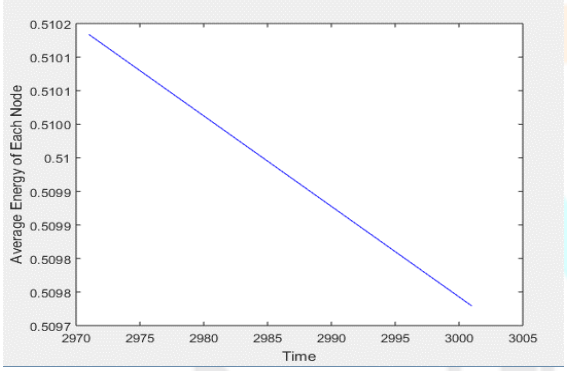

Figure 5: Average Energy plot for each node in Maxima-Minima Method in Grid

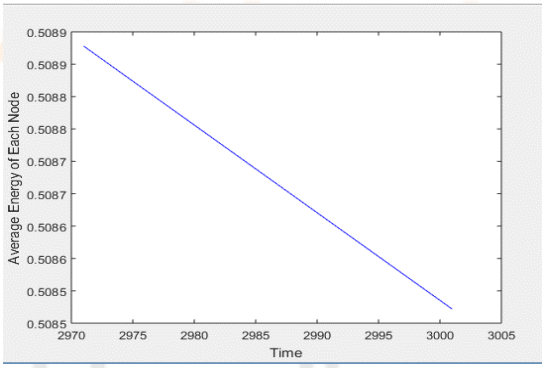

Figure 6: Average Energy plot for each node in Interval Method in Grid

Table 1: Time taken Maxima-Minima & Interval method in Grid

Technique	**Total Time(In Seconds)**
Maxima-Minima Method	57.769636
Interval Method	52.453268

Similarly, for our HEX deployment, from figure 8,9,10 and 11 we observe that energy and time saved in Maxima-Minima Process vis-à-vis Interval Method are nearly the same.

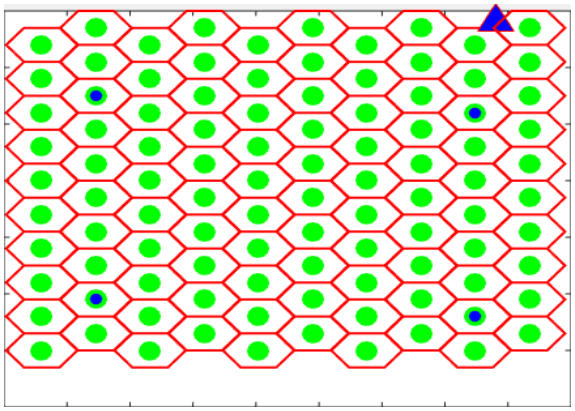

Figure 7: Hex Deployment

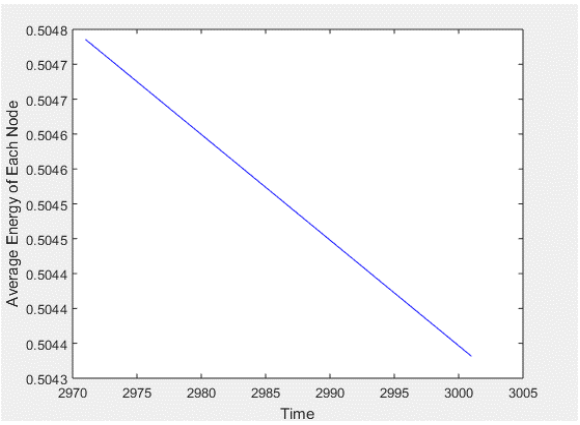

Figure 8: Average Energy plot for each node in Maxima -Minima Method in HEX

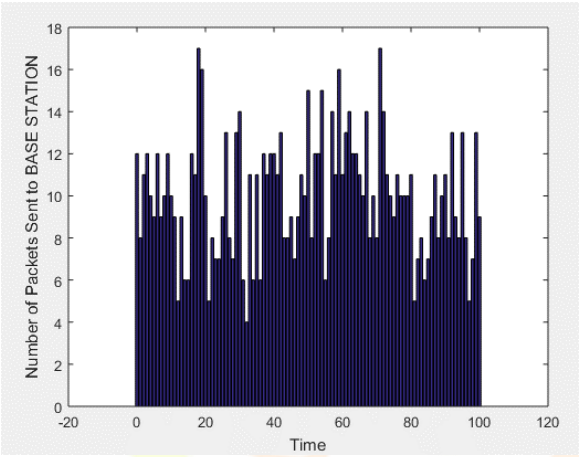

Figure 9: Packets sent to BS in Maxima-Minima method in HEX

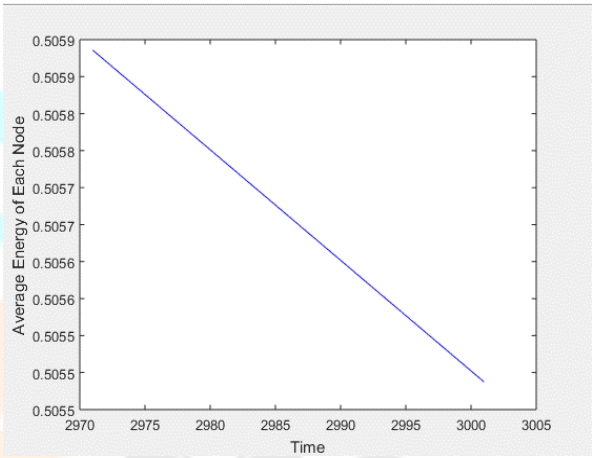

Figure 10: Average Energy plot for each node in interval method in HEX

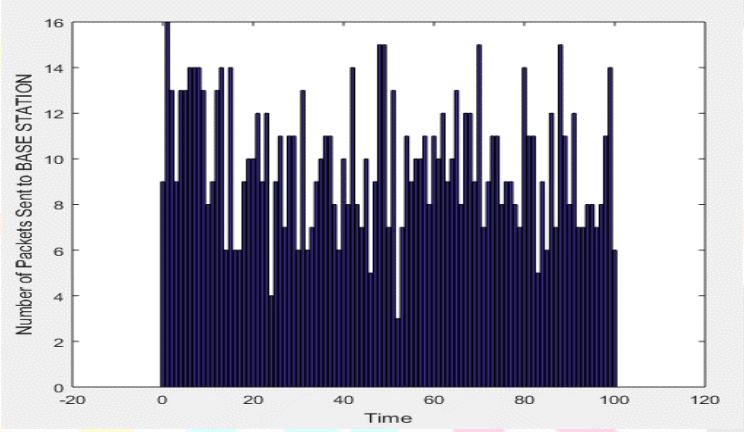

Figure 11: Packets sent to BS in Interval Method in HEX

Table 2: Time taken Maxima-Minima & Interval method in HEX

Technique	**Total Time(In Seconds)**
Maxima-Minima Method	9.169001
Interval Method	8.822937

V. CONCLUSION

It is already observed that TDMA fails in multi or single hop, mesh based deployment [10] [12] [13]. In our method, we have successfully demonstrated two methods in two different topologies which prove efficiency in wireless sensor deployment. In time critical applications, Interval Method is more beneficial as opposed to Maxima-Minima Method. When considering energy conservation, either methods can be employed. It can also be observed that Hexagonal Cell based deployment strategy is more efficient as compared to Grid based deployment.

Table 3: Comparison of Results

Deployment	**Maxima & Minima Method**		**Interval Method**	
	Energy	Time	Energy	Time
Grid	Low	High	Low	Moderate
HEX	Low	Low	Low	Low

VI. ACKNOWLEDGMENT

The authors would like to thank faculty and staff of IGDTUW, Delhi, for providing the facilities for completion of the paper.

REFERENCES

[1] Elby K Eldhose and Jisha G "Active Cluster Node Aggregation Scheme in Wireless Sensor Network Using Neural Network" International Conference on Emerging Trends in Engineering, Science and Technology (ICETEST- 2015), pp 1603-1608.

[2] I.F. Akyildiz, W. Su, Y. Sankarasubramaniam and E. Cyirci "Wireless sensor networks: a survey", Computer Networks 38 (4) (2002) 393-422.

[3] Wendi Rabiner Heinzelman, Anantha Chandrakasan, and Hari Balakrishnan "Energy-Efficient Communication Protocol for Wireless Microsensor Networks", Published in the IEEE Proceedings of the Hawaii International Conference on System Sciences, 2000.

[4] Samuel Madden, Michael J. Franklin, Joseph M. Hellerstein and Wei Hong "TAG: a Tiny AGgregation Service for Ad-Hoc Sensor Network", 5th Annual Symposium on Operating Systems Design and Implementation (OSDI), December, 2002.

[5] Suat Ozdemir and Yang Xiao "Polynomial Regression Based Secure Data Aggregation for Wireless Sensor Networks", IEEE Globecom 2011, pp 1-5.

[6] Stephanie Lindsey and Cauligi S. Raghavendra "PEGASIS: Power-Efficient Gathering in Sensor Information Systems", IEEE Proceedings, Aerospace Conference 2002,pp 3-1125-3-1130, Vol 3.

[7] Victor Cionca, Thomas Newe and Vasile D˘ad˘arlat "TDMA Protocol Requirements for Wireless Sensor Networks", IEEE Second International Conference on Sensor Technologies and Applications 2008, pp 30-35.

[8] C. Fischione, K. H. Johansson, A. Sangiovanni-Vincentelli and B. Zurita Ares "Minimum Energy Coding in CDMA Wireless Sensor Networks" ,IEEE Transactions on Wireless Communications, February 2009, pp 985-994 VOL. 8

[9] Z. Dahham, A. Sali, B. M. Ali and M. S. Jahan "An Efficient CSMA-CA Algorithm for IEEE 802.15.4 Wireless Sensor Networks", IEEE 2012 International Symposium on Telecommunication Technologies, pp 118 – 123.

[10] Surender Kumar ,M.Prateek, N.J.Ahuja and Bharat Bhushan " DE-LEACH: Distance and Energy Aware LEACH" , International Journal of Computer Applications (0975 – 8887) February 2014,pp 36-42 ,Volume 88.

[11] C.Divya, N.Krishnan and T.Gandhi Mathy "Energy Efficient Stable Election Protocol for Clustered Heterogeneous Wireless Sensor Networks" , IOSR Journal of Computer Engineering (IOSR-JCE) Volume 12, Issue 5 (Jul. - Aug. 2013), PP 55-61.

[12] Ichrak Amdouni, Cedric Adjih, Pascale Minet and Thierry Plesse , "Delay Analysis of STDMA in Grid Wireless Sensor Networks", IEEE 2016 International Conference on Military Communications and Information Systems (ICMCIS), pp:1 – 8.

[13] V. A. Kottapalli, A. S. Kiremidjian, J. P. Lynch a,E. Carryer, T. W. Kenny, K. H. Law and Y. Lei "Two-tiered wireless sensor network architecture for structural health monitoring", Smart Structures and Materials 2003: Smart Systems and Nondestructive Evaluation for Civil Infrastructures, Shih-Chi Liu, Editor, Proceedings of SPIE Vol. 5057 (2003), volume 5057, pp 8–19.