A Noval Minimum Transmission LEACH Protocol for WSN (Proposed)

Rajni Rani[1] Gagan Kumar[2]
[1]M.Tech. Student [2]Assistant Professor
[1,2]Modern Institute of Engineering & Technology, Mohri

Abstract— Wireless Sensor networks consisting of nodes with limited battery power and wireless communications are deployed to collect useful information from the sensor field. It is very difficult for the sensor network to operate for a long period of time in an energy efficient manner for gathering sensed information. This paper proposes a Minimum Transmission Concept in LEACH (Low- energy Adaptive Clustering Hierarchy) protocol, which is nearly optimal for this data gathering application in sensor networks. The key idea in LEACH is that the gathered data moves from node to another node (the local Base Station), and eventually a designated node transmits to the Base Station. By randomizing the cluster heads chosen to transmit to the base station, LEACH achieves improvement compared to direct transmissions, as measured in terms of when nodes die. The lifetime of such a sensor system is the time during which it gathers information from all the sensors to the base station. Given the location of sensors and the base station and the available energy at each sensor, the paper proposes an efficient manner in which the data should be collected from all the sensors and transmitted to the base station, such that the system lifetime is maximized.

Key words: Clustering Methods, Energy Efficiency, Routing Protocol, LEACH, Wireless Sensor Networks

I. INTRODUCTION

A wireless sensor network consists of small devices, which collect information by cooperating with each other. These small sensing devices are called nodes which consist of CPU (for data processing), memory (for data storage), battery (for energy) and transceiver (for receiving and sending signals or data from one node to another), as shown in Figure 1. The size of each sensor node varies with applications. For example, in some military or surveillance applications it might be microscopically small.

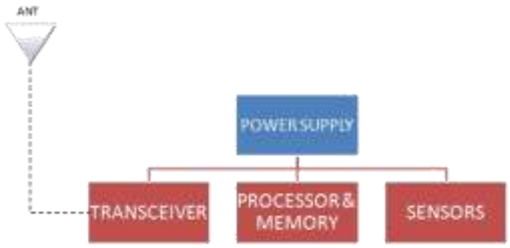

Fig. 1: Sensor Node Architecture

Today, wireless sensor networks are widely used in the commercial and industrial areas such as for e.g. environmental monitoring, habitat monitoring, healthcare, process monitoring and surveillance. For example, in a military area, we can use wireless sensor networks to monitor an activity. If an event is triggered, these sensor nodes sense it and send the information to the base station (called sink) by communicating with other nodes.

In WSNs the only source of life for the nodes is the battery. Communicating with other nodes or sensing activities consumes a lot of energy in processing the data and transmitting the collected data to the sink. In many cases (e.g. surveillance applications), it is undesirable to replace the batteries that are depleted or drained of energy. This paper, therefore, trying to find power-aware and enhanced system lifetime protocols for wireless sensor networks in order to overcome such energy efficiency problems.

A. *Energy Dissipation Radio Model*

We assume a simple model for the radio hardware energy dissipation where the transmitter dissipates energy to run the radio electronics and the power amplifier, and the receiver dissipates energy to run the radio electronics, as shown in Figure 2. Depending on the distance between the transmitter and receiver, both the free space (d2 power loss) and the multi path fading (d4 power loss) channel models are used. If the distance is less than a threshold crossover distance, the free space model is used; otherwise, the multi path model is used. Thus, to transmit a k-bit message a distance d, the radio expends:

$$E_{Tx}(k,d) = E_{Tx-elec}(k) + E_{Tx-amp}(k,d)$$

$$E_{Tx}(k,d) = E_{elec}*k + \varepsilon_{fs} * k * d^2 \qquad d<do$$

$$E_{Tx}(k,d) = E_{elec}*k + \varepsilon_{mp} * k * d^4 \qquad d>do$$

The electronics energy E_{elec} depends on factors such as the digital coding, modulation, filtering, and spreading of the signal, whereas the amplifier energy depends on the distance to the receiver and the acceptable bit-error rate. For the experiments described in this paper, the communication energy parameters are set as:

$$E_{Rx}(k) = E_{Rx-elec}(k)$$

$$E_{Rx}(k) = E_{elec}*k$$

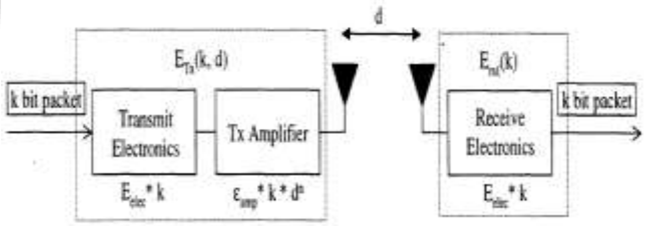

Fig. 2: Radio Energy Dissipation Model

II. LEACH PROTOCOL

Low Energy Adaptive Clustering Hierarchy (LEACH) is the first hierarchical cluster-based routing protocol for wireless sensor network which partitions the nodes into clusters, in each cluster a dedicated node with extra privileges called Cluster Head (CH) is responsible for creating and manipulating a TDMA (Time division multiple access) schedule and sending aggregated data from nodes to the BS where these data is needed using CDMA (Code division multiple access). Remaining nodes are cluster members. This protocol is divided into rounds; each round consists of two phases:

In the Set up phase, all the sensors within a network group themselves into some cluster regions by communicating with each other through short messages. At a point of time one sensor in the network acts as a cluster head and sends short messages within the network to all the other remaining sensors. The sensors choose to join those groups or regions that are formed by the cluster heads, depending upon the signal strength of the messages sent by the cluster heads. Sensors interested in joining a particular cluster head or region respond back to the cluster heads by sending a response signal indicating their acceptance to join. Thus the set-up phase completes.

$$T(n)=\begin{cases}\frac{P}{1-P\left(r \bmod \frac{1}{P}\right)} & n\epsilon G\end{cases}$$

As soon as a cluster head is selected for a region, all the cluster members of that region send the collected or sensed data to the cluster head. The cluster head transmits this collected data to the base station which completes the second phase, called the Steady State Phase.

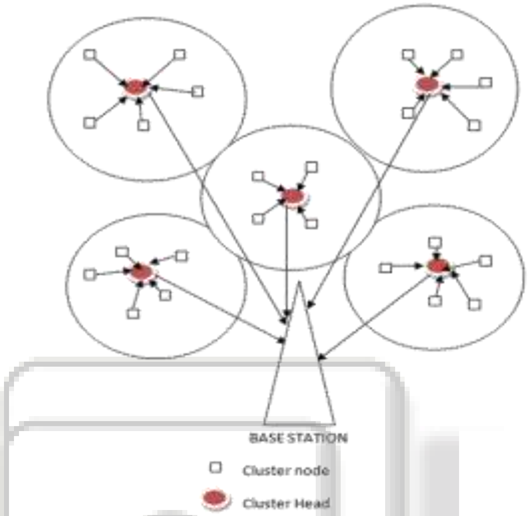

Fig. 3: LEACH Protocol Architecture.

Although LEACH protocol acts in a good manner, it suffers from many drawbacks such like;

– CH selection is randomly, that does not take into account energy consumption.
– It can't cover a large area.
– CHs are not uniformly distributed; where CHs can be located at the edges of the cluster.

Since LEACH has many drawbacks, there is a requirement to make this protocol performs better.

III. PROPOSED PROTOCOL

In our new version of LEACH protocol, we introduced a Minimum Transmission LEACH Protocol, the Protocol contains;

– Cluster Nodes (responsible only for gathering data from environment and send it to the CH),
– Cluster Heads outside radius (the nodes which is located outside from a pre-defined radius to the Base Station),
– Cluster Heads inside radius (the nodes which is located inside a pre-defined radius to the Base Station), as shown in figure 4.

In the original LEACH, the CH is always on receiving data from cluster members, aggregate these data and then send it to the BS that might be located far away from it. The CH will die earlier than the other nodes in the cluster because of its operation of receiving, sending and overhearing. When the CH die, the cluster will become useless because the data gathered by cluster nodes will never reach the base station.

Minimum Transmission LEACH- The fundamental concept of this protocol is that there is a radius around the Base Station, some nodes are inside the radius and others are outside the radius. Cluster Heads which are outside the radius find the nearest Cluster Head which is inside the radius and send data to it. Then these inside Cluster Heads aggregate the data and send it to the Base Station. So that the distance of transmission is reduced and hence reducing energy dissipation. Architecture of Minimum Transmission LEACH is shown in figure 4

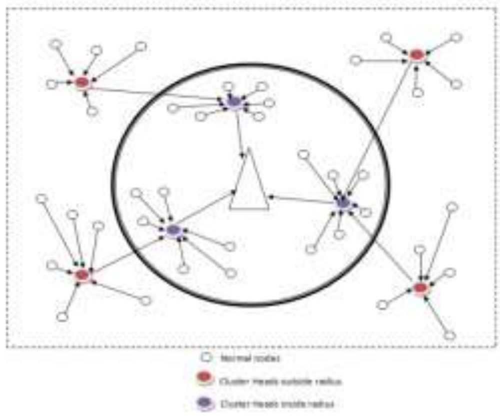

Fig. 4: Minimum Transmission LEACH Protocol Architecture

IV. SIMULATION RESULTS

To validate the performance of LEACH protocol, we simulate the protocol and utilize a network with 100 nodes randomly deployed between (x=0, y=0) and (x=100, y=100) and base station at (50, 50). The bandwidth of channel is set to 1 Mb/s; each data message is 500 bytes long. The initial power of all nodes is considered to be 0.5J.Parameters are shown in Table 1. Simulation result of LEACH protocol is shown in figure 5.

PARAMETERS	
Number of Nodes	100
Network Size	100m*100m
Base Station Location	(50,50)
Radio Propagation Speed	$3*10^8$ m/s
Processing Delay	50 µs
Initial Energy of node	0.5J

Table 1: Result

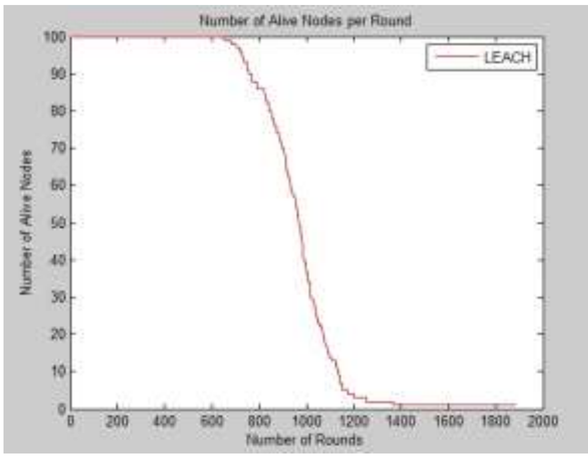

Fig. 5: Simulation Results of LEACH

V. CONCLUSIONS

In this paper we considered a well-known protocol for wireless sensor networks called LEACH protocol which is the first and the most important protocol in wireless sensor network which uses cluster based broadcasting technique. Followed by a new version of LEACH protocol called Minimum Transmission LEACH Protocol. From the simulation results, we can draw a number of conclusions.

- First Node in LEACH protocol dies approximately at 650th round
- All Nodes dies approximately at 1350th round. In our new Protocol 35 % Improvement is expected.

REFERENCES

[1] M. Yebari, T. Addali, A.Z.Sadouq and M. Essaaidi, “Energy conservation challenges in Communication Protocols for Wireless Sensors Networks: State-of-The-Art Study”, International journal on Information and Communication Technologies, Vol. 1, No. 1-2, January-June 2008, pp. 29-35.

[2] W. Heinzelman, A. Chandrakasan and H. Balakrishnan, “Energy-efficient Communication Protocol for Wireless Microsensor Networks”, Proceeding of the 33rd Hawaii International Conference on System Sciences, January 2000.

[3] S. Lindsey, C. Raghavendra, “PEGASIS: Power-efficient Gathering in Sensor Information Systems”, IEEE Aerospace Conference Proceedings, Vol. 3, 9-16 pp. 1125-1130, 2002.

[4] A. Manjeshwar and D. P. Agrawal, “APTEEN: A Hybrid Protocol for Efficient Routing and Comprehensive Information Retrieval in Wireless Sensor Networks”, Proc. Int’l. Workshop on Parallel and Distributed Computing Issues in Wireless Networks and Mobile Computing, April 2002.

[5] W. Heinzelman, A. Chandrakasan, and H. Balakrishnan, “An application specific protocol architecture for wireless micro sensor networks”, IEEE Transaction on Wireless Networking, vol. 1, no. 4, pp. 660-670, Oct. 2002.

[6] C. Li, M. Ye, G. Chen, J. Wu, “An energy-efficient unequal clustering mechanism for wireless sensor networks”, Proceedings of the 2nd IEEE International Conference on Mobile Ad-hoc and Sensor Systems MASS’05, 2005.

[7] Y. He, Y. Zhang, Y. Ji, X.S. Shen, “A new energy efficient approach by separating data collection and data report in wireless sensor networks”, Proceedings of the International Conference on Communications and Mobile Computing, 2006.

[8] Y. Kiri, M. Sugano, M. Murata, “On characteristics of multi-hop communication in large-scale clustered sensor networks”, IEICE Transactions on Communications E90-B, 2007.

[9] StanislavaSoro, Wendi B. Heinzelman, “Cluster head election techniques for coverage preservation in wireless sensor networks”, Journal of Ad Hoc Networks 7, pp. 955–972, 2009.

[10] M.J. Handy, M. Haase, D. Timmermann, “Low energy clustering hierarchy with deterministic cluster head selection”, Proceedings of IEEE MWCN, 2002.

[11] O. Younis, S. Fahmy, “An experimental study of routing and data aggregation in sensor networks”, Proceedings of the 2nd IEEE International Conference on Mobile Ad-hoc and Sensor Systems MASS’05, 2005.

[12] M. Qin, R. Zimmermann: VCA, “An energy- efficient voting-based clustering algorithm for sensor networks”, Journal of Universal Computer Science 13(1), 2007.