INTERNATIONAL JOURNAL FOR TRENDS IN ENGINEERING & TECHNOLOGY
VOLUME 3 ISSUE 3 – MARCH 2015 – ISSN: 2349 – 9303

Analysis of Packet Loss Rate in Wireless Sensor Network using LEACH Protocol

N.S.Thiagarajan
M.E Communication Systems
SRM Valliammai Engineering College
Kattankalathur-603 203
thiagarajan1142@gmail.com

Abstract: Wireless sensor network (WSN) is used to collect and send various kinds of messages to a base station (BS). Wireless sensor nodes are deployed randomly and densely in a target region, especially where the physical environment is very harsh that the macro-sensor counterparts cannot be deployed. Low Energy Adaptive Clustering Hierarchical (LEACH) Routing protocol builds a process where it reduces the Packet Loss Rate from 100 % to 55% .Simulations are carried out using NS2 simulator.

Keywords: Cluster head, Sensor nodes, LEACH

1. INTRODUCTION

WSN could be a terribly massive array of various sensor nodes that are interconnected by a communication network. The elementary elements of a sensor node are a sensing unit, a process unit, a transceiver unit and a power unit. The sensor node senses the physical amount being measured and converts it into an electrical signal. Then, the signal is fed to an A/D convertor and is prepared to be employed by the processor. The processor can convert the signal into data looking on how it's programmed and it sends the data to the network by employing a transceiver. The sensing unit shared between the sensor nodes and are used as input for a distributed estimation system..

The fundamental objectives for WSN are responsibility, accuracy, flexibility, price effectiveness, and ease of deployment. WSN is formed from individual multifunctional sensor nodes. As we all know that Wireless Sensor Network principally consists of little sensor node that is provided with a restricted power supply. The period of associate degree energy-constrained sensor node is set by how briskly the sensor node consumes energy. A node within the network is not any longer helpful once its battery dies. Researchers are currently developing new routing mechanisms for sensor networks to save lots of energy and pro-long the sensing element period. The dynamic clustering protocol permits us to house out the work it must transmit information. The WSN is applied to a large vary of applications, like atmosphere m period of the nodes, environmental observation, industrial sensing, infrastructure protection, battle field awareness and temperature sensing. So, it's essential to boost the energy potency to boost the standard of application service.

2. RELATED WORKS

In LEACH [1], for the complete network, nodes hand-picked in step with a fraction p from all sensor nodes are chosen to function as cluster heads (CHs), where p may be a design parameter. The operations of LEACH are divided into many rounds. Each round includes a setup phase and a steady-state phase. Throughout the setup phase, every node can decide whether to become a CH or not based on predefined criterion. After CHs are chosen, each of the alternative nodes can choose its own CH and be part of the cluster in step with the facility of the many received broadcast messages. Every node can select the closest CH. Throughout the steady-state section, CHs fuse the information received from their cluster members and send the consolidated data to BS by single-hop communication. LEACH uses randomization to rotate CHs for every spherical so as to equally distribute the energy consumption. Therefore LEACH reduces the number of data directly transmitted to BS and balance WSN load, so achieving an element of eight times improvement compared with transmission mechanism.

In [6], the authors planned a Hybrid, Energy-Efficient Distributed Clustering Algorithm (HEED). HEED is improvement of LEACH on the style of CH selection. In every round, HEED selects CHs according to the residual energy of every node and a secondary parameter like nodes proximity to their neighbors or nodes degrees. By iterations and competition, HEED ensures just one CH at a definite range, therefore uniform CHs distribution is achieved across the network. Compared with LEACH, HEED effectively prolongs network lifespan and is appropriate for things like wherever every node has totally different initial energy.

However, LEACH and HEED consume energy heavily within the head nodes that makes nodes die quickly. S. Lindsey et al. Planned to put an algorithm associated with LEACH, and it's referred to as PEGASIS [8]. PEGASIS could be a nearly optimum power economical protocol that uses GREEDY algorithm to create all the sensing element nodes within the network form a sequence. In PEGASIS, the (i mod N) th node is chosen to be a leader and therefore the leader is that the only 1 that must communicate with BS in round i, N is that the total quantity of

nodes. Data is collected by ranging from each endpoints of the chain, and transmitted on the chain, and fused when it transmits from one node to consequent till it reaches the leader. thus PEGASIS sharply reduces the entire quantity of knowledge for long-distance transmission and achieves a much better performance than LEACH by 100% to 300% in terms of network period.

Tree-Based Clustering (TBC) [7] is also an improved protocol of LEACH. It forms many clusters within the same manner as LEACH, and every cluster includes a cluster-head (CH). The nodes among a cluster construct a routing tree wherever the cluster-head is that the root of it. For tree configuration, the cluster-head uses the distance between the sensor nodes and itself. Every node is location-aware, it will estimate the gap between the root and itself. Each cluster is split into some levels. The distance of a node to the root is that the basis for deciding its level within the cluster. The cluster-head is at level-0(root) and a node in level can select the node in and nearest to itself as its parent node. Data transfer at the same time happens between the nodes in 2 close levels, and every node fuses the received knowledge and transmits it to its parent. TBC is a excellent protocol within which every node records the data of its neighbors and builds topography through computing, that is analogous to GSTEB. However some cluster-heads within the network consume a lot of energy than alternative nodes once BS is found far.

PEDAP [9] could be a tree-based routing protocol that creates all the nodes kind a minimum spanning tree, that uses minimum energy for information transmitted. It additionally has another version known as PEDAP-PA that slightly will increase energy for information transmitted however balances energy consumption per node. PEDAP has an equivalent network assumption as PEGASIS and uses data fusion. However, both PEDAP and PEDAP-PA are protocols that require BS to create the topography which is able to cause an oversized quantity of energy waste. This can be as a result of it, if the network desires BS to create the topography, BS ought to send lots of data to the sensor nodes, together with what time is that the Time Division Multiple Access (TDMA) slot, who are their child nodes and Who are their parent nodes. This type of data exchanging can cause lots of energy to be wasted or can cause an extended delay.

3. LEACH

LEACH is represented as a mixture of a cluster-based architecture and multi-hop routing. The term cluster-based is explained by the very fact that sensor nodes using the LEACH protocol functions are based on cluster heads and cluster members. Multi-hop routing is employed for inter-cluster communication with cluster heads and base stations.

Wireless sensors sense data, combine them then send data to the Base Station from a remote area through radio transmission theme as communication medium. Data that is collected by the sensor nodes is distributed to the Base station. Throughout this method plenty of problems occur, like Data collision and also the data aggregation.

LEACH is employed to reduce the data aggregation problems by employing a native data fusion that performs a compression of the number of data that's collected by the cluster head before it sends it to the base station. All sensors form a self-organized network by sharing the role of a cluster head a minimum of once. Cluster head is responsible for sending the data that is collected by the sensor nodes to the base station. It tries to balance the energy dissipation inside the network and enhances the network's life time by rising the life time of the sensor nodes.

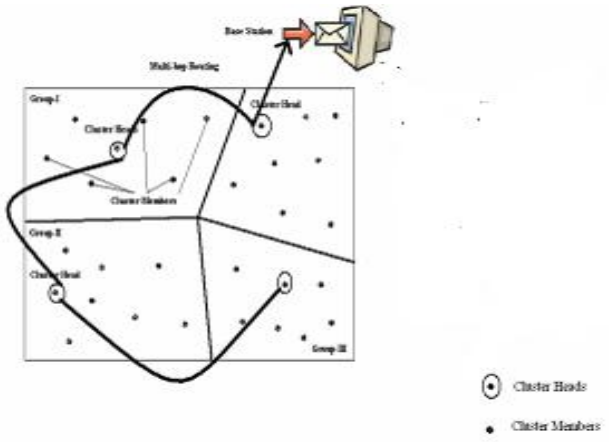

Fig 1. Representation of LEACH protocol

4. OPERATIONS OF LEACH

The operation of LEACH is split into rounds. Every round begins with a set-up phase where the clusters are organized, followed by a steady-state phase wherever many frames of data are transferred from the nodes to the cluster-head and onto the Base Station

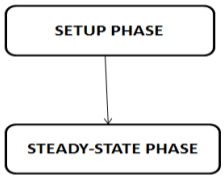

Fig 2. Operations of LEACH protocol- Flow Diagram

4.1 Setup Phase

In LEACH, nodes take autonomous choices to make clusters by employing a Distributed algorithm m without centralized management. Here no long-distance communication with the Base station is needed and distributed cluster formation can be done without knowing the precise location of any of the nodes within the network. Additionally, no international

communication is required to line up the clusters. The cluster formation algorithm ought to be designed specified that nodes are cluster-heads approximately the same number of times, assuming all the nodes begin with constant quantity of energy. Finally, the cluster-head nodes ought to be spread throughout the network, as this can minimize the distance of the non-cluster-head nodes, which want to send their data. A sensor node chooses a random number, r, between 0 and 1. Let a threshold value be T(n) :

$$T(n)= p/1-p \times(r \bmod p-1).$$

If this random number is a smaller amount than a threshold value, T(n), the node becomes a cluster-head for this round. The threshold value is calculated based on the above equation that comes with the required percentage to become a cluster-head for the current round and the set of nodes that have not been selected as a cluster-head in the last (1/P) rounds, p is cluster head probability. Once the nodes elect themselves to be cluster-heads, it broadcasts an Advertisement message (ADV). This message may be a little message containing the node's id and a header that distinguishes this message as an announcement message. Every non-cluster-head node determines to which cluster it belongs by selecting the cluster-head that needs the minimum communication energy, based on the received signal strength of the advertisement from every cluster-head. Once every node has set to that cluster it belongs, it should inform the cluster-head node that it will be a member of the cluster. Every node transmits a join-request message (Join-REQ) back to the chosen cluster-head. The cluster- heads in LEACH act as native management centre to co-ordinate the information transmissions in their cluster. The cluster-head node sets up a TDMA schedule and transmits this schedule to the nodes within the cluster. This ensures that there are not any collisions among data messages and conjointly permits the radio parts of every non cluster-head node to be turned off the least bit times except throughout their transmit time, so minimizing the energy dissipated by the individual.

4.2 Steady State Phase

The Steady-State Phase is broken into frames wherever nodes send their data to the cluster-head at the most once per frame throughout their allotted transmission slot. The Setup phase doesn't guarantee that nodes area unit equally distributed among the cluster head nodes. Therefore, the quantity of nodes per cluster is very variable in LEACH, and therefore the quantity of data that every node will send to the cluster-head varies depending on the quantity of nodes within the cluster. To reduce energy dissipation, every non-cluster-head node uses power management to line the number of transmits power based on the received strength of the advertisement. The radio of every non-cluster-head node is turned OFF till its allotted transmission time. Since all the nodes have knowledge to send to the cluster-head and therefore the total bandwidth is fixed, using a TDMA schedule is economical use of bandwidth and represents an occasional latency approach, additionally for being energy-efficient. The cluster-head should keep its receiver ON to receive all the data from the nodes within the cluster. Once the cluster-head receives all the data, it operates on the data then the resultant data is sent from the cluster-head to the Base Station

5. SIMULATION AND RESULTS

In this section we included the screen shots for operations of LEACH protocol and analyzed the Packet Loss Rate of LEACH protocol.

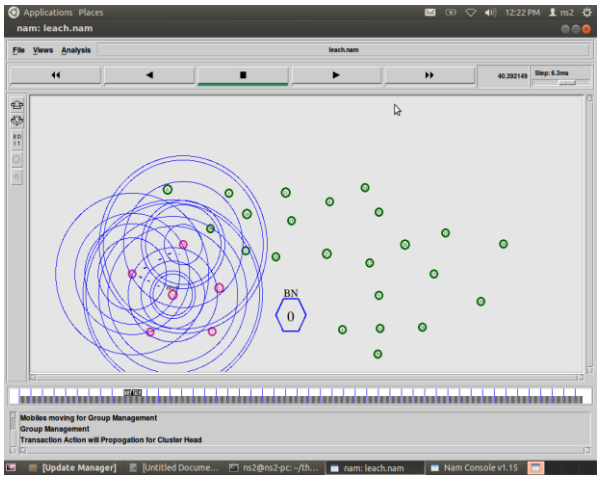

Fig 3 Figure representing Setup phase of LEACH protocol

Figure 2 represents the Setup phase of LEACH protocol. There are 29 sensor nodes and 1 base node. Each nodes group themselves into cluster regions and at one point of time one sensor node in the group acts as Cluster head. The above figure shows Setup phase of Group 1 cluster head. In a similar way setup phase for further groups can be simulated.

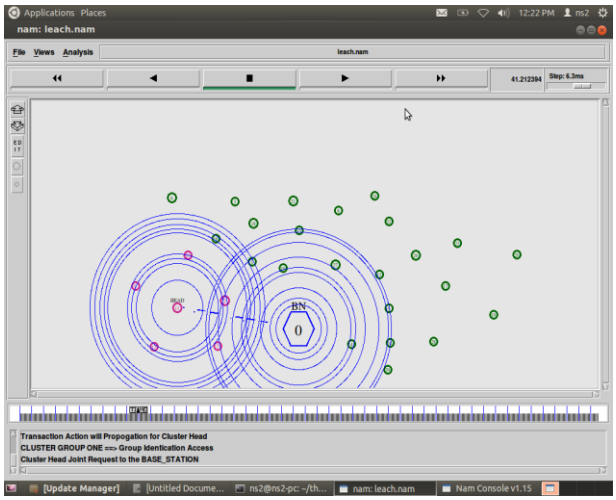

Fig 4 Figure represents Steady State phase of LEACH protocol

The above figure represents the Steady State phase of LEACH protocol. Steady State phase is data transmission from Cluster head to Base Station ie base node. The above figure represents the steady state phase of Group 1 Cluster head.

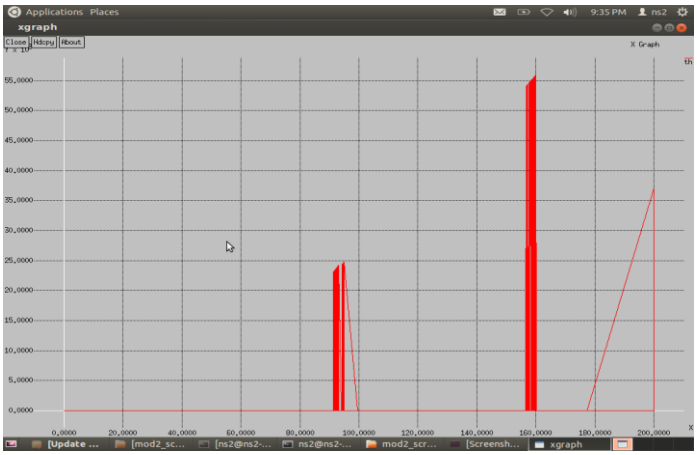

Fig 5 Graph representing Packet Loss Rate (in percentage) Vs Time (in ms)

From the above figure we conclude that there will be a 100% data loss when we use direct transmission from Sensor nodes to Base Station. By using LEACH protocol Packet Loss Rate is reduced from 100% to 55%.

6. CONCLUSION AND FUTURE WORKS

In this paper we improved the Packet Loss Rate of Wireless Sensor Network from direct transmission by using LEACH protocol. Future work can be enhanced by using General Self Organized Tree Based Energy Balanced (GSTEB) routing protocol which includes the Initial phase, Tree constructing phase, Self organized data collecting and transmitting phase and Information exchanging phase.

REFERENCES

[1] Zhiyong Peng, Xiaojuan Ll,"The improvement and simulation of LEACH protocol for WSNs",July 2010.

[2] Wendi Rabiner Heinzelman, Anantha Chandrakasan, and Hari Balakrishnan, "Energy-Efficient Communication Protocol for Wireless Micro-sensor Networks", March 2014.

[3] Mahmood Ali and Sai Kumar Ravula,"Real time support and Energy efficieny in wireless sensor networks", January 2008.

[4] Zhao Han, Jie Wu, *Member*, *IEEE*, Jie Zhang, Liefeng Liu, and Kaiyun Tian," A General Self-Organized Tree-Based Energy-Balance Routing Protocol for Wireless Sensor Network, IEEE TRANSACTIONS ON NUCLEAR SCIENCE, VOL. 61, NO. 2, APRIL 2014.

[5] S. S. Satapathy and N. Sarma, "TREEPSI: Tree based energy efficient protocol for sensor information," in *Proc. IFIP Int. Conf.*, Apr. 2006, pp. 11–13.

[6] O. Younis and S. Fahmy, "HEED: A hybrid, energy-efficient, distributed clustering approach for ad hoc sensor networks," *IEEE Trans.Mobile Computing*, vol. 3, no. 4, pp. 660–669, 2004.

[7] K. T. Kim and H. Y. Youn, "Tree-Based Clustering(TBC) for energy efficient wireless sensor networks," in *Proc. AINA 2010*, 2010, pp.680–685.

[8] S. Lindsey and C. Raghavendra, "Pegasis: Power-efficient gathering in sensor information systems," in Proc. IEEE Aerospace Conf., 2002,vol. 3, pp. 1125–1130.

[9] H. O. Tan and I. Korpeoglu, "Power efficient data gathering and aggregation in wireless sensor networks," SIGMOD Rec., vol. 32, no. 4, pp. 66–71, 2003.

.