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Enhanced Leach for Better Cluster Management Using MAX-HEAP

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Abstract-In this paper Enhancement of Leach is done using MAX-HEAP algorithm for better Cluster Head management. By using MAX-HEAP the no of nodes in under one cluster head is adjusted. So that no over Cluster Head is over loaded. In max-heap cluster head with maximum nodes is selected so that some of the nodes can be shifted to other cluster head's to achieve load balancing. Simulation results are obtained in terms of four metrics- amount of data transmitted, total energy consumed, average no of cluster formation and number of nodes alive. It is observed that the performance of LEACH_MH is somewhat better to LEACH.

Keywords: Wireless sensor network (WSN), Clustering, Leach protocol, Energy Efficient, Max-Heap

I. INTRODUCTION

Wireless sensor networks (WSNs) are ad hoc networks comprised mainly of small sensor nodes with limited resources (low power, low bandwidth, and low computational and storage capabilities) and one or more base stations (BSs), which are much more powerful nodes that connect the sensor nodes to the rest of the world[1].Wireless sensor networks are deployed in the monitoring area by a large number of micro sensor nodes, and the nodes using the wireless communication form a wireless ad hoc network[2].

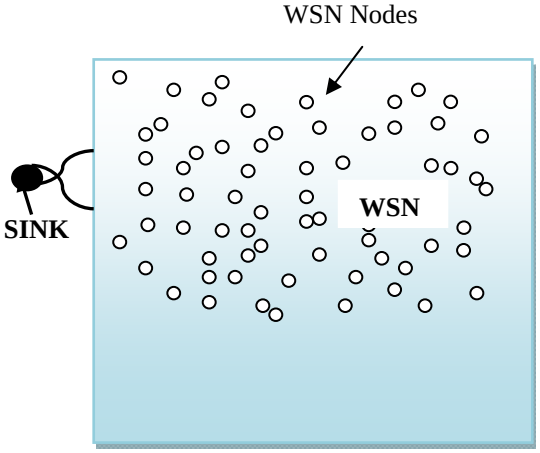

Fig 1 Diagram of Data Flow in a Clustered Network

Sensor nodes have to organize among themselves to get information about the physical environment. The information together by sensor nodes is routed to the base station either directly or through other sensor nodes. The base station is either fixed or mobile node, which is capable of connecting the sensor network to an infrastructure networks or to the internet where users can access and process data[3].

A WSN consist of spatially distributed autonomous sensor nodes to cooperatively monitor physical or environmental circumstances. The nodes talk in the wireless fashion. Source nodes can be transmit their data to target node either directly or through intermediate nodes. These target nodes are connected to a middle gateway, also familiar as base station or sink. Central gateway provides connection to the wired world where data can be collected, processed and analysed[4].

One major application of WSN is to monitor environmental data and to transmit it to a central point called sink node. The sink node analyzes the data which is then used to initiate some particular action. The data analysis agreed out by sink node is to compute smallest or maximum, or computation of average. This data analysis can occur either at the sink node or in the network. If analysis is carry out at sink node every sensed data are to be transmitted to sink node. Upon receiving the data from all the nodes, sink node computes the essential aggregate[5].

Routing in WSN are very challenging due to the inherent characteristics that differentiate this network from other wireless networks or cellular networks. The most important constraint on WSN are the limited battery power or sensor nodes. Restricted computational power and memory size is another constraint. Considering these challenges many routing protocol have been already proposed for WSN. They can be classified into three category :

1. Flat Routing Protocol
2. Hierarchical Routing Protocol
3. Location-Based Network Routing Protocol

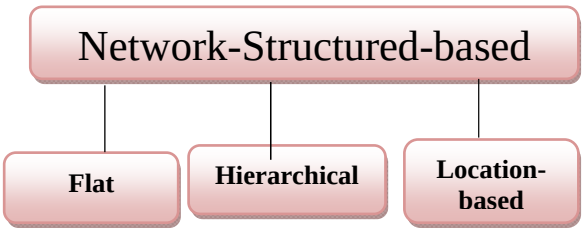

Fig 2 Routing Protocols in WSNs

1. Flat based routing protocol: In this routing all the nodes have the same functionality and they work together to perform sensing and routing tasks[3]. In this type of network it is not possible to assign a global identifier to each node due to large number of nodes. Therefore, base

station can be the send queries to different part of the field and waits for the data from sensors in selected parts of the field. This approach is called data centric routing[5].

2.Hierarchical routing protocol: In this type of network nodes will be assigned different roles in the network like cluster heads, members of clusters, etc. Some of the nodes are responsible for processing and communication, while further nodes can be used for sense the target area. Hierarchical routing is mainly considered as two layer architecture where one layer is engaged in cluster head selection and the other layer is responsible for routing.

Cluster head in hierarchical routing is the node which is responsible for collecting data from other nodes in the cluster, aggregating all data and sending the aggregated data to the base station. create clusters and passing on communication task to cluster heads contributes to a more scalable and energy efficient network[5].

3. Location-based: In location-based network routing, location information of nodes is used to be compute the routing path. This information can be obtained from the global positioning system (GPS) devices attached to each sensor node. Examples of location-based network routing protocols include geography adaptive routing (GAF)and Geographic and Energy-Aware Routing (GEAR)[7].

A. CLUSTERING

one of the important issues in the wireless sensor network is how to save energy consumption to prolonging the network life time. A number of WSN applications need only an aggregate value to be submit to the viewer. In order to maintain data aggregation through well-organized system group, nodes can be separated into a number of small groups called clusters. Each cluster has a organizer, referred to as a cluster head, and a number of element nodes. The cluster formation process ultimately leads to a two-level ladder where the CH nodes form the higher level and the cluster-member nodes form the lower level. The sensor nodes regularly send out their data to the corresponding CH nodes. The CH nodes combined the data (thus reducing the no of transmissions) and broadcast them to the base station (BS) either directly or through the intermediate communication with other CH nodes. A common solution in order balance the energy consumption among all the network nodes is to from time to time re-elect new CHs (thus rotating the CH role among all the nodes over time) in each cluster. The BS is the data processing point for the data received from the sensor nodes, and where the data are access by the end user. It is usually considered fixed and at a extreme distance from the sensor nodes. The CH nodes really act as gateways between the sensor nodes and the BS[10].

B. **LEACH (Low Energy Adaptive Clustering Hierarchy):** One of the most famous hierarchical routing protocols based on clustering, is the LEACH protocol. LEACH incorporates data fusion into the routing protocol to reduce the amount of information that must be transmitted to base station. for us to rely on long lasting node-to-node trust relationship to make protocol secure.

LEACH rearranges the network periodically and dynamically, making it difficult In this method, each cluster members send all the data to the cluster head. The cluster head aggregate this data and send to the BS. So the communication cost is reduced.The operation of cluster forming and data transmission in LEACH is done in two phases.

1. setup phase
2. steady-state phase.

1. Set up phase

In this phase the each node describe whether or not to become a cluster head for current round. All the nodes choose a random number 0 or 1 for complete a decision. A threshold value are setup, if the number of the node is less than threshold value, then the node becomes a cluster head for current round.

2. Steady phase

The network will enter the steady phase when the cluster head assign time slots to its members for using TDMA mode. The steady phase is divided into frame, where nodes send their data to the cluster head at most once per frame during their allocated transmission slot [9].

C. Max Heap

A max binary heap are an almost complete binary tree with keys and objects stored at the nodes, such that a node's key are less than or equal to its parent's. The name "heap" is appropriate: it is described a sort of spreading mound of objects with the largest ones at the top. Note also that the maximum depth of the heap is O (log2n), so provided our operations just move "up and down" the tree, they should run in O (log n) time as required. At each round the rooted CH from the max-heap is selected i.e., the CH which has the maximum number of sensor nodes allotted to it.

II. RELATED STUDY

Nazia Majadi et. al. [1] In this paper, U-LEACH consists of a technique for selecting cluster heads and their corresponding clusters that is Uniform Distribution Technique (UDT). If the coverage area of each CH can be predefined before deciding CHs, then the limitation of uniform distribution of CHs can be improved. The CHs will be efficiently allocated throughout the network. Initially all nodes are homogeneous. The node, which has the maximum remaining energy, advertises itself as the first CH. Then the first CH selects an area, no other node in that particular area can advertise itself as CH. After that another CH is selected from rest of the network. In this way the whole network is divided into some predefined areas. Each area contains one CH and all the nodes in that area constructs a cluster, not a single node will remain outside these areas. Thus the CHs are uniformly distributed throughout the network. The goal of this paper is to build a wireless sensor network in which CHs are uniformly selected based on the remaining energy of the sensor nodes, each sensor node remains inside the transmission range of CHs and therefore, the lifetime of the network is enlarged.

Yi Liu, Shan Zhong, Licai You et. al. [2] proposed a low energy uneven cluster protocol design method. This paper improved the method of randomly choosing cluster head of

LEACH protocol, and removed the defect of the single hop from all the CHs to the sink node.

Firstly, the election model of cluster head was improved, and the node residual energy was considered in the process of threshold and the cluster head election to improve the whole network life cycle. In the multi-hop route, choosing the maximum energy and the nearest node as the next hop and a route transferring data among many clusters was formed. The experiment showed that the method proposed was having great improvement compared with LEACH protocol and prolonged the network life cycle.

Vikas Nandal and Deepak Nandal et. al. [3] proposed a progressive algorithm for the cluster head selection. The proposed algorithm for cluster head selection is based on residual energy, distance & reliability. LEACH (low-energy adaptive clustering hierarchy) is well-known & divides the whole network into several clusters, and the run time of network is broken into many rounds. In each round, the nodes in a cluster contend to be cluster head according to a predefined criterion. Since CHs consume more energy in aggregating and routing data, it is important to have an energy-efficient mechanism for CHs' election and rotation. The cluster head generation algorithm with the original LEACH clustering protocol can cause unbalanced distribution of cluster heads, which often leads to redundant cluster heads in a small region and thus cause the significant loss of energy.

Snehal, K.N.Vhatkar and V.V.Bag et. al. [4] Clustering the sensor nodes are one of the actual techniques to achieve this goal. Low- Energy Adaptive Clustering Hierarchy (LEACH) - A cluster based routing algorithm was proposed as a result for low power consumption. One of problems in the LEACH protocol are "Extra Transmissions". The objective of our paper are to optimize the energy consumption of wireless sensor network by presenting a novel and adaptive technique on the customary clustering protocol of the wireless sensor network. In order to progress network performance, the Distance based LEACH algorithm are proposed where the enhancement are done in the cluster formation technique based on distance parameter. In cluster formation phase of changed LEACH distance of sensor node from cluster head plus distance of cluster head to base station are taken into the account.

Alisha Gupta and Vivek Sharma et. al. [5] Wireless Sensor Network (WSN) has been an active research area over the past few years. However, the salient limit is energy. Due to this limitation, it seems important to design a routing protocol for WSN so that sensing data can be transmitted to the receiver securely and efficiently and at the same time energy consumed must be minimum. Hence there is a need to develop a confidentiality scheme for energy efficient Leach protocol (hierarchical clustering protocol) using homomorphic encryption. In homomorphic encryption data can be aggregated algebrically without decryption and hence less energy consumption.

Sanjay Madaan, Dinesh Kumar and Robin et. al. [6] This paper focuses on the theoretical aspects of clustering techniques in wireless sensor networks, as a mean to improve network lifetime and time synchronization between sensors. Wireless sensor networks (WSNs) are large-scale networks of small low-cost and low-power sensors, to observe and monitor various aspects of physical world. In WSN, data from each sensor is ag-glomerated using data fusion to form a single meaningful result, which makes time synchronization between sensors highly desirable. In this paper, some of the clustering protocols, which have been implemented to improve the network lifetime and clock synchronization, are illustrated. It has been investigated that employing these protocols to select the cluster head results in better performance as compared to non-clustered network and summarize existing clock synchronization protocols based on a palette of factors like precision, accuracy, cost, and complexity.

III. PROPOSED WORK

In this paper we propose a protocol LEACH_MH based on LEACH protocol to balance the load among Cluster head. A max binary heap is an almost complete binary tree with keys and objects stored at the nodes, such that a node's key is less than or equal to its parent's. The name "heap" is appropriate: it is described a sort of spreading mound of objects with the largest ones at the top. With max heap Cluster head can handle the same number of nodes at the same time. Evaluation of the protocol analysis perform the following metrics:

1. Data Transmitted
2. Energy Consume
3. Average No of Cluster Formation
4. Alive Nodes

1. Data Transmitted

Data transmitted is the number of bits transmitted per seconds. It is represented in bits per second or packets per seconds. The protocol which transmits larger amount of data as compared to other protocol is better.

2. Energy Consumed

Energy is consumed in various operations like transmitting data, receiving data, encrypting data, choosing different CHs in each round. The performance of protocol is better whose energy consumed is less than the other.

3. Average Number of Cluster Formation Means the total number of clusters that are formed in network space. Every cluster is headed by a single cluster head. This is defined as the number of the dominated set and it ranges between 1 and N, where N is the number of nodes in the network.

4. Number of Alive Nodes

The nodes which are alive after each round can take part in next round. More the number of nodes alive more the data can be transmitted and energy will be distributed equally. The protocol which has more number of alive nodes after each round performs better and efficiently.

IV. SIMULATION PARAMETERS:

In this section we examine the performance of LEACH_MH through NS2 simulations. A network of 100 nodes is deployed in an area of 100m*100m with BS at (50,175). The main parameters of the simulation parameters are described in Table 1.

Table 1: Simulation Parameters

Parameter	Value
Simulation Time	600 sec
No. of Nodes	100
BS location	(50, 175)
Numbers of CH	5
Maximum X-coordinate value	100 M
Maximum Y-Coordinate value	100 M
Initial node power	2.5 J
Traffic Type	CBR
MAC Protocol	802.11
Mobility Model	Random Waypoint
Routing Protocol	LEACH
Observation Parameters	Energy consumption, data transmitted, alive nodes, Average no of Cluster formation

V. RESULTS

In order to compare LEACH_MH protocol with LEACH, we apply four performances metrics for the comparison: numbers of nodes alive, the consumption of network's energy ,the average no of cluster formation and the data amounts transmitted by the two different protocols.

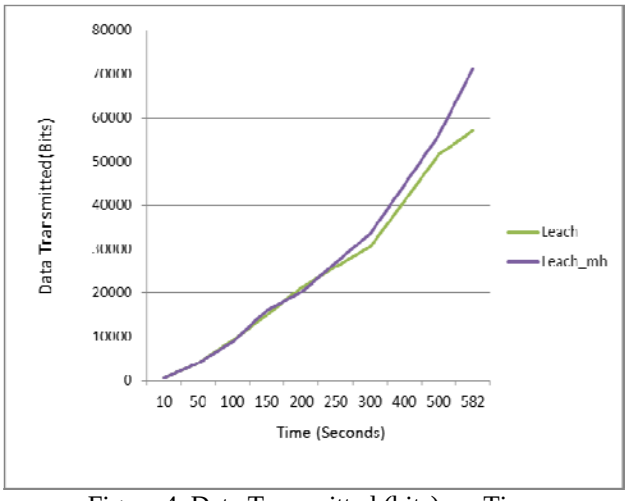

Figure 4 Data Transmitted (bits) vs. Time

The figure 4 shows that LEACH_MH transmits the extra bits as compared to LEACH. This clearly depicts that addition of max-heap in LEACH increases its performance.

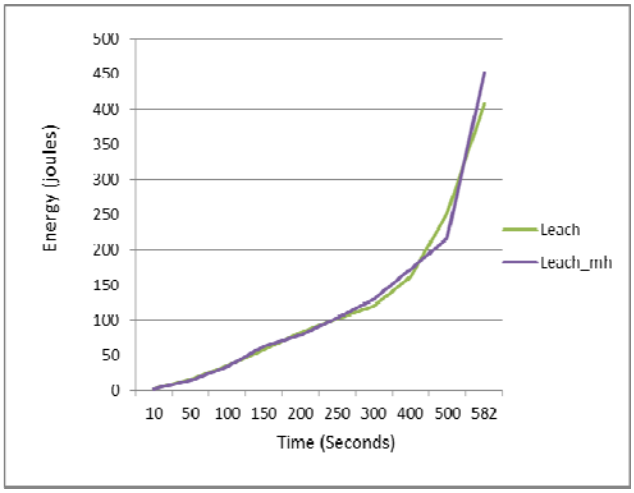

Figure 5 Energy Consumed (joules) vs. Time

The figure 5 shows that LEACH_MH consumes more energy as compared to LEACH. Since MAX-HEAP provides the better load balancing.

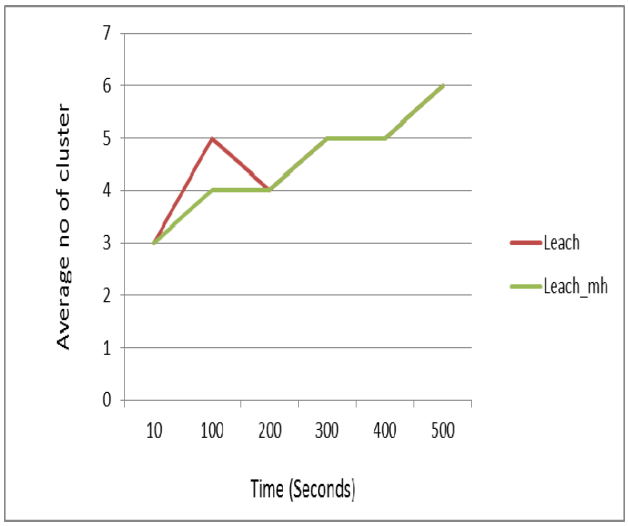

Figure 6 Average no of Cluster formation vs. Time

The figure 6 shows that LEACH_MH formed the same no of the cluster in the network as compaed to LEACH.

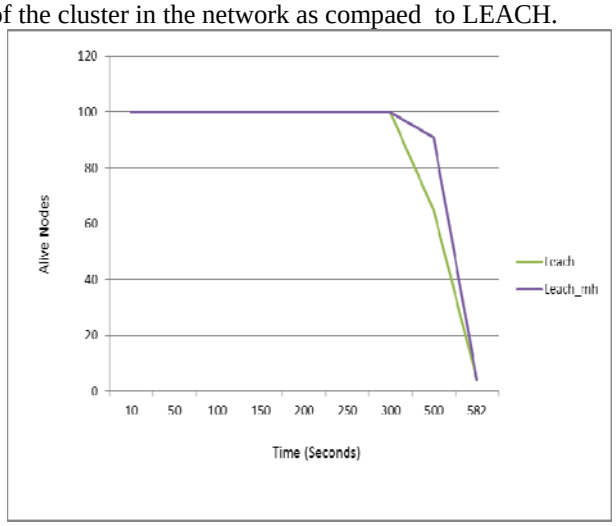

Figure 7 Alive Nodes vs. Time

The figure 7 shows that numbers of nodes alive in LEACH_MH are same as compared to LEACH.

CONCLUSION

In this paper, we have presented LEACH protocol with MAX-HEAP for providing the proper load balancing scheme to energy efficient LEACH protocol. We have analyzed the behavior and different performance metrics for LEACH_MH and LEACH. Graphs of performance comparison shows that LEACH_MH formed same no of cluster in the network and same no of nodes alive by LEACH. But the data transmitted in LEACH_MH transmits more number of bits as compared to LEACH and the energy consume in LEACH_MH consumes more energy as compared to LEACH.

REFERENCES

[1] Nazia Majadi. U-LEACH, *"A Routing Protocol for Prolonging Lifetime of Wireless Sensor Networks"*, (IJERA) Vol. 2, Issue4, July-August 2012.

[2] Yi Liu, Shan Zhong, Licai You, Bu Lv, Lin Du, *"A Low Energy Uneven Cluster Protocol Design for Wireless Sensor Network,"* Int. J. Communications, Network and System Sciences, 2012, 5, 86-89.

[3] Vikas Nandal and Deepak Nandal , *"Maximizing Lifetime of Cluster-based WSN through Energy-Efficient Clustering Method,"* IJCSMS Vol. 12, Issue 03, September 2012

[4] Snehal Kole, K.N.Vhatkar and V.V.Bag, *"Distance Based Cluster Formation Technique for LEACH Protocol in Wireless Sensor Network"* International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 3, Issue 3, March 2014.

[5] Alisha Gupta and Vivek Sharma, ***"****A Confidentiality Scheme for Energy Efficient LEACH Protocol Using Homomorphic Encryption"*, International Journal of Advanced Research in Computer Science and Software Engineering (IJARCSSE), ISSN: 2277 128X, Volume-3, Issue-5, May 2013.

[6] [6] Sanjay Madaan, Dinesh Kumar and Robin, *"Clustering Techniques for Network lifetime Improvement: A Survey*" International Journal of Science and Research (IJSR) Volume 2 Issue 12, December 2013.

[7] [7] Mortaza Fahimi Khaton Abad and Mohammad Ali Jabraeil Jamali, *"Modify LEACH Algorithm for Wireless Sensor Network*" IJCSI International Journal of Computer Science Issues, Vol. 8, Issue 5, No 1, September 2011.

[8] [8] C.Divya, N.Krishnan and A. Petchiammal, *"Increase the Alive Nodes based on the Cluster Head Selection Algorithm for Heterogeneous Wireless Sensor Networks"* Global Journal of Computer Science and Technology, Volume XIII, Issue IX , Version I, 2013.

[9] [9] Sanjay Madaan, Dinesh Kumar and Robin, *"Clustering Techniques for Network lifetime Improvement: A Survey*" International Journal of Science and Research (IJSR) Volume 2 Issue 12, December 2013.

[10] [10] Usha and Dr.N.Sankarram, *"A Survey on Energy Efficient Hierarchical (Leach) Clustering Algorithms in Wireless Sensor Network"* International Journal of Innovative Research in Computer and Communication Engineering Vol.2, Special Issue 1, March 2014.