



## Review paper on Leach protocol in Wireless Sensor Network

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**Abstract-** wireless sensor network enables the regular monitoring of military ,civil and other application. This paper proposes a new improved cluster algorithm of LEACH protocol which is intended to balance the energy consumption of the entire network and extend the lifetime of the network . In this paper we propose a leach protocol that works on network layer in OSI model. Leach protocol stands for Low-Energy Adaptive Clustering Hierarchy , a clustering-based protocol that utilizes randomized rotation of local cluster base stations (cluster-heads) to evenly distribute the energy load among the sensors in the network . LEACH is able to distribute energy dissipation evenly throughout the sensors, doubling the useful system lifetime for the networks we simulated.. It provides a better results than conventional protocols.

**Keywords**—WSN, sensor nodes, communication capabilty,leach protocol. Cluster Head , Hierarchical routing,

### I. INTRODUCTION (WSN)

sensor network is defined as a composition of a large number of low cost, low power multi-functional sensor nodes which are highly distributed either inside the system or very close to it. Nodes which are very small in size consist of sensing, data processing and communicating components. The position of these tiny nodes need not be absolute; this not only gives random placement . These tasks, across a wide spectrum of both civilian and military applications, include environment monitoring, scene reconstruction, motion tracking, motion detection, battlefield surveillance, remote sensing, global awareness, etc. They are usually time-critical, cover a large geographical area, and require reliable delivery of accurate information for their completion

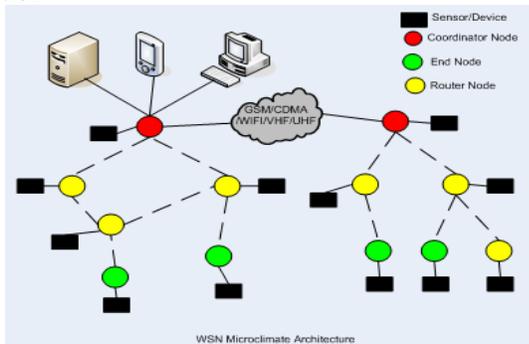


Fig 1 wireless sensor network

### II ENERGY ANALYSIS OF LEACH PROTOCOL

There have been several network routing protocols proposed for wireless sensor networks. We examine two such protocols, namely direct communication with the base station and minimum-energy multi-hop routing using our sensor network and radio models.

**In Direct Communication** Using a direct communication protocol, each sensor sends its data directly to the base station. If the base station is far away from the nodes, direct communication will require a large amount of transmit power from each node. So this protocol will quickly drain the batteries of the nodes. If the base station is close to the nodes or sensor nodes have enough energy only then this protocol is acceptable.

**Multihop Routing Protocol** In these protocols, nodes route data destined ultimately for the base station through intermediate nodes. Thus nodes act as routers for other nodes' data in addition to sensing the environment. These protocols differ in the way the routes are chosen. In MTE each node sends a message to the closest node on the way to the base station.

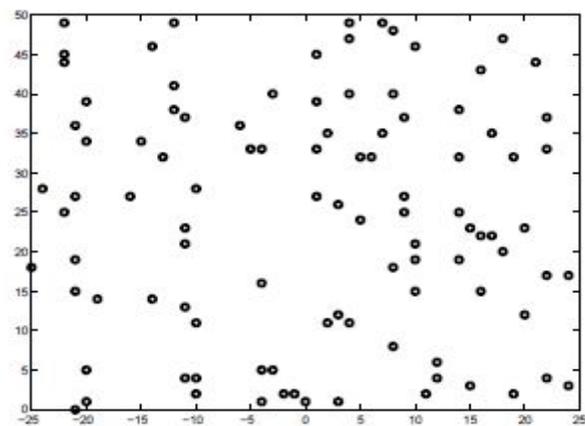


Fig 2: 100 node random network

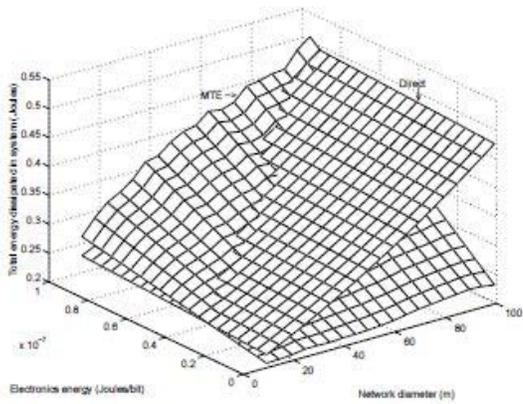


Fig 3: total energy dissipated in the 100 node random network using direct communication and MTE routing

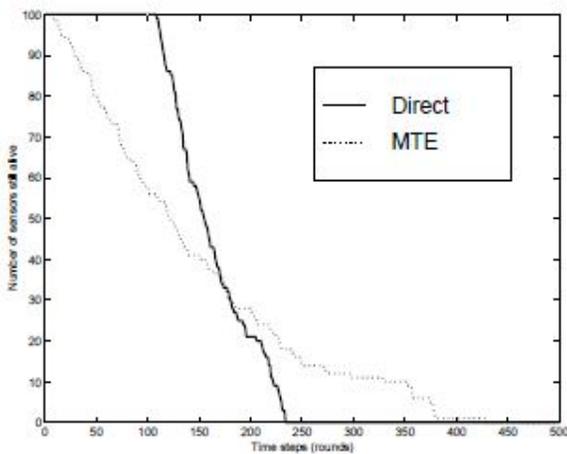


Fig 4: System lifetime using direct transmission and MTE routing

As we see in above diagram, it is clear from that the nodes that are close to the base station will send large number of message to the base station thus these nodes will die quickly. as a result it will shorten the system's lifetime. In addition, as nodes close to the base station die, that area will not be monitored because sensor nodes of that area have already died. In fig 1 we deploy the sensor nodes in the environment. The after that we compare the direct communication protocol and the MTE protocol. fig 2 shows the number of the sensors that remain alive after each round for direct transmission and MTE routing with each node initially given 5.0J energy. After the energy dissipated in a given node reached a set threshold, that node was considered dead for the remainder of the simulation.

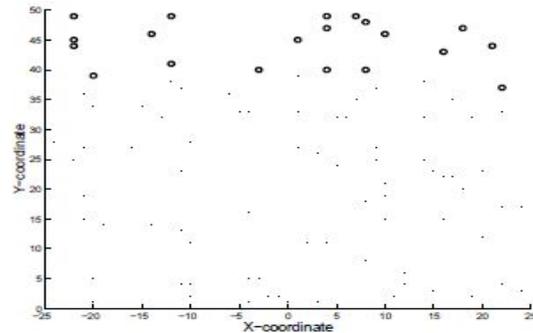
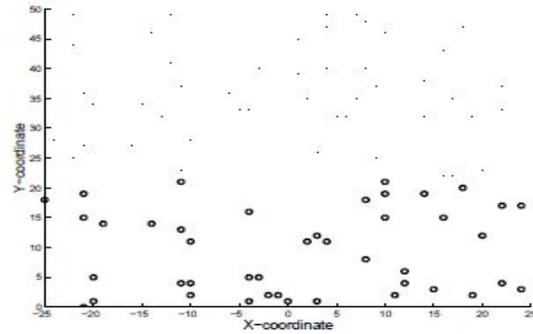


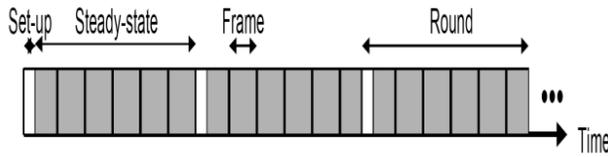
Fig 5 For direct communication and the MTE routing.

- Sensors that are alive are represented by the circles.
- Sensors that are dead are represented by the dots

Fig 5 shows that the nodes that are far away from the base station have to consume more energy to send the message that's way that nodes die quickly in direct communication. In MTE routing the nodes that are close to the base station are used as a sensor for the other nodes. In this way, these nodes are also died.

### III LEACH PROTOCOL (LOW ENERGY ADAPTIVE CLUSTERING HIERARCHY)

LEACH protocol is a typically representation of hierarchical routing protocol. It is a self adaptive and self organized. Leach protocol uses round as unit, each round is made up of cluster set-up stage and steady state storage for the purpose of reducing unnecessary energy costs. The steady-state phase duration is usually much longer than set-up phase duration. However, the first phase is more important, in which sensor nodes are allowed to elect themselves as cluster-heads randomly, and then divided into clusters. Each node that becomes the cluster head (CH) will create a TDMA schedule for the sensor nodes within the cluster. That allows the radio components of each non-CH-node to be turned off all times except during their transmit time. Following figure will represent this:



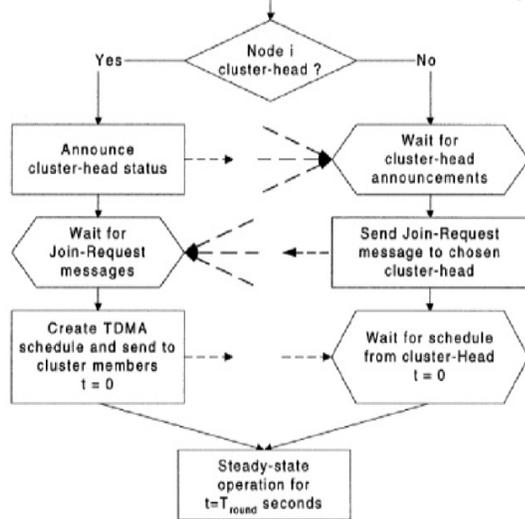
**Fig 7: Timeline operation of leach protocol**

Now we will discuss above terms one by one

**Setup phase:** this phase is also called the cluster forming phase. At the stage of cluster forming, a node randomly choose a number between 0 and 1. If the number is less than the threshold value  $t(n)$ , then it become cluster head in this round, else it become normal node. Threshold value  $t(n)$  is calculated by following method:

$$t(n) = \begin{cases} \frac{p}{1 - p * (r \bmod \frac{1}{p})} & \text{if } n \in G \\ 0 & \text{if } n \notin G \end{cases}$$

Here  $p$  is the percentage of the cluster head nodes in all nodes,  $r$  is the number of the round,  $G$  is the the collection nodes that have not been head node in the first  $1/P$  rounds. Using this threshold, all nodes will be able to be head nodes after  $1/P$  rounds. The analysis is as follows: Each node becomes a cluster head with probability  $p$  when the round begins, the nodes which have been head nodes in this round will not be head nodes in the next  $1/P$  rounds, because the number of the nodes which is capable of head node will gradually reduce, so, for these remain nodes, the probability of being head nodes must be increased. After  $1/P-1$  round, all nodes which have not been head nodes will be selected as head nodes with probability 1, when  $1/P$  rounds finished, all nodes will return to the same starting line.



**Fig 8 Cluster Formation of LEACH Protocol**

**Steady stage** after the clusters formation, the nodes start to transmit the data. Cluster head receive data from the cluster members, the received data was sent to the gateway after other nodes. If the frame data transmission. Cluster head node creates a TDMA schedule telling each node when it can transmit. The schedule is broadcast back to the nodes in the cluster. In order to reduce energy cost, steady stage is composed of multiple frames and the steady stage is much longer that set up phase.

### IV. A NEW IMPROVED PROTOCOL LEACH-TLCH

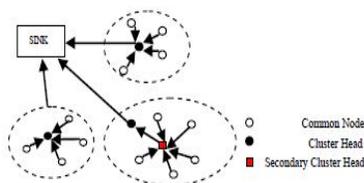
In leach protocol, due to the randomness of the clusters forming, the energy of cluster head is very different, because of the base station and cluster heads. Cluster heads are responsible not only for sending data to the base station but also for collecting and fusing the data from common nodes in their own clusters. In the process of data collection and transmission, the energy consumed by data transmission is greater than that of data fusion. If the current energy of a cluster head is less or the distance to base station is much far, then the cluster head will be died quickly because of a heavy energy burden. To overcome these drawbacks, a new LEACH-TLCH) protocol is proposed here.

**LEACH-TLCH:( LEACH protocol with two levels cluster head):** is an improved protocol based on LEACH protocol, the methods of cluster head selection and clusters forming are same as LEACH protocol.

**Case 1** if the average energy of the current node is average, then common node with maximum energy in this cluster will selected as the secondary cluster head.

**Case 2.** If the current node's energy is more than average energy then there is no need to select a secondary cluster head. In a cluster which has secondary cluster head, the secondary cluster head is responsible for receiving and fusing data collected from the member nodes and sending them to its cluster head, the cluster head is only responsible for transporting data to base station. In a cluster without secondary cluster head, the cluster head is responsible for collecting data from the member node and sending them to base station after the data was fused. It is clear from the first-order energy transfer model that the energy consumption of data receiving and data fusion are less than that for data transferring, especially for long distance data transferring, so the life of clusters with secondary cluster heads will not be extended a lot so as to bring new energy imbalance of energy

consumption of entire network. The network topology of the improved algorithm is shown



**Fig 9 network topology**

**Brief description of the improved protocol**

- **The stage of cluster forming:** the nodes chooses a number 0 or 1 ,if the number is less the  $t(n)$  value, the node becomes cluster head otherwise it becomes normal node. Cluster broadcast this own information to the all other nodes , and the all other nodes will listen this message. All normal nodes determine which cluster they should join in this round . after deciding which cluster they will join CSMA protocol will be used send a confirmation message to their cluster head. At this point, the cluster forming stage is completed.
- **The selecting of secondary cluster head:** every cluster head node decides whether to set a secondary cluster head according to the current energy itself and the distance of the base station from itself. . if its energy is low then its choose a secondary cluster head with the maximum energy node in the cluster . if it \has sufficient energy then there is no need to choose secondary cluster head.
- **To create transport schedule:** All clusters are divided into two categories, in clusters with secondary cluster heads, the secondary cluster head broadcasts message of being secondary cluster head to the other ordinary nodes and builds a schedule (uses TDMA access channel, a time slot is assigned to each node), informs the schedule to the other nodes. In clusters without secondary cluster head, the cluster heads distribute sending time slot to the others after get the join information of normal nodes. The stable stage begins when each node have gotten its sending time slot.

Data transferring: When clusters have formed and the TDMA schedule is determined, the nodes start to transfer the monitoring data. The secondary cluster heads receive data from the other nodes and fuse these data, these fused data was sent to the cluster heads, then cluster heads send these data to base station by single-hop method. In those clusters without secondary cluster head, the cluster heads receive the information from other nodes, fuse them and send them to base station.

**IV CONCLUSION**

In this paper , we described LEACH protocol clustering based protocol that distribute the load of sensor nodes and increase system's lifetime. In leach protocol the environment is divided into clusters and each cluster have cluster head . other nodes choose its cluster head . and send back message to cluster head to which they will join. Each node send its data to its cluster head and future cluster head send this data to the base station. We also propose a improved protocol LEACH-TLCH (leach Two level cluster head) in this we make secondary cluster head if the energy of the cluster head is less than the average energy in network.

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