

## Energy Efficient Approach for Wireless Sensor Network: A Survey

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**Abstract** — Energy Efficiency is the major issues in wireless sensor network (WSN). Hierarchical routing protocol or clustering is the best solution for reducing energy consumption in WSN. LEACH (Low energy Adaptive clustering Hierarchy) is good hierarchical protocol .There are many protocols based on LEACH but still have issue of energy efficiency. In this paper we have mention how to increase energy efficiency of WSN. There are lots of works going on for the Cluster Head selection for increase network lifetime. If Cluster head (CH) is properly selected then efficiency of the particular cluster is increase and due to this efficiency of the network will increase. In this paper survey of different method to improve energy efficiency of wireless sensor network is given.

**Keywords-** Clustering, Energy Efficiency, LEACH, Cluster Head, Lifetime

### I. INTRODUCTION

**Wireless Sensor Network (WSN)** consists of many nodes. Nodes in the WSN sensed the surrounding and transfer the sensed data to Base Station. Sink receive sensed data, aggregate that data and take decision for particular action on application [2]. There are various application based on WSN like Disaster Recovery, Fire Detection, Animal Tacking. In these kind of applications sensor node require energy for various operations, but at some place battery cannot be replaced or recharged; so energy consumptions is the major issue now a days[2].

A sensor node includes three major modules, namely sensing, processing and communication. The sensing node consists of a sensor and an ADC (Analog to Digital Converter) which senses the environment. ADC converts the sensed analog data to digital form. The power unit consists of a battery which provides energy for sensing module and processing module [1].

To minimize the energy consumption in WSN, various techniques have been proposed by the researcher [1].The energy required for transmission is more than energy required for reception [1]. In case of single hope transmission the sensor sends the data directly to base station. The nodes which are far away from the base station need more energy than the nodes which are nearer to the base station. In this context Clustering approach is used to reduce energy consumption.

In the clustering approach sensor node is selected as a Cluster Head (CH). There are two approaches to elect CH i.e. self-elected or elected based on certain factors like threshold value, residual energy, distance from nodes etc. Cluster Head selection plays an important role in minimization of energy consumption in WSN.

LEACH (Low Energy Adaptive Clustering Hierarchy) is a clustering algorithm that allows dynamic selection of Cluster Heads for energy utilization in WSNs. LEACH is divided into number of rounds for selecting CH.

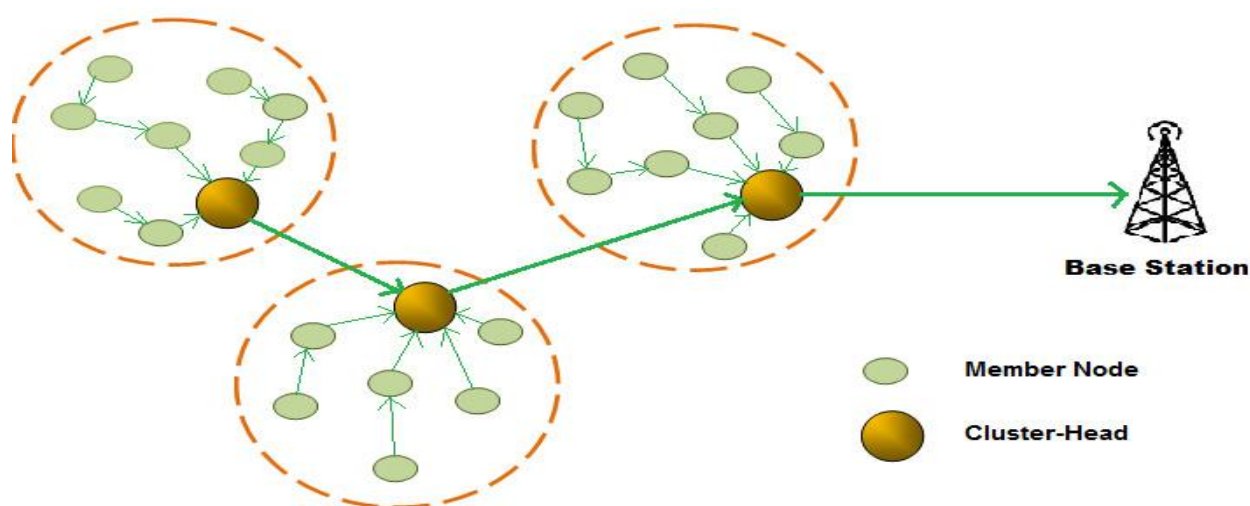


Fig: 1 Clustering Scenario in WSN <sup>[3]</sup>

At the beginning of each round of CH selection normal node chooses random number  $x$  between 0 and 1 and check with certain threshold value and then convert from normal node to Cluster Head. The threshold value is calculated as follow:

$$T(n) = \begin{cases} \frac{1}{1 - P \cdot \left( r \bmod \left( \frac{1}{P} \right) \right)}; & \text{if } n \in G \\ 0, & \text{Otherwise} \end{cases} \quad (1)$$

Where  $P$  is the desired percentage of CH which is predefined value,  $r$  is the current round number and  $G$  is the set of nodes that have not selected as a CH in last  $(1/P)$  rounds.

The main purpose is to design and develop energy efficient technique for WSN to increase the network lifetime. And increase the overall performance of the network. There are number of energy efficient approaches available based on the different parameters like CH selection approach, Inter cluster communication etc.

LEACH is better routing protocol as the responsibility of CH is distributed around all sensor nodes, and also data aggregation to reduce energy consumption [7]. But still LEACH ignores the residual energy at each node during the CH phase. There are various ideas have been proposed to overcome the deficiencies of this which is discuss in next section.

## II. RELATED WORK

With respect to network topology, the routing protocols in the WSNs may be classified in two categories such as clustered routing and Flat Routing. In the case of Flat routing protocol, the status of all nodes is equal. It generates the route by local operations and information feedback among nodes. The typical Flat routing algorithms are DD (Direct Diffusion) protocol [8], SAR (Sequential Assignment Routing) [9], SPIN (Sensor protocol for information via Negotiation) [10], Rumor Routing [11] and so on.

In 2014, V.K. Subhashree, C. Tharini, in their work they present Modified LEACH protocol for proper selection of CH using three phases. The three phases of this papers are (1) Setup phase (2) Steady setup phase (3) Reclustering Phase. In this Paper they have consider the QoS related parameters like throughput, delay, network lifetime[3].According this paper it reduce the failure of cluster head due to the energy depletion which will increase the network lifetime.

In 2013, Geon Yong Park, Heeseong Kim, Hwi Woon Jeong, present a novel cluster head selection approach using K-mean algorithm. It is based on the concept of finding the cluster head minimizing the sum of Euclidean distance between the head and the member nodes [4]. This will select cluster head in three phases. (1) Initial Clustering (2) Reclustering (3) Choosing CH. K-mean algorithm is used for Cluster formation[4].Due to cluster formation energy of the network is improved compare to LEACH protocol [4]. One issue in this paper is time taken clustering

In 2015, Sujee R, Dr. Kannammal K.E. compare the behavior of LEACH protocol in Homogenous and and Heterogeneous environment. In this paper author have just compare LEACH in heterogeneous and homogeneous environment. LEACH protocol normally works in two phase (1) Setup Phase (2) Steady Phase. And according to simulation results LEACH in Heterogeneous environment significantly reduce energy consumption and increase network lifetime [5].

In 2015, S. Potthuri, T. Shankur present the cluster head selection algorithm based on the Huffman coding. In this paper they have mention how the cluster head will be elect for the cluster. According to this paper the nodes having the least weight will be chosen to be cluster head [6]. This technique will enhance the performance by increasing the lifetime so energy will be optimized [6]. Throughput, number of alive nodes and number of dead nodes are taken in consideration for comparison.

In 2014, Basanta K. Nayak, Monalisa Mishra, present novel cluster head selection algorithm for increasing energy of the network. They make Front Leading Energy Efficient Cluster Head (FLEECH) for choosing Cluster Head. They have improved network lifetime, and reduce energy consumption [1].

In this paper selection of cluster head will be depend on the (1) Distance to base station (2) Average distance to other nodes in the same cluster (3) Residual Energy of the node. In this method process will be done in three phase i.e. Setup Phase, CH selection phase, Steady setup phase.

According to Basanta K Nayak using FLEECH protocol network lifetime will increase and efficiency of network will get increase.

### III. COMPARISION

Following table shows the comparison between different methods used for cluster head selection.

Table: 1 Comparison between different cluster head selection Method

PARAMETERS	LEACH	Modified LEACH	K-mean Algorithm	FLEECH
Data Aggregation	YES	YES	YES	YES
CH Selection	Random	Nodes near to BS	Based on K mean algorithm	Based on Residual Energy and distance from Sink Node
Cluster Stability	POOR	POOR	POOR	AVERAGE
Energy Efficiency	POOR	MEDIUM	GOOD	GOOD
QOS	NO	NO	YES	NO

### IV CONCLUSION

Hierarchical routing protocol is one of the simplest and most commonly used in wireless sensor network. There are number of ways available for increasing the efficiency of wireless sensor network. In this paper we describe different types of cluster head selection method in LEACH protocol for increasing the efficiency of wireless sensor network. Different methods are used for Cluster Head selection. If CH is properly selected then efficiency of network will get increase.

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