

# A Review: Energy Efficient Clustering Protocols In Wireless Communication

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**Abstract**—Sensor nodes form a vital part in the wireless sensor network. These sensor nodes are used for sensing, transmitting and receiving the data from the other nodes. The energy of the sensor nodes used for transmitting the data depicts the life span of the network. As the sensor nodes are battery operated, energy consumption is one of the main issues in the wireless sensor network. Low is the energy consumed more is the lifetime of the network. For this problem various energy efficient algorithms were designed that were used for increasing the lifetime of the network thus making the system more efficient. Modified LEACH is one of such energy efficient protocol that helps in saving the node energy and hence increasing network's lifetime. This paper presents a detailed study of modified LEACH protocol. Along with this various other energy efficient protocols are analyzed and the comparison is made. From the results obtained it is concluded that modified LEACH is better and efficient than the existing protocols.

**Keywords**—wireless sensor network (WSN), Energy efficient algorithms, LEACH, Network lifetime

## I. INTRODUCTION

Wireless sensor network comprised of several sensor nodes that are interconnected by a communication network. These sensor nodes are used for the sensing, receiving and transmitting of the data. The basic component of the sensor nodes is the sending unit, processing unit, transceiver and a power unit. The wireless sensor networks are reliable, accurate, cost effective and easily deployed. The lifetime of the network is defined by the energy consumed by the sensor nodes. Once the battery of the nodes dies, it is no longer useful. So various routing mechanisms have been developed that will help in increasing the lifetime of the network by consuming less amount of energy. The network efficiency depends on the energy consumed for transmitting the data by the nodes.

The sensor nodes that are used in the network operates on the battery, the lifetime of the network decreases if the node dies earlier. So the energy utilization of the node is one of the major challenges. Traditionally the nodes were considered to be homogenous as the each node had the same energy. Currently the various energy efficient protocols have been used that are used for enhancing the efficiency of the network. These protocols will increase the life time of the network

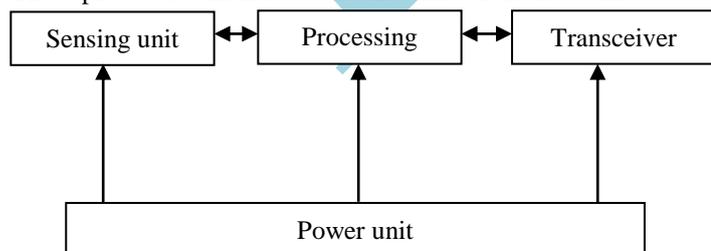


Fig 1: Architecture of wireless communication module

As wireless sensor network is used for various applications like environmental monitoring, infrastructure protection, temperature sensing, etc. So to improve the quality of the application services it is necessary to improve the energy of the network.

## II. LITERATURE SURVEY

LEACH protocol is the energy efficient protocol that is used to increase the lifetime of the network. This section represents the detailed study of LEACH protocol. Various works have done in this area. Some of the papers have been described below:

Sheetal Watkar et al [1] presents the comparison of various energy efficient protocols of WSN, the lifetime and the energy consumption of the network is checked after applying each protocol. WSN network consist of various nodes that are used for the communication. To increase the lifetime of the network the energy consumption should be less. So there is the need to minimize the energy of the network. So from the results obtained best algorithm is selected.

Supriya Dhauta et al [2] present a survey of various clustering techniques. The main issue of the wireless sensor network is that the sensor nodes operate on the battery, that will affect the network lifetime as more energy is consumed by the nodes the lifetime of the network will decrease. Traditionally the homogeneous networks were considered in which the each node is assigned the same amount of energy in order to increase the lifetime of the network, after that the heterogeneous network were considered in which different energy is provided to the nodes. This paper presents the survey of clustering algorithms of both Homogeneous and Heterogeneous wireless sensor networks.

Leena Y. Bara et al [3] present the study of the LEACH. LEACH is the energy efficient protocol that will increase the life time of the network. The nodes preset in the network are used to divide into the clusters, the cluster head is selected, this cluster head will further communicate with the sink. When the cluster head node dies the communication will stop. Various performance parameters are considered that will depict the efficiency of the network. The parameters such as Packet Delivery Ratio, Throughput, Delay, and lifetime are considered. From the results obtained it is concluded that this

protocol is more efficient than the existing protocol of the wireless sensor network.

Shakuntala Yadav, et al [4] present the study of various techniques that are used in the LEACH protocol. LEACH protocol is one of the routing protocols that is used for the transmission of data from between one sensor nodes to another. This is basically a cluster based protocol in which various clusters of nodes are made and accordingly a cluster head is selected that will communicate with the base station. The nodes will directly communicate with the cluster head and this cluster head are communicating with the other cluster heads and the base station. So in this paper a comparison is performed on the basis of various parameters and from the results obtained the suitable technique is selected

Meena Malik et al [5] present a detailed study of the LEACH protocol. LEACH is basically an energy efficient protocol that is designed to enhance the network lifetime. In a wireless sensor network the sensors are used for the communication, the energy utilization of the sensor affects the network efficiency. The more is the energy consumption of the node less is the efficiency. So for this problem in various energy efficient protocols have been designed LEACH is one of them. In this paper comparison is done on the basis of the of various performance parameters that shows the efficiency of this method.

Sarbjpreet Kaur et al [6] present the study of the LEACH protocol. In WSN the nodes are operated with the help of the batteries that depends on the energy efficiency. Energy utilization of the node is the major challenge that is faced by the WSN network. For this various clustering techniques have been designed, with the help of such clustering algorithms the energy consumption is reduced that will result in the increase in the lifetime of the network. In this paper a review of various LEACH versions is discussed. A- LEACH, K-LEACH, O-LEACH and V-LEACH, EELBCRP are discussed and comparison is made to find the suitable protocol for reducing the consumption of the energy.

M. Madheswaran, et al [7] presents the enhancement that is done in the LEACH protocols. LEACH is the energy efficient protocol used in the wireless sensor network. In this paper various limitations of the LEACH protocol are considered and various modifications have done to make LEACH protocol more efficient. From the results obtained it is concluded that the method is efficient and better than the traditional methods.

Khushboo Pawar et al [8] present the modified LEACH protocol. As LEACH is one of the best known protocols that is preferred for the energy dissipation of the node in wireless sensor network. It is basically a Hierarchical routing protocol that will decrease the energy consumption of the network, thereby increasing the lifetime of the network. In this paper a heterogeneous protocol is presented that will increase the reliability of the network. On the basis of the weight value the cluster head is selected after the first node die. From the results obtained it is concluded that this algorithm will increase the stability of the network. This technique is further enhanced by applying genetic algorithm that will increase the stability of the system.

### III. ENERGY EFFICIENT PROTOCOLS

In a wireless sensor network the sensor nodes are used for the communication. These nodes are operated with the help of batteries the energy consumption of the node will affects the efficiency of the system. Various energy efficient protocols have been designed to enhance the efficiency of the system. By decreasing the energy consumption the lifetime of the network is increased and thus the efficiency of the system also increases.

LEACH: It is the basic protocol that is used to increase the lifetime of the network. LEACH stands for Low Energy Adaptive Clustering Hierarchy protocol. It is basically a clustering technique in which the cluster head in network will directly communicate with the base station. The nodes present in the network will form the clusters and among the cluster the cluster head is selected. The nodes that are present in the cluster will communicate with the cluster head, and the cluster head will in turn communicate with the base station. In this the cluster head, gathers the data from the nodes and transmit the data to the base station. So the energy of the cluster head is more than the other nodes of the cluster thus forming a heterogeneous network.

Many other clustering algorithms are proposed based on LEACH, such as TEEN (Threshold Sensitive Energy Efficient Sensor Network Protocol), PEGASIS (Power Efficient Gathering in Sensor Information Systems), HEED (Hybrid Energy-Efficient Distributed Clustering) etc. In DEEC protocol the cluster head selection is done using the initial and residual energy of the nodes. In TEEN protocol the cluster head selection transmits the collected data to the upper layer. It is basically a reactive protocol.

EDCS protocols solve the major problem of the energy in the wireless sensor network. In this the energy of the network for every round is considered that is beneficial to pick the cluster accurately

### IV. CLUSTERING HIERARCHY PROTOCOL

In clustering algorithm clusters head will directly communicate with the base station communicate in single hop. Generally the clustering algorithm can be divided into two phases:

- i) Setup phase
- ii) Steady state

#### I) Set up phase:

In this step the nodes take decisions to form clusters without any centralized control. The cluster is formed without knowing the exact location of the nodes in the network. In this no global communication is required for setting the clusters. The algorithm that is designed should be done in such a way that the cluster head is approximately the same number of times, assuming all the nodes start with the same amount of energy. The cluster-head nodes are spread across the network so that the distance of the node and the other nodes that will transmit the data. The threshold value is kept as the sensor node, choose a random number,  $r$ , between 0 and 1

$$T(n) = p / (1 - p) * (r \bmod p^{-1})$$

If the threshold value is greater than the random value, then the  $T(n)$  will be the cluster head of the current round. The probability equation described is used for choosing the cluster head.

## II) Steady state phase:

In this phase the operation is divided into various frames. These frames are used for sending the data from the nodes to the cluster head during their allocated transmission slot.

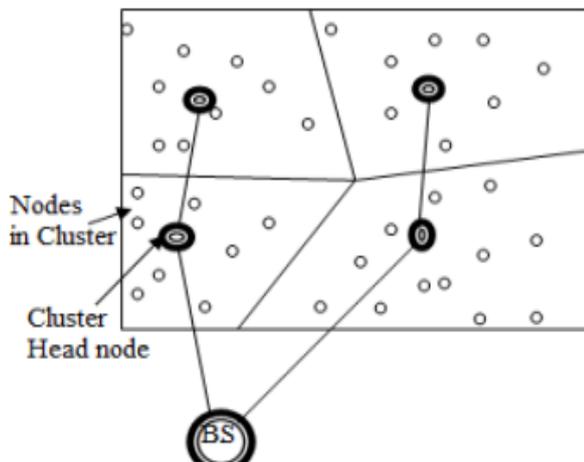


Fig 2 Applying LEACH protocol [3]

The nodes are not evenly distributed among the cluster head nodes so in LEACH protocol the number of nodes per cluster varies because of which the node will send the data to the cluster head depending on the number of nodes present in the cluster. The energy utilization of each node is reduced by using the power control. So with the help of this power control the radio of each non-cluster head nodes is turned off till the allocated transmission time occurs. In this the bandwidth is fixed as the data is sent from nodes to the cluster head by using TDMA. The cluster head needs to be active every time to receive the data from the nodes. After collecting all the data from the nodes, various operations are performed on the collected data and finally the data is sent to the base station. These are the two basic phases of the LEACH protocol.

## V. CONCLUSION AND FUTURE SCOPE

Energy efficient protocols are designed for the Wireless sensor network. These protocols are used for enhancing the efficiency of the network. Energy utilization of the sensor nodes is the major challenge in the wireless sensor network. The main aim of this work is to examine the energy efficiency and the energy efficient protocols. From this work survey finds that advancements in LEACH provide better results than the existing protocols. Various other factors like fault tolerance, topology change, cost, environment, scalability, and power consumption for realization of sensor networks are also taken in consideration.

From the results obtained it is concluded that advancements in LEACH are much efficient than the traditional approaches. In

future various modifications on CH selection and routing between nodes can be done in the existing models of LEACH protocol in order to make the protocol more efficient. The energy consumption of the nodes should be reduced that will in turn increase the network lifetime. The algorithm can be designed by using multi hop communication pattern and optimal number and election of cluster heads.

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