

# A Review on LEACH based Routing Protocol to Reduce Energy Consumption in Wireless Sensor Network

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**Abstract**— The mobile adhoc networks is the self-configuring and decentralized type of network. The wireless sensor networks are the part of mobile adhoc networks. The sensor network is used to sense the environmental conditions likes temperature, pressure etc. The sensor nodes are very small in size due to which battery of the sensor nodes are limited. In the previous times various techniques has been proposed which will reduce energy consumption of the sensor nodes and increase lifetime of the network. In this paper, various energy efficient techniques are reviewed and compared in terms of various parameters.

**Key words:** WSN, LEACH, MATLAB

## I. INTRODUCTION

Wireless sensor networks consist of individual nodes that are able to interact with their environment by ways of sensing or controlling physical parameters; these nodes have to collaborate to fulfill their tasks as, usually, a single node is incapable of doing so; and they use wireless communication to enable this collaboration. The sensor nodes communicate not only with each other but also with base station using wireless radio, allowing them to send their data at remote area for processing, analysis and storage [1].

Wireless networks are computer network that are not connected by any cables. With the use of a wireless network, we can avoid the cost of cables for connecting. Wireless networks use radio waves to connect devices such as laptops to the internet.

### A. Types of Wireless Network:

#### 1) MANET:

MANET stands for Mobile Ad-hoc Network. It is an infrastructure less wireless network. It can be formed either by mobile nodes or by both fixed and mobile nodes. Nodes are randomly connected with each other and forming arbitrary topology. They can act as both routers and hosts.

#### 2) WSN:

WSN is the type of network which is used to sense the environment conditions like temperature, pressure etc. and this type of network is generally deployed on far places like forest, desert etc. Due to small size of sensor nodes, battery power of these nodes is limited, so it becomes very difficult to recharge them or to exchange them.

#### 3) VANET:

VANET is self-organized network that can be formed by connecting vehicles aiming to improve driving safety and traffic management with internet access by drivers and programmers.

### B. Wireless Sensor Networks:

Wireless sensor networks consist of individual nodes that are able to interact with their environment by ways of sensing or controlling physical parameters; these nodes have to

collaborate to fulfill their tasks as, usually, a single node is incapable of doing so; and they use wireless communication to enable this collaboration. The sensor nodes communicate not only with each other but also with base station using wireless radio, allowing them to send their data at remote area for processing, analysis and storage.

### C. Leach Protocol:

Low-Energy Adaptive Clustering Hierarchy (LEACH) is one of the most popular hierarchical routing algorithms for sensor networks. It is a cluster-based protocol having the following features: randomized, adaptive, self-configuring cluster formation, localized control for data transfers, application specific data processing, such as data aggregation. The idea of LEACH is to form clusters of the sensor nodes based on the received signal strength and use local cluster heads (CH) as routers to the sink i.e. all cluster members can transmit sensed data to the base station (BS) through CH only. This will save energy since the transmission to BS will only be done by cluster heads only instead of all the sensor nodes. Optimal number of cluster heads is estimated to be 5% of the total number of nodes. Threshold value is set by the given formula:

$$T(n) = p/1-p(r \bmod 1/p) \text{ if } n \in G$$

$$T(n) = 0 \text{ otherwise}$$

Operation of LEACH is based on rounds and each round consists of two phases - setup phase and steady state phase.

#### 1) Set-up Phase:

- 1) In the first round all the advanced nodes generate a random number between 0 and 1 and if it is less than the threshold  $T(n)$  then the node is elected as a cluster head for that round. Go to step 3.
- 2) In all other rounds the remaining energy of cluster heads are checked. If it is greater than a predefined threshold, then it will continue as the cluster head in the next round also. So go to steady-state otherwise select new cluster head as described in step 1.
- 3) CHs broadcast hello message.
- 4) Clusters are formed depending on the signal strength a normal node receives from different CHs.
- 5) The normal nodes send a join message to the corresponding cluster heads that in turn create TDMA schedule for data transmission and broadcast it to the members.

#### 2) Steady-state Phase:

- 1) Like LEACH all the cluster members will send data to their corresponding cluster-heads in their allotted time slot.
- 2) Cluster Heads aggregate the received data and transmit it directly or indirectly through other CH to the BS.
- 3) Once all the Cluster Heads finish the control returns to steady phase again.

## II. LITERATURE REVIEW

- 1) N.Bhavana[10] proposed “Energy efficient MAC protocols for Wireless Sensor Networks: A Survey” works on wireless communicating sensors network. A MAC protocol is suggested which improve energy efficiency by increasing sleep duration, decreasing idle listening and overhearing, and eliminating hidden terminal problem or collision of simultaneously transmitted packets.
- 2) F.S. Salman[8] proposed. “Medium Access Control Protocol for Wireless Sensor Network – a Survey” presented the complications and challenges in the design and development of power aware medium access control protocol for wireless sensor networks. This paper depicts numerous medium access control protocols for the sensor networks, and highlights their potency and limitations wherever possible. However, no protocol is accepted as standard. This is because the MAC protocol in general will be application specific.
- 3) H.Hans-Christian[2] proposed “Mac Protocols for Wireless Sensor Networks” presented different MAC protocols for wireless sensor networks and compared them to each other. After presenting a selection of MAC protocols their properties were compared to each other.
- 4) L.Sherly[13] proposed “An Energy Efficient Wakeup Schedule and Power Management Algorithm for Wireless Sensor Networks” proposed a new homogenous asynchronous scheduling in this paper. In various protocols designed for power-saving, the sensor nodes will be put into sleep state when there is no transmission.
- 5) S. Rupali [14] proposed “Energy Management in Wireless Sensor Network” proposed an energy efficient dynamic power management technique which can reduce power consumed by each sensor node by shutting down some components of sensors according to our algorithm which yields better savings and enhanced life time. Energy consumption in wireless sensor networks is influenced by many factors. A lot of research is being done in this area.
  - 1) Data reduction techniques
  - 2) Algorithms to choose the cluster that a node joins
  - 3) Event based communication
  - 4) Reduce the power consumed by the sensing task
  - 5) Shorter higher quality links vs. Longer lossy links
  - 6) Jaideep and Rajiv proposed “Fault Tolerant Mobility and Aware Routing Protocol for Mobile Wireless Sensor Networks” [15] mentioned that wireless sensor network has made its steps in mobility based applications like health monitoring, wildlife monitoring, search and rescue, it is desirable to have a reliable routing protocol to deal with the routing issues of mobile sensor nodes and battery is also the main constraint for sensor nodes so routing protocol should be energy efficient.

## III. MODIFIED LEACH PROTOCOL

The modification in LEACH presents an energy efficient clustering algorithm based on LEACH for wireless sensor network. We have simulated the proposed algorithm on MATLAB and compare the performance of LEACH, MODLEACH and the proposed protocol. Simulation shows

that the lifetime and throughput of our proposed method are more than that of LEACH and MODLEACH. This improvement is achieved by the heterogeneity of nodes and efficient use of remaining energy of the cluster heads which remains unused in LEACH. The cluster heads communicate with the base station directly or indirectly using multihop hierarchical routing through other CHs which makes our algorithm suitable for large-scale wireless sensor networks. Whereas single hop LEACH is not suitable for such network due to the limit in effective communication range of the sensor nodes.

## IV. TABULAR COMPARISON

Author	Year	Description	Outcomes
H. Hans-Christian	2010	Mac Protocols for Wireless Sensor Networks	In this, XMAC and WiseMAC are used for energy efficiency.
L. Sherly	2012	An Energy Efficient Wakeup Schedule and Power Management Algorithm for Wireless Sensor Networks	HMAC protocol is used for reducing the energy consumption.
N. Bhavana	2011	Energy efficient MAC protocols for Wireless Sensor Network	A MAC protocol is suggested which improve energy efficiency by increasing sleep duration, decreasing idle listening and overhearing, and eliminating hidden terminal problem or collision of simultaneously transmitted packets.
S. Salman and J. Sultanullah,	2011	Medium Access Control Protocol for Wireless Sensor Network	It presents the complications and challenges in the design and development of power aware medium access control protocol
Jaideep and Rajiv	2014	Fault Tolerant Mobility and Aware Routing Protocol for Mobile Wireless	It has been proposed that achieve fault tolerance of cluster heads while routing and mobility management of

		Sensor Networks	mobile sensor nodes to reduce packet loss during data transmission in MWSN.
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#### V. CONCLUSION

In this work, it is being concluded that sensor nodes are very small in size due to which battery of the sensor nodes are limited. In this work, various techniques are reviewed and it is being analyzed that LEACH protocol is most efficient protocol for WSN. In future we can work on proposed hybrid type of clustering which will be based on static and dynamic clustering.

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