

Survey Study on LEACH Protocols For Wireless Sensor Networks

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Abstract

Low Energy Adaptive Clustering Hierarchy (LEACH) protocol is to start with various leveled cluster based routing protocol effectively utilized as a part of the Wireless Sensor Networks (WSN). In this paper, different upgrades utilized as a part of the first LEACH protocol are inspected. The fundamental operations, favorable circumstances and restrictions of the altered LEACH protocols are compared contrasted with other similar protocols. Further the issues of LEACH is understood and how the other protocols are tackled from enhancing base protocol.

Keywords: LEACH, Modified LEACH, Hierarchical Cluster Based Routing, Wireless Sensor Networks (WSN).

Introduction

A Wireless Sensor Network (WSN) comprises of a vast number of little nodes with sensing, estimating, and remote interchanging capabilities [1][13][19]. The sensors joined to the nodes measure surrounding conditions identified environment, process the information and transmit to the base station. Moreover, sensor nodes are furnished with a radio handset or other remote specialized gadget, a little microcontroller also an energy source [4]. Since in most WSN applications the important source is a battery it plays a critical part in such applications on the grounds that sensor nodes are by and large bounded with constrained energy. In this way, safeguarding the devoured energy of every node is an essential objective that must be considered when building up a routing protocol for WSN. All in all, routing in WSNs [3] can be separated into levels, various leveled, and area built directing depending with respect to the system structure. Various leveled directing is otherwise called group based routing on the grounds that in

this kind of routing sensor nodes are gathered together and structure groups. In each group, a higher lifespan node is appointed as a head-node also known as Cluster head (CH). The CH goes about as the pioneer they could call their own cluster having the obligations like gathering and accumulating the information from their individual groups and transmitting the collective information to the Base station (BS) [5][18].

The most extraordinary progressive routing protocol in WSN's are LEACH, PEGASIS, TEEN, EECS, HEED etc [13]. Among these all, LEACH is the least difficult routing protocol in WSN whose principle point is to spread the energy stack similarly among all sensor nodes in the system furthermore delay system life time. In this paper we look out on different Section II literature Review describes LEACH and its types and their efficiency, comparative study tabulated and flow chart, Section III Conclusion.

Related Work

Low Energy Adaptive Clustering Hierarchy i.e. LEACH[1][19] is the first progressive bunch based directing set of guidelines for remote sensor system. In LEACH, described in figure 1 the nodes group themselves into neighborhood groups. A committed node favored as cluster head is reliable for outlining and utilizing a TDMA (Time Division Multiple Access) plan and totaling the information originating from diverse nodes and sending it to the BS [10]. The essential standard is that it allots general vitality utilization of the system consistently to every sensor node through intermittently selecting distinctive nodes as group head. This sets aside a few minutes of nodes near to the lifetime of system. The procedure of LEACH is separated into round. In this convention each round has two stages: Set-up Phase and Steady-state Phase. Each round starts with a set-up stage when the clusters are sorted out, taken after by a consistent state stage when information are transferred from the nodes to the cluster head(CH) and on to the BS[1][6].

CHs transmit the total cluster "compressed" information to the base station [2]. The course of events graph that incorporates both two phases for a solitary round of LEACH is given beneath [6].

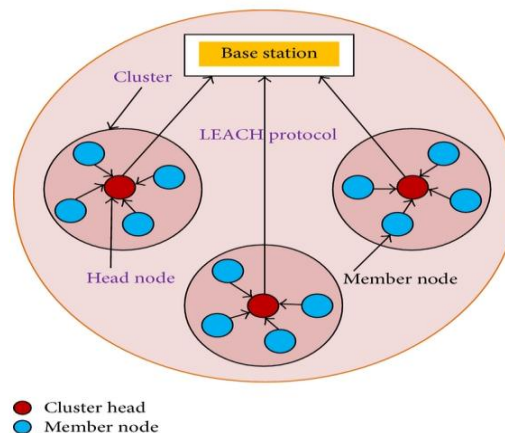


Figure 1: LEACH protocol Clustering Structure

It is the first step of the set-up phase. Here the decision of each node to elevate as a CH is made for the current round. This decision is made by the n node by choosing a random number r between 0 and 1 [6]. The node becomes a CH if the randomly obtained value is less than a threshold $T(n)$ which is calculated by the following formula [3][13][16][17].

$$T(n) = \begin{cases} \frac{x}{1-x*(r \bmod \frac{1}{x})} & \text{if } n \in S \\ 0 & \text{otherwise} \end{cases}$$

Where,

n = number of nodes.

x = priori likelihood of a node being chosen as a CH.

r = an arbitrary number somewhere around 0 and 1 that is chosen by a sensor node.

In the event that this arbitrary number is less than the limit esteem $T(n)$, then the separate hub turns into the CH for the present round.

S = the set of nodes that were not acknowledged as CH in the last “ $1/p$ ” occasions.

At the point when the TDMA timetable is settled for every node, then as per the dispensed timetable every node can transmit information to their separate CH. The CH nodes must keep its recipient on to get all the information from the nodes in the group [6]. When they get all the information from the nodes, they perform collection mechanism to pack the measure of information, and next this information is sent to the base station. After a certain time, another round starts with the Promotion Phase

Disadvantages of LEACH

LEACH is the least difficult various leveled convention which has bunching methodology and if executed legitimately, can prompt vitality effective systems administration in WSNs [18][14]. Yet at the same time these huge vitality funds, there raises a few issues as depicted beneath:

- LEACH is suitable for little size system in light of the fact that in LEACH it accept that all hubs can speak with one another and have the capacity to achieve sink which is not generally valid for extensive size system [1][13][15][19].
- In LEACH there is no component to guarantee that they chose CHs will be consistently appropriated over the system. So all group heads may be pack just in one piece of the system [17].
- In LEACH intermittent element bunching happens after the finishing of each round that conveys noteworthy overhead which may adjust energy gain inferred by the bunching choice. Since LEACH has numerous downsides, numerous analysts have been carried out to improve this convention performs. Some of these progressions are quickly depicted in the taking after focuses [3][19].

Progressions in Different sorts of LEACH

A) Leach-F

It is the changed adaptation of LEACH convention with altered groups and turning group heads [7]. Here bunches are shaped once and altered, and the bunch head's

position pivots among the hubs inside the group. As bunches are shaped just once so there is no situated up overhead at the start of each round. Filter F does not permit new hubs to be added to the framework and don't modify their conduct in view of hubs passing on.

B) Leach-C

W. B. Heinzelman et al. Proposed application particular convention construction modeling for WSN which is known as LEACH Centralized (Filter C) [8]. It is an improvement over Drain convention. Filter C, utilizes an unified grouping calculation and the similar steady state as LEACH. Drain C is more effective than LEACH on the grounds that Drain C conveys around 40% more information every unit energy than LEACH.

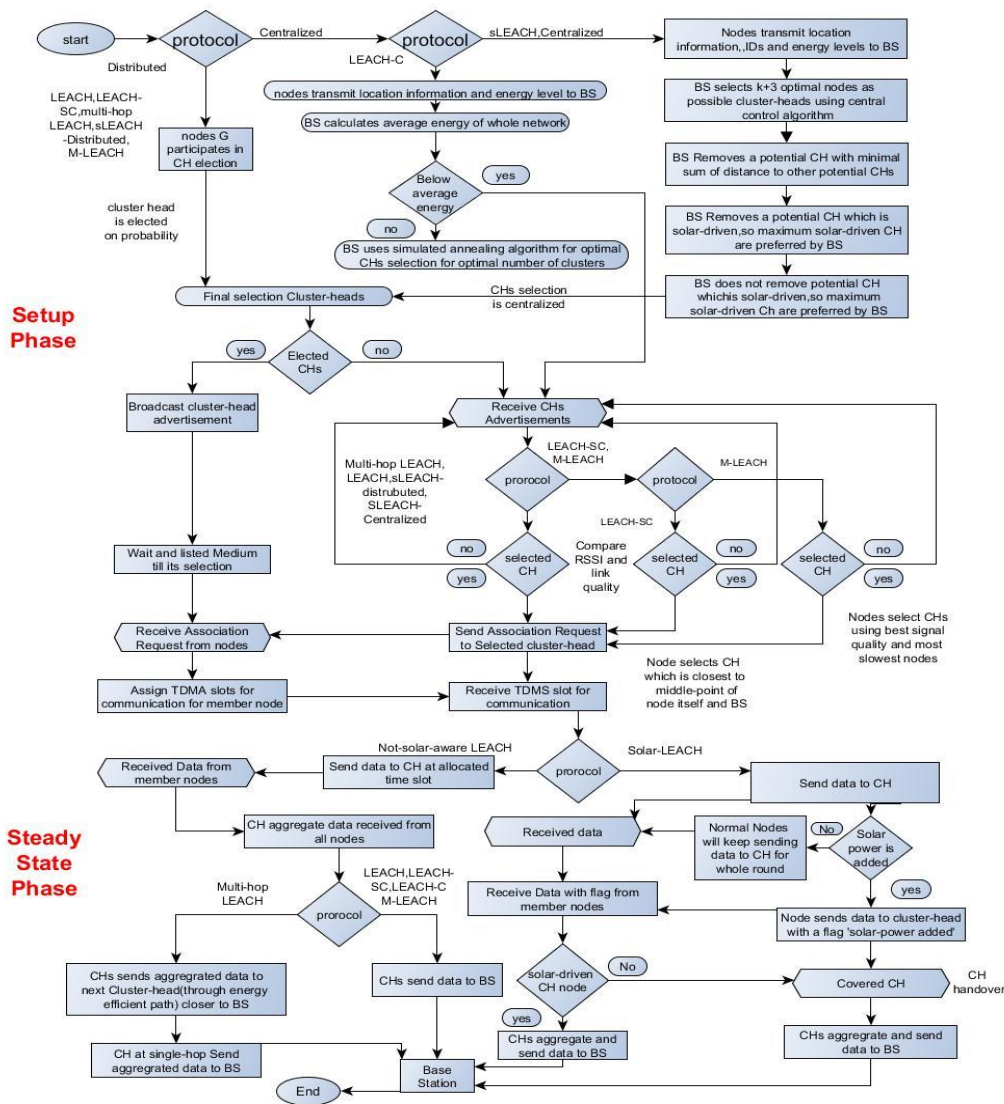


Figure 2: Flowchart of LEACH Protocol and its Types[34]

C) E-Leach

Energy LEACH (E-LEACH) [9] enhances the CH determination method in LEACH. It makes remaining energy of node as the fundamental metric to choose the CH after the first round. Because the energy level will be vary after the first round.

D) V-Leach

Version of –LEACH(V-LEACH) [10] is another rendition of LEACH Protocol which minimize the energy consumption. The fundamental idea driving Vice node taking lead once existing Ch dies-e) **H-LEACH**

Hierarchical LEACH (H-LEACH) [3][17][18] is proposed to minimize the energy level using minimizing the transmission distance. More distance more power, less distance less power. H-LEACH performance its first round as similar like LEACH. For further clustering a Master Cluster Head is chosen for optimal transmission distance to base station. [26]

Luan et al. [20] proposed an algorithm based on LEACH by consolidating Node Degree and Remaining Energy of WSNs. The CH is elected based on the number of nodes is connected and the maximum remaining energy. Taneja and Bhalla [21] proposed an improved version of LEACH: Three Levels Hierarchical Clustering LEACH Protocol (TLHCLP) for Homogeneous WSNs. Base station is considered as the location center and a predefined radius is utilized. Nodes are ordered as nodes inside Mao Ye et al. [22] proposed EECS: An Energy Efficient Clustering Scheme for periodical information gathering application. The election stage for CHS, a fixed number of hopeful nodes are chosen based on the remaining energy holds by the nodes. And executing the load balancing to achieve the minimum energy consumption. Gupta et al. [23] proposed a low energy utilization chain-based routing protocol LEACH-CC. LEACH-CC uses a centralized clustering algorithm, to minimize energy, delay to increase the lifetime of network

Beiranvand et al. [24] proposed Improved –LEACH(I-LEACH) chooses a node with higher residual energy, numerous quantities of neighbors, and minimum distance to the BS as CH node. Results demonstrated that I-LEACH enhanced the execution no less than 65%, reductions the utilization of energy up to 62%, and enhances the effectively PDR by no less than 56% when contrasted with the these calculations for WSN. Base Station Controlled Dynamic Clustering Protocol(BCDCP)[25] proposed a distribution of energy equally to all the nodes in the network to increase the lifetime of the network. The work is compared with LEACH and PEGASIS. PBEACP (Priority Based Energy Aware and Coverage Preserving routing) [27] also used the residual energy to elect a CH.

In this paper [28] proposed edge optimization for part sensors utilizing Genetic algorithm. A few LEACH protocols use circular grid by utilizing sink at the inside of the network. Joining edge enhancement to LEACH proficiently structure better groups and upgrade the WSN lifetime. Rahmanian et al., [29] proposed evolutionary algorithm in brought together grouping. LEACH C is joined with evolutionary algorithm, and fitting choice of developmental administrators an effective clustering is structured in light of each node's energy. The consequences of proposed work are contrasted and the aftereffects of the Simulated Annealing method.

Jeng Long et al. [30] proposed a GA based versatile clustering utilizing an ideal likelihood expectation to yield better execution as far as lifetime of network in WSN. In the LEACH preparation stage is included before beginning the first round. In the preparation stage, all nodes do the procedure of CH determination and send their statuses around an applicant CH or not, node IDs, and their positions to the BS. At that point the BS looks applies GA to discover an ideal likelihood of nodes being cluster heads by minimizing the aggregate energy utilization needed for finishing one round in the sensor field. At that point an ad message is shown by BS to send ideal estimation of likelihood to the all nodes. After the notice, the set up and steady state stage are utilized and like LEACH. Dexin Ma et al., [31] proposed an Adaptive Assistant-Aided Clustering Protocol utilizing Niching Particle Swarm Optimization (AAAC-NPSO) to upgrade the lifespan and rate of information conveyance by upgrading energy dispersal of the WSN.

Singh et al. [32] utilized PSO approach for building energy mindful clusters by ideal choice of CHs. The semi conveyed PSO calculation is utilized to minimize the expense of spotting ideal position for CH of a cluster. The target capacity is chosen by utilizing the leftover energy, intra-cluster separation, node degree and head tally of the probable cluster heads. The execution PSO enhancement is contrasted and LEACH-C and PSO-C. The reenactment results demonstrated that lifetime, average packet transmissions, cluster head determination rounds supported by PSO and average energy consumption are better in the proposed technique.

Satyesh et al., [33] utilized PSO algorithm by utilizing expense capacity in view of the energy level of nodes to discover K number of ideal clusters. The set up and steady state stage were like LEACH; however the BS executes the PSO algorithm to focus the best K group heads that can minimize the expense capacity

Author	Algorithm proposed	Communication pattern	Energy efficiency	Advantages	Limitations
Sharma et al	PEGASIS	Chain based	High	No. of rounds are 100 to 200% higher than LEACH.	Excessive delay for distant nodes.
Khan et al	Ad-LEACH	Single hop	High	The network life time is 66% more than LEACH. Increases the number of rounds around 1500 to 2500 rounds.	Instability region is 40% more than LEACH.
Dakshayini et al	E-LEACH	Single hop	Very high	Reduced the radio communication range by proper selection of CH. No. of rounds are 200% higher than LEACH.	The network should be equipped with GPS for monitoring the position of the nodes and CH.
Nguyen et al	LEACH-C	Chain based	Very high	Number of data received at base station is 8% more than LEACH.	Not give good performance if the nodes are mobile.
Dembla et al	EE-LEACH	Single Hop	Very high	Energy consumed is reduced up to 43% for 100 nodes and 44% for 200 nodes.	CH need to be distributed uniformly.

Taneja et al	TLHCLP	Multipath model	High	Life time is improved from 20% to 42% for 100 nodes.	Algorithm should ensure that all nodes become cluster members.
Gupta et al	LEACH-A	Chain based	Very high	Life time of the network increases 80% and throughput increases 1.2 times than LEACH	A multi path route algorithm based on energy hops is proposed to reduce the energy consumption.
Bhadeshiya et al	LEACH sub CH	Single hop	High	Fixed number of CH increased throughput and reduced the energy consumption significantly.	Optimum number of clusters must be selected for best results.
Mao et al	EECS	Single hop	Very high	Life time increases 135% and energy utilization is 93% more than original LEACH.	Future work should include multi hop communication.
Nguyen et al	M-LEACH	Multi hop	Very high	Throughput is 8 times greater than LEACH-C	Velocity threshold and round time models should be developed. Location monitoring is an overhead.
Mu Tong et al	LEACH-B	Single hop	high	Residual energy of nodes is considered for CH selection and 25% efficient than LEACH	Other parameters like node degree, distance are yet to be considered for best CH selection

Comparisons of Modified LEACH Algorithms

Conclusion

In this overview, the preferences and limits of different upgrades of adjusted LEACH were talked about. The accompanying table demonstrates the points of interest and the constraints of different upgrades made on LEACH calculation. Each study in variation of LEACH routing protocol is discussed to the cause of minimizing the energy consumption and to increase the throughput. But still some of the research is going on to improve the performance of the LEACH protocol. Our research is also focusing on to improve the performance on LEACH to minimize the Energy hole and to increase the throughput in funneling problem based on load balancing.

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