

# ENHANCEMENT OF LEACH PROTOCOL IN WSN

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**Abstract** - Wireless Sensor Network contain number of nodes. Lifetime of Sensor nodes depend on their battery power, which cannot be reenergize. Thus, to save the node energy & lifetime of the Network energy efficient LEACH protocol is introduced. Wireless sensor networks are facing many experiments such as the partial source in processing power, storage and energy. The cluster heads communicate with the base station in single-hop mode which makes LEACH cannot be used in large-scale wireless sensor networks for the limit effective communication range of the sensor nodes. Hierarchical or cluster base routing protocol for WSNs is the most energy-efficient among other routing protocols. This paper presents use of LEACH protocol and its various protocols and compare with clustering method, advantages and disadvantages.

**Keyword**– Wireless Sensor Network, LEACH, LEACH-Balanced, LEACH-Centralized, LEACH-Energy, LEACH-Fixed number of cluster, LEACH-Multihop, LEACH-Quadrature, Weighted- LEACH, Threshold-based-LEACH, Vice-LEACH.

## I. INTRODUCTION

A wireless sensor organize includes of huge number of littler sensor hubs. A sensor which comprises of sensor, actuators, memory, and a processor used to impart. The sensors are controlled in an impromptu way in the region important to screen occasions and gather information about the environment [1]. Wireless sensor network architecture is shown in fig.1.

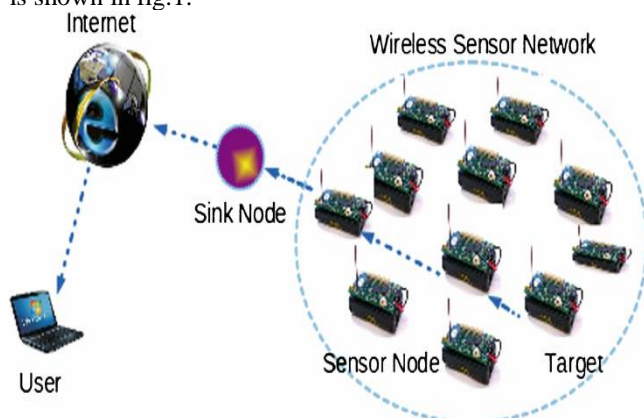


Fig.1. Wireless Sensor Network Architecture [2]

On the off chance that the hub is not able to interface with other through direct connection, that is they are out of scope range of each other. By utilizing the in among hubs the information can be sent to the next hub. A system with bunching is circulated into a few groups in each group. One of the sensor hubs selected as a cluster head (CH) with the group part. All sensor hubs works formed to serve the demand. Group head gathers the information locally from the bunch supporter and transmit the information straightforwardly or by means of multi-bounce transmission to the sink. Since the bunch heads spend more vitality than the non-group heads, so convey the workload of bunch heads among the remote sensor hubs all together the adjust vitality utilization. .

Our work is organized as follows. Section II presents the basic concepts of LEACH protocol. Sections III survey various descendants of LEACH protocols. Section IV provides summary table that compares some protocols and finally conclude the survey in section V.

## II. LEACH PROTOCOL

LEACH is called "Low Energy Adaptive Clustering Hierarchy" is the main vitality rationing steering convention and mainstream among all grouping calculations for WSN. It decreases the vitality altogether [4]. In LEACH groups are framed by appropriated calculation. As a matter of first importance, a hub is chosen as a CH with a likelihood  $p$  and educates its choice to all hubs and after that each non-CH hub decides its group by picking the CH that can have minimum correspondence vitality. The essential rule behind is that it appoints general system's vitality utilization to every sensor hub intermittently. Accordingly, it can decrease the vitality utilization and the life expectancy of the whole system is drawn out. The part of CH is turned inside the groups and among the hubs occasionally with a specific end goal to adjust the heap. This pivot is performed by every hub by picking an arbitrary number or limit esteem  $T(n)$  in the vicinity of 0 and 1. On the off chance that the arbitrary number  $< T(n)$ , the hub will turn into the group set out toward the current round  $r$ , and different hubs join in the closest bunch. After the finish of one time of information

transmission, the system begins bunch reproduction for the new round. [5].

$$T(n) = \begin{cases} \frac{p}{1 - p \left( r \bmod \frac{1}{p} \right)}, & \text{if } n \in G \\ 0 & \text{otherwise} \end{cases}$$

Where  $p$  is the desired percentage of CH nodes in the several sensors,  $r$  is the current round number, and  $G$  is the set of nodes which is not selected as CHs in the last  $1/p$  rounds [5].

### III. DESCENDANTS OF LEACH PROTOCOLS

- A. *LEACH-B (LEACH-Balanced)*: LEACH-B enhanced convention includes a moment choice of group heads to adjust the number bunch head in the set-up stage considering the hub's leftover vitality per round. Keeping in mind the end goal to spare the vitality utilization and to draw out the life expectancy of the system, the convention needs to guarantee that the segment of group is adjust and uniform. To accomplish this objective, the quantity of CHs should be commended, and the system needs an ideal CHs sum [6]. The initially chose number and the lingering vitality of bunch heads can be learned by each hub through the CHs' promotion messages [6].
- B. *LEACH-C (LEACH-Centralized)*: LEACH-C is an upgraded rendition of LEACH, in which the group development is finished by the base station. Toward the begin of each round every one of the hubs send their area and current vitality to the base station. The base station processes the normal vitality of the system and checks just those hubs which are having vitality higher than the normal vitality, as proper bunch head hub. Presently it applies recreated tempering calculation utilizing applicant hubs to decrease the target work [7]. This calculation endeavours to limit the measure of vitality for the non-group make a beeline for transmit their information to the bunch head, by decreasing the aggregate total of squared separation between all the non-group head hubs and the nearest group head. The resultant bunch head (CH) and their individuals will be communicated to the system. In the event that the hub's own particular ID matches with bunch head ID, it chooses himself as group head else it will discover the TDMA opening to send the information to proportional group head. The information transmission period of LEACH-C is like the LEACH. The upside of LEACH-C is that, it can similarly dispense vitality utilization between sensor hubs by situating bunch heads into the focal point of group. Be that as it may, each sensor hub, in any case, ought to be stacked with GPS collector set and it doesn't surety the adjust of vitality utilization of entire sensor systems [8].
- C. *LEACH-E (Energy Low Energy Adaptive Clustering Hierarchy)*: E-LEACH in light of LEACH convention
- to strength the vitality utilization of sensor hubs keeping in mind the end goal to take care of the over-burden vitality utilization issue. The E-LEACH endorses the same round origination with the first LEACH. In various levelled directing conventions, the quantity of bunch heads is a key issue that influences the execution of steering conventions [9]. In the event that the quantity of bunch heads is less, each group go to cover bigger territory, this will fundamental the issue that some group individuals get a long way from their group heads and devour a great deal more vitality. Thusly, it is important to choose ideal bunch make a beeline for make the vitality utilization least. In the E-LEACH we utilize the base traversing tree between bunch heads, select the group head which has biggest lingering vitality as the root hub [9].
- D. *LEACH-F (Fixed number of cluster Low Energy Adaptive Clustering Hierarchy)*: The essential thought of group development in LEACH-F is begin of the system setup and after that is being settled. The CH position replaces among the hubs inside the group that is same as LEACH. The upside of this strategy contrasted with LEACH is that, there is no setup overhead toward the begin of each round like LEACH. For bunches development, LEACH-F utilizes incorporated group arrangement calculation that is same as LEACH-C. The inconvenience of this convention is that the settled groups in LEACH-F don't allow new hubs to be added to the system and don't alter their execution when any hub passes on in the system [10]. The overhead of re-bunching in fundamental LEACH is evacuated by LEACH-F convention as once the static number of groups is shaped; they are rationed all through the system.
- E. *LEACH-M (LEACH-Mobile)*: The LEACH-Mobile operation is laughed hysterically into rounds. Each round is appropriated into two stages, to be specific setup stage and enduring state stage. In setup stage groups are controlled and in relentless state stage information are exchanged to the base station. The indispensable idea in LEACH-Mobile convention is to affirm whether a portable hub is fit for speaking with particular cluster head inside the availability allocated in TDMA plan. In LEACH calculation, the cluster head holds up to assemble the detected information from non cluster head hubs as indicated by TDMA planning amid the relentless state stage. There is a slight change in unflinching the state period of the LEACH convention to bolster movement of hubs [11]. The cluster head in LEACH portable first sends the req. message for information transmission to non cluster head hub for social occasion the detected information at each

schedule vacancy. At the point when the information detected are sent by non clusterhead hubs, the clusterhead will make the schedule vacancy rundown of hubs from which the information is gotten by the TDMA availability at all the time when a casing closes. It likewise makes note of the hubs from which the information are not gotten in the vacancy toward the finish of each edge. In the wake of choosing which group to join, the hub will illuminate the relating clusterhead. The new clusterhead will reexamine the bunch participation rundown and TDMA calendar, and after that communicate the new TDMA timetable to its group individuals. The recently joined part works as indicated by the new calendar [11].

F. *LEACH-MH (LEACH-Multihop)*: Multihop-LEACH was for the most part recommended for steering information in remote sensor systems which have a static base station to which recorded information needs to be directed. All the sensor hubs are viewed as static, homogenous and vitality obliged. The sensor hubs are unsurprising to detect the earth always and in this manner have information sent at a settled rate. These principles make it improper for sensor systems where a moving source should be directed. The operation of Multihop-LEACH is isolated into two stages: the setup stage and the unfaltering state information exchange stage [12]. In the set up stage, the bunches are controlled and group heads chose. All through the setup stage, the group heads are chosen in light of the upheld rate of likelihood of bunching for the system and the quantity of times the hub has been a bunch head up until this point. This choice is made by every hub n picking an irregular number in the vicinity of 0 and 1. On the off chance that the number is not as much as an edge  $T(n)$ , the hub turns into a group set out toward the current round. The limit is set as takes after:

$$T(n) = \begin{cases} \frac{P}{1-P(r \bmod 1/p)} & \text{if } n \in G \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

Where  $P$  is the desired cluster-head probability,  $r$  is the number of the current round and  $G$  is the set of nodes that have not been cluster-heads in the last  $1/P$  rounds. Once the hubs have chosen themselves to be group heads they communicate an ad message (ADV). Each non bunch head hub chooses its group for this round by picking the bunch head that needs least correspondence vitality, in view of the got flag quality of the notice from each bunch head. After every hub chooses to which bunch it has a place, it illuminates the group head by transmitting a join ask for message (Join-REQ) back to the bunch head [13]. In the wake of accepting every one of the messages from the hubs that might want to be incorporated into the bunch and in light of the quantity of hubs in the group, the group head makes and reports a TDMA plan, allocating every hub a schedule opening when it can transmit. Each bunch interconnects utilizing distinctive CDMA codes to lessen impedance from hubs having a place with different groups. The CDMA code to be utilized as a part of the current round is transmitted alongside the TDMA arrangements. In the relentless state stage, the real information exchange to the base station happens. Upon acknowledgment every one of the information, the group head hub totals it before sending it to the next bunch head hubs. After a persuaded time, decided from the earlier, the system backpedals to the set up stage and enters another round of choosing new bunch heads. Between group and intra-bunch multi-bounce correspondence are the two noteworthy thoughts considered in Multihop-LEACH convention [13].

G. *Q-LEACH(Quadrature-LEACH)*: Q-LEACH convention is a stage of regular Quadrant based directional steering convention and Low Energy Adaptive Clustering Hierarchy (LEACH) conventions. These two conventions converged to frame a cross breed based steering convention. That convention is named as QLEACH. This convention takes the advantages of both Q-DIR steering convention and LEACH convention. The proposed framework presents novel improved Q-LEACH convention for proficient steering. That framework contains two noteworthy operations there are group development and information transmission [14]. The entire sensor system is isolated into four quadrants i.e., (q1, q2, q3, q4). Where sensor hubs are also irritated in every quadrant. The source and the relating goal hubs are put in similar quadrants. At that point the comprehensive sensor system is partitioned into n quadrants with the end goal that the source and goal falls under a similar quadrant. In grouping, whole system is isolated into steady or variable measured bunches containing sensor hubs in it. At first sensor hubs are gathered to shape a bunch. Each group is considered by a bunch head that is in charge of correspondence among base station/sink and other non-bunch head hubs [14].

H. *T-LEACH (Threshold-based LEACH)*: T-LEACH, It is an edge based group head helper conspires for bunching conventions of remote sensor systems. T-LEACH diminishes the quantity of bunch head choice by utilizing edge of outstanding vitality. Lifetime of the whole systems can be delayed contrasted and the present bunching conventions by decreasing the volume of head determination and substitution cost [15]. In LEACH convention, because of the intervention of groups framing, the vitality of bunch head is exceptionally adjusted, so do the separations between group heads and base station. Bunch heads are mindful not just to send information to the base station additionally to gather and consolidating the information from regular hubs in their own particular groups. In the strategy for information gathering and transmission, the vitality roused by information transmission is more prominent than that of information combining. On the off chance that the present vitality of a group head is less or the separation to base station is much far, then the bunch head will be passed on rapidly in view of a substantial vitality stack. To address these issues, this article proposes another enhanced calculation i.e TLEACH on the best way to adjust the vitality heaps of these group heads [15].

I. *V-LEACH (Vice-LEACH)*: New form of LEACH convention, the bunch contains; CH (mindful just to send information that is gotten from the group individuals to the BS), bad habit CH (the hub that will end up being a CH of the group if there should be an occurrence of CH kicks the bucket), group hubs. In the first LEACH, the CH is dependably on getting information from bunch individuals, total these information and afterward send it to the BS that may be situated far from it. The CH will bite the dust past than alternate hubs in the bunch in light of its system of getting, sending and listening in [16]. At the point when the CH kick the bucket, the group will end up noticeably futile in light of the fact that the information gathered by bunch hubs will unquestionably not achieve the base station. In V-LEACH convention, other than having a CH in the bunch, there is a bad habit CH that plays the part of the CH when the CH kicks the bucket in light of the fact that the thought processes we proclaimed above by doing this, group hubs information will dependably achieve the BS; no compelling reason to choose another CH each time the CH passes on. This will broaden the general system life time [16].

J. *W-LEACH (Weighted-LEACH)*: W-LEACH is a concentrated information accumulation calculation. W-LEACH comprises of a setup stage and an unfaltering state stage like conventional LEACH. In the setup stage, W-LEACH first gauges a weight esteem,  $W_i$ , and appoints it to every sensor  $S_i$ . Alter the meaning of  $p$  to be the rate of the extraordinary number of CHs rather than the real number of CH as it is characterized in the first LEACH. A greatest of  $p\%$  of alive sensors are,

then, chosen to be CH in view of the figured weights, with the end goal that the higher the weights the better the shot for them to be CH. Take note of that not at all like LEACH, W-LEACH does not mull over regardless of whether this sensor was a CH for past close adjusts. After all CHs are picked, groups are shaped with the end goal that every sensor is relegated to its closest CH .

#### IV. COMPARISON OF LEACH AND ITS DESCENDANTS PROTOCOLS

In this survey, LEACH based routing protocols are described. LEACH protocol improves the life time of a WSN and saves the energy by random revolution of CH and allocates the TDMA schedule to each cluster members to escape collision. Selection of CH is arbitrary, even though LEACH expands energy productivity but it does not work well in large coverage area which need Multihop transmission, does not support flexibility, consistency, etc. To overcome these Drawbacks, to develop more efficient descendant of LEACH are developed which are summarize on various expectations, shown in table 1.

Table.1. Survey on LEACH and its Descendant protocols

LEACH Descendant	Clustering Method	Advantages	Disadvantage
LEACH	Distributed	Load distribution in network	CH are not uniformly
LEACH-B	Distributed	Network lifetime increase	Overhead increase
LEACH-C	Centralized	Achieves more rounds in n/w	Overhead on the BS
LEACH-E	Distributed	Improves CH selection	CH is always in active
LEACH-F	Centralized	Delay is small	Cover larger region
LEACH-M	Distributed	Mobility of CH node	Overhead increase
LEACH-MH	Distributed	Maintain multihop routing	distance between the CHs and the sink node would get increased
Q-LEACH	Centralized	significantly improved network parameters	Life time of network will be less
T-LEACH	Distributed	Reducing the CH selection	CH based on threshold
V-LEACH	Distributed	Introduce vice CH	Extra processing for vice CH
W-LEACH	Centralized	Increase lifetime of network	CH selection is random

## CONCLUSION

The main concern of this survey is to examine the energy efficiency and throughput enhancement of these routing protocols. An energy efficient routing protocol is the major concern in Wireless Sensor Networks (WSNs). Main focus of our study is how these extended protocols work in order to increase the life time and how quality routing protocol are improved for WSNs. Furthermore, this paper also highlights some of the issues faced by LEACH and also explains how these issues are tackled by extended versions of LEACH. We compare the features and performance issues of the selected hierarchal routing protocols.

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