

# COMPARATIVE ANALYSIS OF DIFFERENT VERSIONS OF LEACH PROTOCOL ON THE BASIS OF DIFFERENT PARAMETERS

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## ABSTRACT

A wireless sensor network with large number of sensor nodes can be used as an effective tool for gathering data in various situations. So the major issue in the WSN is the energy consumption of the network. In this paper leach protocol and its lifetime is represented. Leach protocol and its energy consumption is discussed and how leach is different from other versions of leach. In this paper survey of leach protocol and its various energies consumption are discussed.

## Keywords

WSN, Leach protocol, Versions of Leach protocol

## 1. INTRODUCTION

A remote sensor sort out (WSN) is a remote framework involving spatially coursed self-decision devices using sensors to screen physical or characteristic conditions. A WSN structure joins an entry that gives remote accessibility back to wired world and dispersed centers. The remote tradition you select depends upon your application necessities. A phase of the on the market seat marks be a component of a dyad of 4G cps radios in light weight either of IEEE 802.15.4 or IEEE 802.11 (Wi-Fi) measures or cull radios that square measure often 900 mega cycle. A wireless sensor system can be characterized as a system of gadgets that can impart the data accumulated from a checked field through remote connections. It comprises of base stations and quantities of hubs. On the off chance that hub can't speak with other hubs of the system through direct connection, it implies hub is out of range. So now the transmission is carried by the middle nodes or the intermediate nodes. In this there is no wired connection. Broadcasting means the sensor node send the message to all nodes in the network. Tong, M, and Tang, M, (2010).

The fundamental issue in WSN, sensor hub has restricted battery life in light of the fact that the sensor hubs estimate is little so battery measure, processor, storage room for information, and these all are little as sensor hubs. Batteries which are used in WSN cannot be replaced nor can they be recharged. We have to solve the problem of energy protection. Kole, S, Vhatkar, K. N, and Bag, V. V. (2014). There is different number of protocols designed to improve the lifetime of network or to reduce the energy consumption which will discussed below. The significant test of remote sensor systems as for attributes which incorporate are Fault tolerance, Network Lifetime, Scalability, Quality of Service which include packet delivery ratio, reliability, delays etc. WSN assumes an imperative part in numerous applications for example in surveillance, health, Industries, Monitoring, Habit and forest fires, Natural disaster, Medical, Environment. WSN has different characteristics which are explained below: Suri, P., Bedi, R. K., & Gupta, S. K. (2015).

- a) Control consummation constraints for hubs utilizing batteries
- b) Capacity to adapt to hub disappointments
- c) Mobility of nodes
- d) Dynamic network topology
- e) Failures related to communication.
- f) Heterogeneity of nodes
- g) Ease of use

Pham, M. L, Sharma, T., Singh, H., & Sharma, A. (2015). Hierarchical routing protocol is choose because it is the best protocol. Hierarchical routing protocol is one of the most energy efficient, more scalability, and minimum use of energy constraint. This is only the protocol which tries to improve network lifetime by minimizing node energy consumption. In hierarchical routing protocol the whole

network id divided into groups and each group is checked and controlled by a CH which is known as cluster head. Before sending the data to BS whole data is collected by CH and then CH pass it to BS. , P., Bedi, R. K., and Gupta, S. K. (2015). In WSN control sparing systems are arranged in two classifications.

- Planning the sensor nodes to substitute amongst dynamic and sleep mode
- Altering the transmission or detecting range of the remote nodes

Madheswaran, M., & Shanmugasundaram, R. N. (2013). WSN has different number of protocol as leach is one of the protocols which have low energy but efficient protocol. Leach is low energy adaptive clustering hierarchy. Singh, S. K., Singh, M. P., and Singh, D. K. (2010). In this protocol all the transmission is completed by cluster heads but not by all the nodes. Leach protocol have two phases one is setup phase and other one is steady phase. In step phase one node is select as CH on the basis of probability

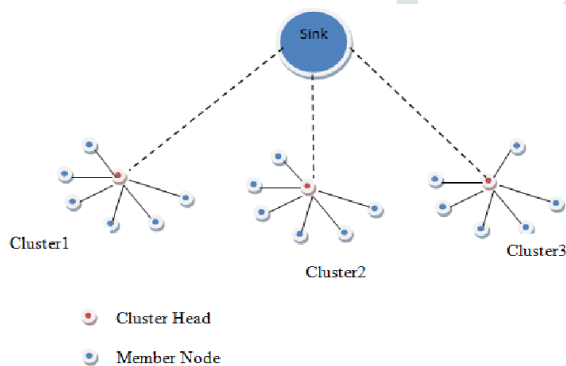


Fig 1:

Leach Aggregation Algorithm , E. S., and Gupta, E. R. (2015), Al-Baz, A., & El-Sayed, A. (2018)

All the nodes transfer the whole data to CH. Jain, P., & Chaudhary, A. (2017). CH then transfers it to BS. Selection of CH is on the basis of two factors. Al-Baz, A., and El-Sayed, A. (2018)

- Percentage of nodes
- History of nodes which is served as CH.

In steady phase CH collect data by TDMA slot. CH collects from all nodes and sends to BS. Kaur. H, Verma. A, & Kapoor. M. (2017).

In this paper description of leach protocol with their different versions.

## 2. LITERATURE REVIEW

**Yassein M. et al.; [2009].** A new version of leach protocol was proposed to reduce the energy consumption. In which there was vice CH that takes the role of CH when the CH dies. In this there is no need to select the CH again and again by which energy consumption is reduced. Yassein, M. B., Khamayseh, Y., and Mardini, W. (2009).

**Shio K. et al.; [2010].** There was survey of routing protocols on the basis of location information, network layering and in-network processing, data centric, path redundancy, network dynamics. Although the paper concluded the design of routing protocols for duty-cycled WSNs, and three dimensional sensor fields. Singh, S. K., Singh, M. P., and Singh, D. K. (2010).

**Snehal K. et al.; [2014].** Proposed an algorithm to optimized the energy consumption of WSN by introducing a novel and adaptive technique on the traditional clustering protocol. Improvement is done on cluster formation by applying distance parameter through distance based leach algorithm. Kole, S., Vhatkar, K. N., and Bag, V. V. (2014).

**K. et al.; [2015].** Proposed a new algorithm pollination based optimization to improve the network lifetime and to reduce energy of the nodes. The PBO algorithm used for homogenous clustering in WSN and cluster head is chosen on the basis of remaining energy and distance. Kaur, E. S., and Gupta, E. R. (2015).

**Tarun S. et al; [2015].** The various routing protocols was described with their different issues, their challenges. Comparison of various routing protocols has been discussed by the author. Sharma, T., Singh, H., and Sharma, A. (2015).

**Harpreet k. et al.; [2017].** Proposed to investigate and find insight into the effect of energy efficient for Wireless Sensor Network using Leach and Leach-C protocol. In this various parameters are described such as different no of rounds, number of dead cells, total no of packet received to base station and end to end delay. In this there are five different levels of energy nodes. Kaur. H, Verma. A, & Kapoor. M. (2017).

**Hassan O. et al.; [2017].** To minimize the distance between BS and cluster head a new algorithm was proposed and also the number of dead nodes which is far away from BS are reduced. Their objective was to avoid the death of the nodes which are far away from base station. Oudani, H., Krit, S., Kabrane, M., Bandaoud, K., Elaskri, M., Karimi, K., and Elmaimouni, L. (2017).

**Payal J. et al.; [2017].** The two protocols the Leach and Pegasus protocol was proposed. In this there was comparison between both the protocols. The author shows the performance of both protocols on the basis of network

lifetime, communication overhead and percentage of node deaths. Jain, P., and Chaudhary, A. (2017).

**Siva P. et al.; [2018].** Proposed a genetic algorithm which was based on low energy adaptive clustering hierarchical routing protocol. Genetic algorithm includes three steps Selection, Cross over and Mutation. The author shows comparison between different protocols by varying initial energy and Cluster Probability. Sivakumar, P., and Radhika, M. (2018).

**3. Different Versions of Leach Protocol** There are many different versions of leach protocol some of the protocols are explained below.

- I. **A-LEACH**:-Assisted Leach protocol is abbreviated as A-LEACH. In leach protocol the data aggregation and routing is carried by cluster heads. In assisted leach the helper nodes are introduced. A node which is closer to base station in every cluster assigned the routing job and in case of cluster head performs all the data aggregation. In this helper node chooses a next hop the node which is nearest to base station from neighboring helper node. The receive signal strength of base station is used. Back on Signals are there to decide which is nearer to base station in helper node selection and route up phases. The dissipation energy is less as compare to other. Kumar, S. V., and Pal, A. (2013).
- II. **K-LEACH**:- In K-leach the cluster head is chosen upon the least distant from the center of cluster but in case of leach the cluster head is on based of random selection. K- leach protocol uses the K-medoids clustering algorithm. In this selection of cluster head by Euclidian distance at the center of cluster or nearer of cluster which gives more efficient solution in wireless sensor networks. In k-leach it is divided into many rounds and each round contains cluster formation phase and steady state phase. In cluster formation phase in first round cluster are formed by K-medoids by using Euclidian algorithm. After that the nodes which become cluster head send information to all other nodes. The other nodes send cluster joining information to cluster head. Then it uses TDMA schedule. In steady phase nodes send their data according to TDMA schedule when cluster head receives it aggregates the data. The cluster head will send directly to base station. Bakaraniya, P. and Mehta, S. (2013).
- III. **Leach-B**:-Balanced Leach is abbreviated as Leach-B. This is an enhanced algorithm of Leach Protocol. Leach-B was implemented to remove the shortcomings of Leach protocol by the choosing of cluster head on the basis of residual energy but in leach protocol no cluster head is formed on the basis of residual energy. In this firstly selection of cluster head is based on leach protocol and second selection is based upon the node residual energy. The near optimal number of cluster head is calculated. Leach-B network has constant number of clusters and balanced cluster distribution. Energy dissipation is balanced and lifetime of Leach-B is longer as compare to Leach Protocol. Tong, M., and Tang, M. (2010).
- IV. **LEACH-C**:-Leach-C is Leach Centralized. It is improved version of leach protocol. In leach protocol cluster head is selected on basis of two factors as in leach CH is selected by node where as in Leach-C CH are selected by base station. There are two phases step up phase and steady phase. In step up phase BS select cluster head with the help of average node energy, location and energy level to BS. Transmission takes place between nodes which contain cluster\_id. In short BS gathers all the location data of all nodes and transmits its data. Energy charge of communicating with base station becomes higher. As the performance may be not as good as BS may be far away from BS. Sivakumar, P. and Radhika, M. (2018), Kaur, E. S. and Gupta, E. R. (2015) , Nayak, P. (2014).
- V. **O-LEACH**:-In this protocol firstly all the nodes send their location information to the BS. BS divides the field into four sub divisions based on location information. Now some nodes are selected as CH based on probability from each sub division and broadcast information to nodes. Selection of clusters will depend upon Received Signal Strength Indicator. Nodes send their request to CH. Time slots is allocated to nodes using TDMA so that appropriate communication can be done without congestion. Every node communication its allocated slot with its defined CH. Kasana, A., Sachan, V. K., & Singh, N. K. (2016).

**VI. V-LEACH:** - V leach is produced to reduce energy consumption. In V-Leach each cluster has one CH that is one can transfer information from sensor node to BS and also one vice-CH its means the node that will become CH in case of cluster dies. When CH dies cluster node gathers data from environment and sends to CH. In this there is no need to select the CH again and again. Because there is vice CH. In case of CH dies the vice-CH

takes the role of CH. As in case of Leach protocol we need to select CH again and in case of CH die it will become useless as the data gathered by cluster nodes will never reach to base station. So this way the overall network lifetime will extend. Yassein, M. B., Khamayseh, Y., and Mardini, W. (2009).

**Table 1: Comparative Analysis of different versions of leach protocols in WSN** Asha, G., Durgadevi, S., and Shankar, M. K. (2014), Singh, S. K., Singh, M. P., and Singh, D. K. (2010).

S.No	Protocol	Communicati on Pattern	Energy Efficiency	Packet Loss	Delay Ratio	Advantages	Disadvantages
1.	A-LEACH Kumar, S. V., and Pal, A. (2013).	Single hop	Minimized energy dissipation	less	Less	Helper node chooses a next hope the node which is nearest to base station.	The dissipation energy is less
2.	K-LEACH Bakaraniya, P. and Mehta, S. (2013).	Single hop	Almost same as leach protocol. As Leach has low energy.	Less	Less	The cluster head is chosen upon the least distant from the center of cluster	Average energy consumption is almost similar to leach protocol
3.	LEACH-B Tong, M., and Tang, M. (2010).	Single hop	High	More	More	Residual energy of nodes is considered for CH selection	Others parameters can be considered for CH selection
4.	LEACH-C Sivakumar, P. and Radhika, M. (2018), Nayak, P. (2014).	Single hop	Very High	More	More	Number of data received at bus station is more	If nodes are mobile it do not provide good performance
5.	Q-LEACH Kasana, A., Sachan, V. K., & Singh, N. K. (2016).	Single hop	Increased	More	More	Selection of clusters will depend upon Received Signal Strength Indicator.	Q-Leach is for homogenous networks.
6.	V-LEACH Yassein, M. B., Khamayseh, Y., and Mardini, W. (2009).	Single hop	Low	Less	Less	When CH dies the vice CH send all data to BS	It has no solution when vice cluster head dies.



7.	R-LEACH Kamath, H. S. (2013).	Multi hop	Reduced	Less	Less	Relay node is chosen between CH and sink so to balance energy consumption.	Only in the case of energy dissipation rate.
8.	M-LEACH Suri, P., Bedi, R. K., and Gupta, S. K. (2015).	Multi hop	Very High	More	More	Throughput is greater	Location monitoring should be developed.
9.	E-LEACH A, Deswal, S, and Singh. P (2016), Rai, A, Deswal, S, and Singh. P (2016)	Single hop	Very High	More	More	Proper selection of CH reduces the radio communication range	The network should be provided with GPS for monitoring the position.
10.	RFID LEACH T., Singh, H., & Sharma, A. (2015)	Multi hop	High	More	More	Energy consumption is reduced	Packet collision is more.

**VII. R-LEACH:** -In this protocol it is divided into two phases set up phase and steady state phase. In set up phase improved threshold is used to decide which node would become CH. Then CH will be chose. After that CH will broadcast the message with node residual energy and its distance from the base station. When cluster will form there is relay node from cluster head based on the two factors that is relay node and distance from node. The nodes are distributed then cluster head are chosen on the basis of threshold value and cluster head aggregates the data and transmission is carried out to the R node which aggregates the data and sends to BS. Kamath, H. S. (2013).

hop to multi hops between CH and BS. Suri, P., Bedi, R. K., and Gupta, S. K. (2015).

**IX. E-LEACH:-** E-Leach is abbreviated as Energy leach. E-Leach is divided into rounds. In first round every node can become CH as they have the same probability to become CH. In this main factor is residual energy of nodes which will decide to become CH or not but after the first round. After first round is completed the residual energy of every node is different. Mean nodes have more energy to become a CH rather than nodes with less energy. A, Deswal, S, and Singh. P (2016), Rai, A, Deswal, S, and Singh. P (2016)

**VIII. M-LEACH:** -In case of Leach protocol CH directly communicates with BS the distance between them does not matter. As M-Leach is abbreviated as Multi hop leach protocol. It selects optimal path between CH and BS. Multi hop communication is carried among CHs. According to optimal path CHs transmit data to corresponding CH which is nearer to BS. This way CH sends data to BS. The difference between Leach and M-Leach is that the in M-leach the communication mode from single

**X. RFID -LEACH:-** The enhancement is carried in leach protocol which is known as RFID protocol. Different modes are applied on leach protocol. These modes are Sleep, Ready, Active mode. The modes are applied to remove the shortcomings of leach protocol. In active mode only sensed data is carried out. In Ready mode sensed data also

transmitting data to the BS. The sleep mode is used to save energy and balance the energy consumption. The main problem in RFID protocol is clock synchronization by which packet losses occur and the performance of network degrades. Sharma, T., Singh, H., & Sharma, A. (2015), Kaur, K., & Kumari, N. (2014).

## 5. CONCLUSION

Wireless sensor network is very much in demand today because of use in different applications. In wireless sensor networks sensors are battery operated. These networks are energy constrained. To increase the lifetime of network researchers discovered different protocols. In this paper analyzing large number of papers related to wireless sensor network and leach protocol. In this paper different versions of leach protocol are discussed. And comparison of different versions of leach protocols is discussed. As the applications of WSN are increasing day by day so that's why researchers are working more on energy consumption algorithm.

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