Simulation & Performance Evaluation of Optimal LEACH Subject to other Protocols in Wireless Sensor Network

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***Abstract*— Advance wireless sensor network (WSN) technology is Low- power electronics and Low-power radio frequency design has enabled the development of small, relatively inexpensive & low-power sensor technology. The important challenges in design of network are three key resource1) Energy 2) Communication bandwidth 3)coverage area . LEACH (Low Energy Adaptive Clustering Hierarchical) is a hierarchical clustering algorithm. It is more efficient than proactive n reactive protocol. LEACH protocol have some disadvantage. To overcome disadvantage we improved LEACH protocol by using optimal path forwarding algorithm and multihop technique i.e O-LEACH protocol. O-LEACH is more efficient than LEACH protocol and it uses static deployment technique. The paper is concluded by mentioning valuable observations made from analysis of results about AODV and LEACH and Optimal LEACH protocols.**

***Index Terms*— WSN, LEACH, AODV, O-LEACH, PDF, Troughput**

I. INTRODUCTION

A Wireless Sensor Network (WSN) consists of a large number of sensor nodes that co-operatively monitor a specific region of interest. Typically, a sensor node is a small hardware device consisting of a processing unit, a sensing unit, a communication unit and a power unit that is used for sensing, data processing and communication purposes. These nodes collectively gather sensed information and forward it to the special node called *base station* which acts as interface between the sensor nodes and users. The uniqueness of a sensor

node lies in its small size and light weight. However, there are a lot of constraints such as limits on resources in terms of energy, memory, computational speed, band width and so on [1][2]. Because of these constraints the interactions between sensors are limited to short distances and low data rates. These sensors are used in wide range of applications and real time applications such as nuclear power plants, habitat monitoring, military applications, security purpose etc [3]. Sensors gather useful information in a timely manner and send it to a centralized node named *sink*. The sink node is also known as base station and is responsible for further processing such as node query. Due to the large number of sensor nodes and the voluminous data that should be reported, data communication should be done in energy efficient manner. Centralized solutions for data collection are not recommended. Obvious drawbacks of this type of solutions include hindering the network since the base station becomes a bottleneck, the bandwidth allocated is not efficiently used and all sensor nodes consume a lot of scarce and valuable power to communicate with the base station. Hence, the optimum solution becomes a distributed data collection algorithm, where data mining techniques such as clustering are applied to the sensor nodes. When there are large

number of sensors in the sensing field, sensors will be clustered to reduce the data redundancy. The cluster head will take care of this work. Clustering of sensor nodes is considered as one of the very successful techniques of mining useful information from a distributed environment. It is a particularly useful technique especially for applications that

require scalability to hundreds and thousands of nodes. Clustering also supports aggregation of data in order to summarize the overall transmitted data. However, the current literatures either focus on node or data cluster in alone. Clustering of sensor nodes deals with two main operations: 1) identifying cluster heads, and 2) assigning nodes to respective cluster heads. These two operations should be done at a very energy-efficient level. On the other hand, data clustering deals with collecting the similar data for aggregation purposes. The process of choosing the cluster head should take into consideration node design factors such as energy level of the sensor node and load balancing as well as their similarity in terms of the sensed data. A successful clustering algorithm is the one that produces an optimal amount of clusters, with each having a single cluster head responsible for inter and intra-cluster communication.

This paper *focuses* on the problem of minimizing the energy consumption of sensor nodes during sending data and aggregating sensed data of the sensor nodes of the cluster. Minimization of energy can be achieved by using improved or Optimal LEACH communication protocol. Where the previous work uses LAECH protocol to form the clusters and to aggregate the sensed data of the sensor nodes of the cluster, but it is having a drawback in consuming energy of the sensor. This Optimal LEACH protocol used optimal path for sending data towards sink node. The rest of the paper is organized as follows: Section 2 reviews related work. Section 3 gives working of the LEACH protocol. Section 4 gives simulation of leach protocol n result comparing with AODV protocol. section 5 gives conclusion.

LEACH Protocol

Low Energy Adaptive Clustering Hierarchy (LEACH) is the first hierarchical cluster-based routing protocol for wireless sensor network which partitions the nodes into clusters, in each cluster a dedicated node with extra privileges called *Cluster Head (CH)* is responsible for creating and manipulating a *TDMA* (Time Division Multiple Access)

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schedule and sending aggregated data from nodes to the BS where these data is needed using *CDMA* (Code Division Multiple Access**)**. Remaining nodes are cluster members. This protocol is divided into two rounds; each round consists of *two* phases:

A. Set-up Phase

Each node decides independent of other nodes if it will become a CH or not. This decision takes into account when the node served as a CH for the last time (the node that hasn't been a CH for long time is more likely to elect itself than nodes that have been a CH recently).

In the following advertisement phase, the CHs inform their neighbourhood with an advertisement packet that they become CHs. Non-CH nodes pick the advertisement packet with the strongest received signal strength.

In the next cluster setup phase, the member nodes inform the CH that they become a member to that cluster with "join packet" contains their IDs using CSMA. After the cluster-setup sub phase, the CH knows the number of member nodes and their IDs. Based on all messages received within the cluster, the CH creates a TDMA schedule, pick a CSMA code randomly, and broadcast the TDMA table to cluster members. After that steady state phase begins

B. Steady phase

Data transmission begins, Nodes send their data during their allocated TDMA slot to the CH. This transmission uses a minimal amount of energy (chosen based on the received strength of the CH advertisement).

The radio of each non-CH node can be turned off until the nodes allocated TDMA slot, thus minimizing energy dissipation in these nodes..

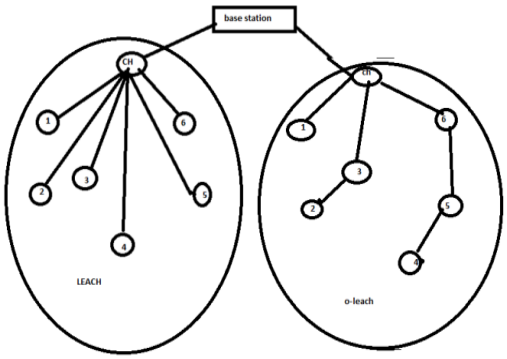
When all data has been received, the CH aggregates these data and sends it to the BS. LEACH is able to perform local aggregation of data in each cluster to reduce the amount of data that transmitted to the base station.

Although LEACH protocol acts in a good manner, it suffers from many drawbacks such like;

- CH selection is randomly, that does not take into account energy consumption.
- It can't cover a large area.
- CHs are not uniformly distributed; where CHs can be located at the edges of the cluster.

II. Proposed Method And Protocol

According to survey of leach protocol. we found that there are some disadvantages of leach protocol. To avoid that disadvantage we proposed a new protocol that is optimal leach clustering hierarchical protocol .In this protocol we used optimal path forwarding algorithm. with the help of this protocol source node select shortest path to send data towards the cluster head. Distance is directly proportional to energy consumed .hence we used shortest path to send data towards the cluster head. It uses static deployment technique that increase coverage area of network.



[1] O- LEACH provide clarity about position of sensor nodes and the number of cluster heads in the network because it uses static deployment technique. In static deployment technique position of node already known .we deploy node in such a way that cover a maximum area .

[2] Each Cluster-Head not directly communicates with BS. Even all non cluster head not directly communicate with cluster head. It uses shortest path for communication that consume less energy.

[3] The CH uses most of its energy for transmitting and collecting data. Hence we select a CH randomly according to their energy. so it become less chance of CH die early.

[4] CH changes randomly according their residual energy .Each non cluster head get equal chance to become CH.Is uses load balancing that increase the life of network.

SIMULATION PARAMETER PERFORMANCE METRICS.

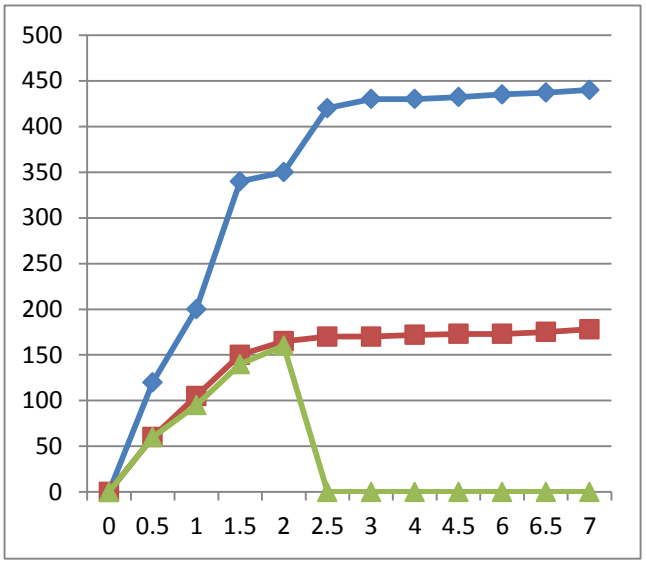
1	Channel Type	Wireless Channel
2	Radio-Propagation Model	Propagation TwoRayGround
3	Network Interface Type	WirelessPhy
4	MAC Type	Mac/802_11
5	Interface Queue Type	Queue/DropTail/PriQueue
6	Link Layer Type	LL
7	Antenna Model	Antenna/Omni Antenna
8	Max Packet In Ifq	50
9	Number Of Mobilenodes	20
10	Define Routing Protocol Here	AODV,LEACH
11	X Dimension Of Topography	300
12	Y Dimension Of Topography	300
13	UDP Set Packetsizee	1000
14	Packet interval	0.07
15	Idle power	1
16	Rx power	1
17	Tx power	2
18	Sleep power	0.001
19	Transition power	0.2
20	Transition time	0.005

SIMULATION RESULTS AND PERFORMANCE ANALYSIS

In order to compare different protocols, it is important to have good models for all aspects of communication. In this simulation we have used network model and radio model for computation of energy dissipation as discussed earlier. Following Figures shows energy ,delay jitter, throughput ,packet delivery ratio, related to the number of nodes for routing protocols AODV ,LEACH and OLEACH

Protocol. To eliminate the experimental error caused by Randomness, the experi- ment was repeated for 10 times and the average was taken as the final result. As seen from the graphs, the LEACH is more energy efficient than AODV and O-LEACH is more efficient than LEACH.As O_LEACH used optimal path for data forwarding so its required less amount of energy as compared to other two protocol that is clearly observed from graph(a).

Time vs Energy graph



Fig(a) energy consumption for AODV,LEACH,O-LEACH

TIME VS DELAY GRAPH

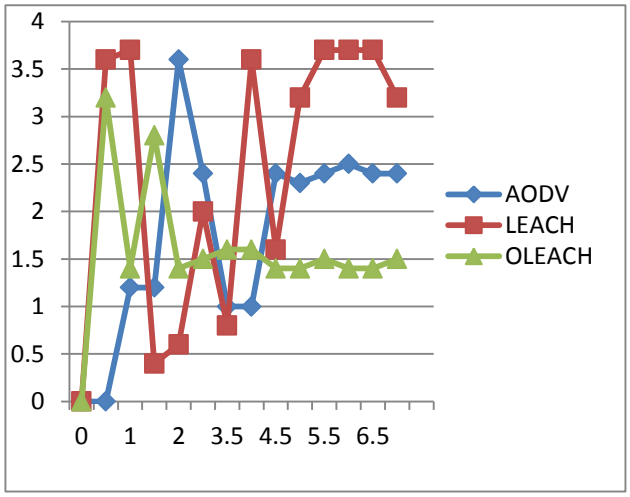
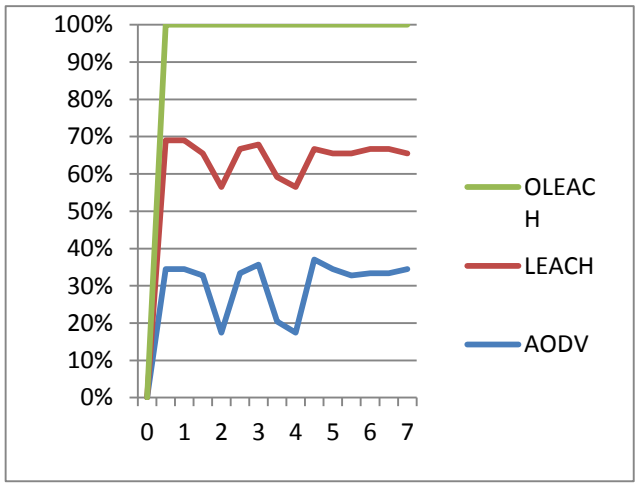


Fig **(B) End To End Delay For Aodv ,Leach,O-Leach**
Packet Delivery Fraction Vs Time

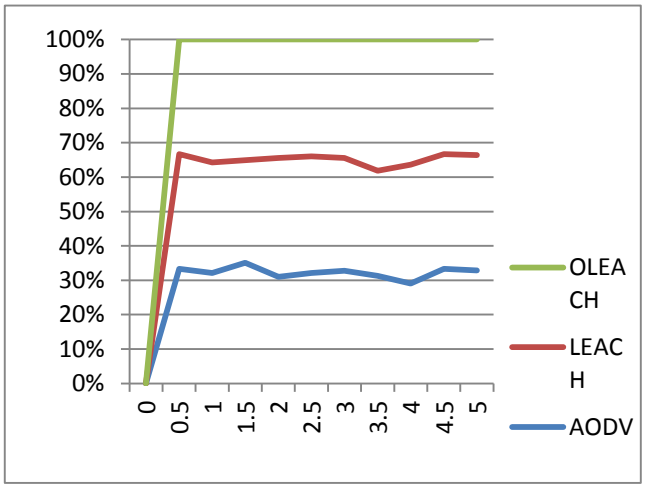


Fig**(C) Pdf For Aodv , Leach And Oleach**

Packet delivery fraction is calculated by extracting data from AODV.tcl file, LEACH.tcl file, O-LEACH.tcl file and three curves one for AODV, one for LEACH, one for O-LEACH are plotted by taking time event on X-axis and %age of PDF on Y-axis as shown in figure for 1 , 2 , 3 ,4 , time event respectively from figure GRAPH(C). it is quite clear that PDF for O-LEACH is better

Average delay is calculating by extracting data from AODV.tcl , LEACH.tcl, O-LEACH.tcl file and three curves one for AODV, one for LEACH, one for LEACH are plotted by takingof time on X-axis and average delay on Y-axis as shown in GRAPH(B) for event 1, 2, 3.5, 4.5 nodes respectively. From figure, it is quite clear that the average end-to-end delay has increased in case of AODV, due to overhead increased. But it is less in LEACH but as time goes on it also increases.But in case of O-LEACH end to end delay decreases as time goes on

Throughput vs time



Fig(D) Throughput For Aodv ,Leach, O-Leach

Throughput is calculating by extracting data from AODV.tcl , LEACH.tcl, O-LEACH.tcl file and three curves one for AODV, one for LEACH, one for O-LEACH are plotted by taking of time on X-axis and average throughput on Y-axis as shown in GRAPH(d) for event 1, 2, 3.5, 4.5 nodes respectively. It is quite clear that the throughput of O-LEACH is better as compared to AODV and LEACH

III. CONCLUSION

In this paper we have evaluated three protocol AODV, LEACH, O-LEACH. These protocols have been tested on NS2 simulator by using four fraction energy, end to end delay, packet delivery ratio , throughput. According to analysis we found that O-leach energy efficient than LEACH protocol O-LEACH consume least energy. In our protocol cluster formation has been decided by us. we already known the position of node so less amount of energy required for cluster formation.

In the foreseeable future, the factors in hierarchical routing protocol which affect the cluster building, communication of CHs and data fusion of clusters will be one of the research directions which can be more helpful to enhance a network lifetime of the WSN.

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