International Journal of Engineering Research and General Science Volume 3, Issue 4, July-August, 2015
ISSN 2091-2730

A Comprehensive Performance analysis of energy efficient routing protocol OLEACH in the mobile ad-hoc network

Jayshree Jaunjalkar, Nutan Dhande, Dhananjay Sable

M-Tech Student, Dept. of CSE, Agnihotri college of engineering, Nagthana Road, Wardha (MS), RTM Nagpur University
jayshree.jaunjalkar@gmail.com Contact No. 9860813779

Abstract— A mobile ad-hoc network (MANET) consists of a group of mobile nodes (MNs) that communicate with each other without the presence of infrastructure. MANET has a changing topology due to the movement of mobile nodes in the network. These mobile nodes are battery operated and require battery resources for communication purpose, also these resources are limited. So, some energy efficient routing protocols are used in MANET to provide battery resources to mobile nodes. This protocols help to reduce the power consumption of nodes and also lengthen the battery life to improve the life time of the network thus, improve network performance of the network. In this paper, an attempt has been made to implement the energy efficient routing protocol i.e. LEACH (Low Energy Adaptive Clustering Hierarchy) and again modify this protocol using optimal selective path forwarding algorithm, named as OLEACH. Using this protocol, we can improve the network performance by reducing the power consumption of mobile nodes in the network.

KEYWORDS— MANET, AODV, LEACH, OLEACH, ENERGY EFFICIENT ROUTING PROTOCOL, MOBILE NODES (MNS), ETC

INTRODUCTION

A **mobile ad hoc network** (**MANET**) is a continuously self-configuring, infrastructure-less network of mobile devices connected without wires. This network consists of a group of mobile nodes for communication purpose in the network. It is an infrastructure less networks means mobile nodes are connected dynamically in arbitrary manner and communicates in a point-to-point approach without linking central access points. Mobile ad-hoc network contains mobile nodes based on battery operated and have very limited battery resources. Also topology of the mobile Ad-hoc network is dynamic and depends upon the movement of the nodes so accordingly it can change rapidly and unexpectedly. This changing topology affects the routing of packets which causes routing overhead, packet loss, and delay. For routing of packets and enhancing the network performance, conventional routing protocols do not work efficiently in MANET as expected therefore energy efficient routing protocols are used. These routing protocols are used to find out suitable routes between the communicating nodes.

Classification of routing protocols:

The routing protocols can be divided as flat- routing, hierarchical routing and geographic position assisted routing depending on the network structure.

Flat routing protocols:

Proactive, Reactive, and Hybrid are the flat routing protocols. Proactive routing protocols are also called Table-Driven routing protocols. In this group of protocols routes to all the nodes are predefined. And routing information is maintained in the routing table at each node in the network, accordingly packets are transferred from source to the destination. Some examples of these routing protocols are: DSDV (Distance Sequence Distance Vector Routing) Protocol, OLSR (Optimized Link State Routing), and WRP (Wireless Routing Protocol).

Reactive routing protocols are also called On-Demand routing protocols. In this group of protocols, routes are established between the source and destination when required. When source node has a data packet to send then route discovery mechanism is perform to find out the routes to the destination nodes. Some examples of these routing protocols are: DSR (Dynamic Source Routing) Protocol, AODV (Ad-hoc On-demand Distance Vector Routing) Protocol, and TORA (Temporally Ordered Routing Algorithm).

A hybrid protocol means the combinations of reactive and proactive protocols and takes advantages of these two protocols and as a result, routes are found quickly in the routing zone. Example of this protocol is: ZRP (Zone Routing Protocol).

Hierarchical routing protocols:

A Hierarchical-network is used when the size of network inside a MANET increases tremendously. Some examples of this protocol are: Hierarchical State Routing (HSR), Cluster-head Gateway Switch Routing Protocol (CGSR), and Land-Mark Ad-Hoc Routing Protocol (LANMAR).

Geographical Routing Protocols:

Two approaches to geographic mobile ad- hoc networks are i.e. Actual geographic coordinates (as obtained through GPS – the Global Positioning System) and Reference points in some fixed coordinate system. For the effective location-based routing, the routing updates must be done faster in compare of the network mobility rate as the node positions changes quickly in the network. Some of its examples are: Geo-Cast (Geographic Addressing and Routing), DREAM (Distance Routing Effect Algorithm for Mobility), GPSR (Greedy Perimeter Stateless Routing).

DESCRIPTION OF ROUTING PROTOCOLS: AODV, LEACH AND OLEACH

A. Ad Hoc On Demand Distance Vector Routing (AODV) Protocol:

The Ad-hoc On-Demand Distance Vector Routing (AODV) is a reactive routing protocol for MANET. It uses on-demand approach for finding the routes. It is reactive routing protocol therefore route discovery is source initiated and each nodes maintains the next hop routing information corresponding to each flow for data packet transmission. In a route discovery process, the source node broadcasts a route request packet (RREQ). A route request carries the source identifier (SrcID), the destination identifier (DestID), the source sequence number (SrcSeqNum), the destination sequence number (DestSeqNum), the broadcast identifier (BcastID), and the Time-To-Live (TTL) field. RREQ packet contains destination sequence number which indicates the freshness of the route that is accepted by the source. When the destination or node that has a route to the destination receives the RREQ, it checks the destination sequence numbers it currently knows ant one particular in the RREQ. to assurance the freshness of the routing information, a route reply (RREP) packet is created and forwarded back to the source node only if the destination sequence number is equal to or greater than the one specified in RREQ. It uses only symmetric links and RREP follows the reverse path of the respective RREQ. Upon receiving the route reply (RREP) packet, each intermediate node along the route information updates its next hop table entries with respect to the destination node. AODV protocol also find out link breakage in the network by sending the route error (RERR) message back to the source nod following the reverse path on the link in the network.

B. Low Energy Adaptive Clustering Hierarchy (LEACH) Protocol:

LEACH is based on a hierarchical clustering structure model and energy efficient cluster-based routing protocols for sensor networks. In this routing protocol, nodes self organize themselves into several local clusters, each of which has one node serving as the cluster-head. In this protocol, nodes elects cluster head nodes for each clusters as randomly choosen maximum energy node in the current cluster becomes cluster head node and other nodes in that cluster are called as non-cluster head node. Cluster head node collects data from non- cluster head nodes and passed it on to the base station. Source node to destination or sink node communication occurs through this maximum energy cluster head node. If the energy of the cluster head node goes below down then second highest energy node in that cluster becomes the cluster head node. In order to prolong the overall lifetime of the sensor networks, LEACH changes cluster heads periodically.

C. Optimized LEACH (OLEACH)

Optimized LEACH is modified LEACH Protocol containing optimal path forwarding algorithm. Optimal path forwarding algorithm finds the optimal route from source node to the CH node through the different clusters and cluster heads. This mechanism shows the node changes dynamically mean routed node from source node and send the energy level with packet to the neighbor node in case any node failure, then the packet transmitted to neighboring path node and check with proper energy for communication from source to destination or sink node. Some advantages of optimal selective path forwarded method such as Intelligent decision making, less overhead signaling, Maximizing packet distribution.

RELATED WORK

This paper has compared the performance analysis of the energy efficient proactive and reactive routing protocols i.e. EAODV, AODV, DSDV, DSR, TORA in MANET considering parameters load, node mobility, delay, packet sending rate and energy consumption for enhancing the network performance of different routing protocols, when frequent link failure occurs in network due to mobility of the nodes in the network. Where routing protocol DSDV uses proactive "table driven" routing strategy, while EAODV, AODV, TORA and DSR use "on-demand" routing strategy. From the results obtained from this paper it is conclude that in low mobility and low load scenarios, all the protocols react in a similar way, while with mobility or load increasing DSR outperforms EAODV, AODV, TORA and DSDV routing protocols. TORA and DSR routing protocol gives poor performance when mobility or load are increased. [1]

This paper has presented comparison of different protocols in MANETs like AODV, LEACH and TORA protocols on NS2 simulator using three metrics- packet delivery fraction (PDF), average end-to-end delay, and packet loss. The PDF has shown that AODV and TORA gives better performance but LEACH is not better for PDF. The average end-to-end delay has shown that delay has increased in case of AODV, TORA but less in LEACH as compared to AODV and TORA. Packet losses in AODV, TORA will be more and in LEACH is less. [2]

This paper presents comparison of three protocols AODV, DSDV, and LEACH using a variety of workloads such as packet delivery ratio, routing overhead, throughput and average delay. Results indicated that AODV and LEACH both perform better but AODV is less reliable than LEACH. [3]

This paper has presented EEDBC-Mobile an enhancement of the LEACH-Mobile protocol. The proposed protocol uses a technique that provides an optimal clustering technique with a use of DBSCAN algorithm to better organized and well formed clusters. This protocol is judge against with energy efficient protocols like LEACH-Mobile and LEACH-Mobile Enhanced. The simulation results shows that EEDBC-Mobile is much better when compared to LEACH-Mobile in terms of different metrics like Energy consumption, Network life time, Throughput, delay and data delivery ratio. [4]

This Paper has proposed an Energy Efficient Location Aided Routing Protocol (EELAR) that is an optimization to the Location Aided Routing (LAR). EELAR makes significant reduction in the energy consumption of the mobile nodes batteries through limiting the area of discovering a new route to a smaller zone. Thus, EELAR protocol makes an improvement in the control packet overhead and delivery ratio compared to AODV, LAR, and DSR protocols using NS2 simulation and thus the mobile nodes life time is increased. [5]

This paper has proposed an efficient power aware routing (PAR) scheme in MANETs and analyses the derived algorithm with the help of NS2. Simulation results shows that the proposed scheme PAR is delivering more packets in different network scenarios as well as network life time of the PAR is better even in high mobility scenarios. This scheme enhance the latency of the data transfer but it results in a significant power saving and long lasting routes. Metrics used here for evaluation are path optimality, link layer overhead, total energy consumed etc. [6]

PROBLEM DEFINATION:

MANET consists of many mobile nodes, communicating with each other in the network. These mobile nodes are powered by battery. The resource constrained nature of MANET suffer from many challenges in its design and operation, which degrades its performance and also the major fact that mobile nodes run out of energy quickly, has been an issue.
Many energy efficient routing, power management and power dissemination protocols have been specially designed for MANET, where energy consumption is an essential design issue for preserving the longevity of the network. Energy efficiency is the major concern in the mobile ad-hoc network.

OBJECTIVE OF THE PROPOSED SYSTEM:

From the above discussion, this paper analyzed that in MANET problems arises due to the power consumption factor which degrades the network performance. To overcome the above review problem, the hierarchical routing protocol i.e. LEACH is implemented in this paper. Using this protocol we can reduce problem of energy consumption to some extent but here further modification of LEACH is done that modified LEACH called as optimized LEACH i.e. OLEACH. This protocol gives best result than LEACH protocol and also helps to improve network performance. And finally evaluating the result and comparing the performance analysis of AODV, LEACH and OLEACH protocol using NS-2 tool for several choosen scenario.

SIMULATION PLATFORM

In this section a comparative study between the behaviors of three routing protocols AODV, LEACH, and OLEACH will be given by simulation. The well known NS2 [7] simulation tool is used. It is a discrete event network simulator for networking research. It provides supports for simulation of group of protocols like TCP, UDP, DSR, and AODV.
The purpose of the study was to investigate the behaviors of AODV, LEACH and OLEACH for energy consumption, packet delivery ratio (PDR), Delay, Throughput, and jitter are the parameters.

SIMULATION SET UP

A simulation set up was performed by taking 20 mobile nodes in the network of 300 m*300 m area. Simulation time will be 22 sec for this scenario and the size of each packet was set to 1000 bytes.

Table1. Simulation Parameters and their value

Sr. No.	Parameters	Value
1.	Channel Type	Wireless Channel
2.	Radio-Propagation Model	Two-Ray Ground
3.	Network Interface Type	Wireless Physical
4.	MAC Type	MAC/802.11
5.	Interface Queue Type	Queue/ DropTail/ PriQueue
6.	Link Layer Type	LL
7.	Antenna Model	Omni directional Antenna
8.	Queue Length	50
9.	Number of Mobile Nodes	20
10.	Routing Protocol	AODV,LEACH, OLEACH
11.	Network Size	300m*300m
12.	Packet Size	1000 bytes
13.	Packet Interval	0.07 ms
14.	Simulation Time	22 ms

SELECTED PERFORMANCE METRIC FOR EVALUATION:

In order to compare the AODV, LEACH and OLEACH protocol the quantitative metrics are used to measure and evaluate the performance of the simulation. A set of performance metrics are used for comparing the protocol of this work is shown in fig1.

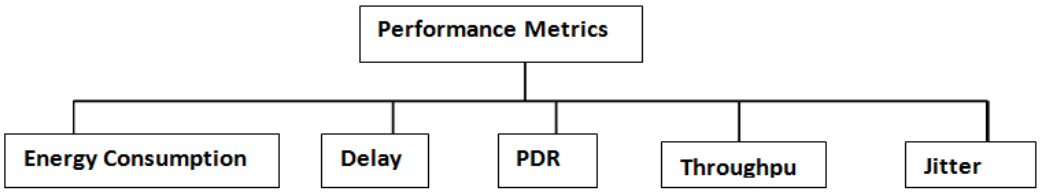

FIG1. A SET OF PERFORMANCE METRICS

Each of these metrics parameters can be described briefly as follows:

Average Energy Consumption: Average Energy Consumption is calculated as the average difference between the initial level of energy and the final level of energy that is left in each node.
The lower the energy consumption the longer is the networks lifespan.

Delay: It is the average delay between the sending of the data packet by the sender and its receipt at the receiver including some delays due to buffering, processing at intermediate nodes etc.
If Average end-to-end delay is high means the protocol performance is not good due to the network congestion.

Packet Delivery Ratio: It is the ratio between the number of data packet that are sent by the source and the number of data packets that are received by the receiver.

Throughput: The ratio of total data received by a receiver from a sender for a time the last packet received by receiver measures in bit/sec and byte/sec.

Jitter: It is the variation in the time between arriving packets.

EXPERIMENTAL RESULTS

In This section presents the performance of the AODV, LEACH and OLEACH protocol obtained by simulation using NS2. Performance evaluation and comparison between these three protocols is shown in fig 2, 3, 4, 5, 6.

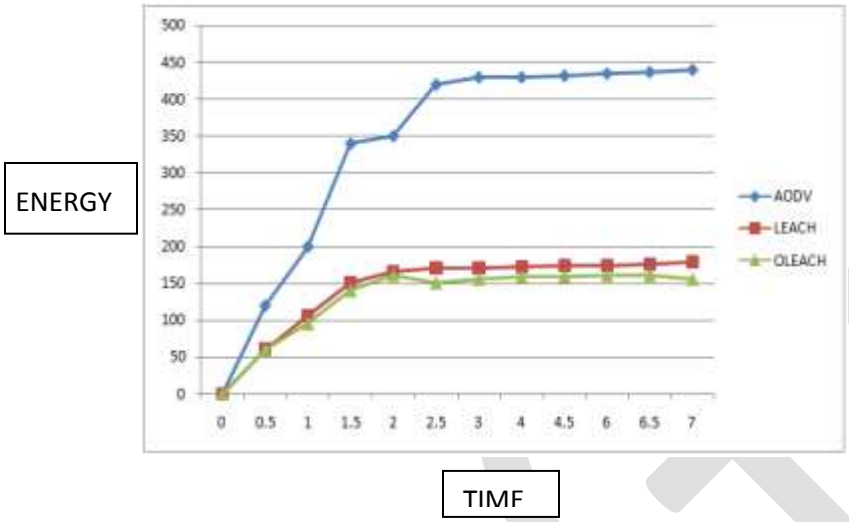

Fig2. Energy Graph

In the figure2, time for simulation is used as X axis and energy consumption as Y axis. From this graph, it can be observed that the energy consumption of OLEACH protocol is less than LEACH and AODV. This provides confirmation that the OLEACH improves the lifetime of network as compared to LEACH and AODV.

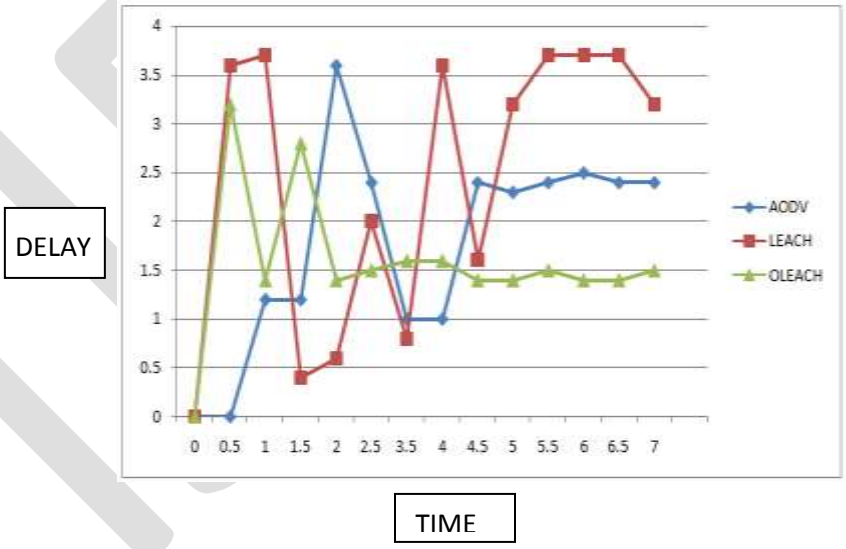

Fig3. Delay Graph

Figure 3, presents the delay taken by the routing protocols. It is clear from the figure that OLEACH gains less delay with the variation of time but AODV and LEACH gives the highest delay as compared to OLEACH.

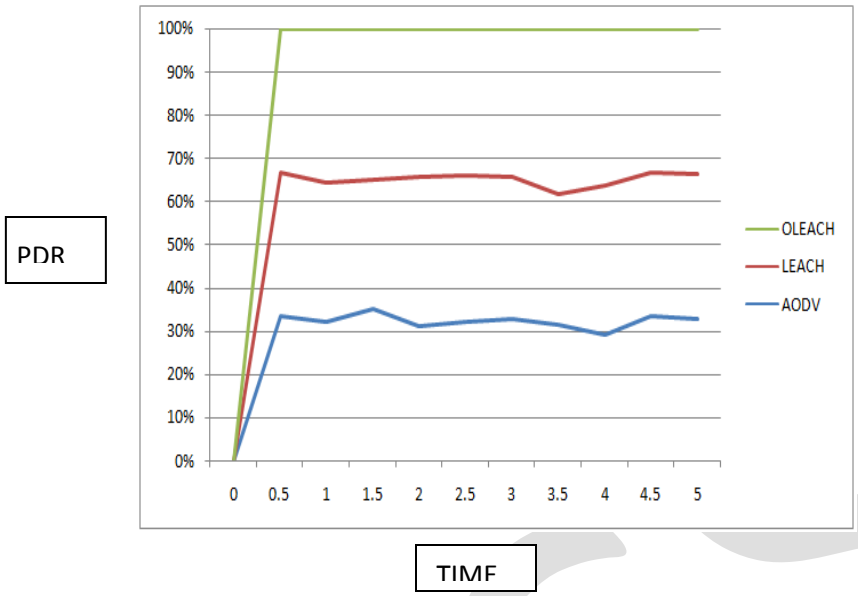

Fig4. PDR Graph

In Figure 4, PDR graph is plotted as time for simulation versus PDR. PDR is shown in percentage. Graph results show that packet delivery ratio of OLEACH achieved more when compared to AODV and LEACH protocol. This means OLEACH provides good degree of reliability

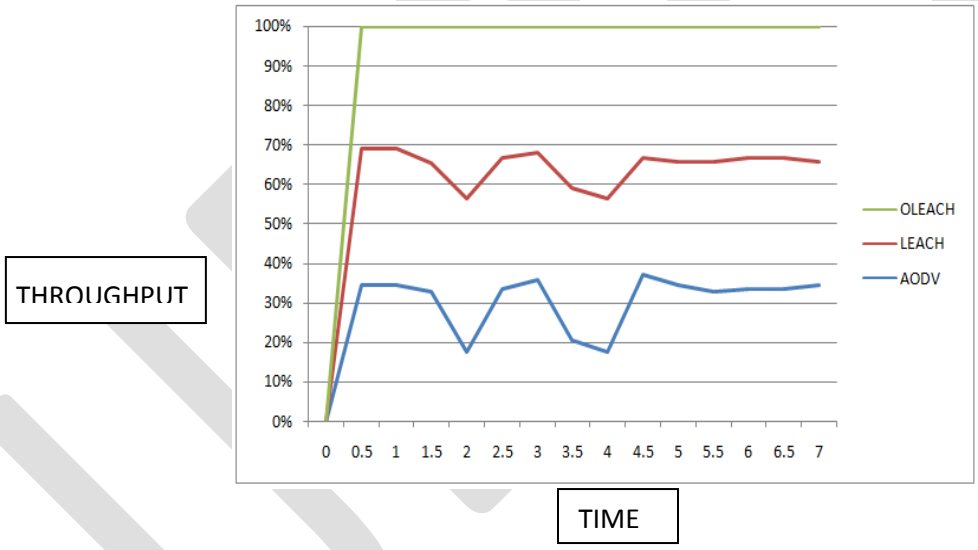

Fig5. Throughput Graph

Figure 5, shows the comparison of throughput obtained using OLEACH, LEACH and AODV. Throughput is shown in percentage. Graph Results show that OLEACH provides more throughputs as compared to other two protocols.

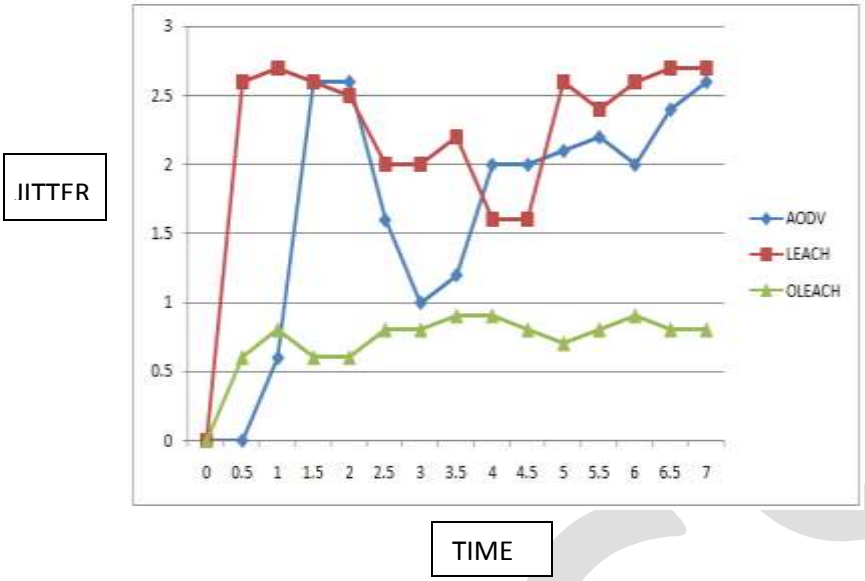

Fig6. Jitter Graph

Figure 6, shows that comparison of jitter obtained using OLEACH, LEACH and AODV. Results show that OLEACH has high jitter than AODV and LEACH protocol.

CONCLUSION

In Mobile ad-hoc network the main purpose of designing energy efficient routing protocol is to efficiently use the energy of the network so that the network lifetime get increased. In mobile ad-hoc network many energy efficient routing protocols are available now-a-days. One of the most efficient routing algorithms everyone uses is the LEACH routing protocol. The ultimate objective behind the routing protocol design is to keep the sensors operating for as long as possible, thus extending the network lifetime. The energy consumption of the sensors is dominated by data transmission and reception. Therefore, routing protocols designed for MANET should be as energy efficient as possible to prolong the lifetime of individual sensors, and hence the network lifetime. Because of this reason LEACH protocol selected. It gives better performance in energy efficiency and network life time. We can say the advantage of LEACH overcomes the problem of MANET. But further modified LEACH named as OLEACH (Optimized LEACH) using optimal selective path forwarding algorithm is implemented. This modified or improved LEACH gives better result than normal LEACH. In this paper simulation results of three protocols i.e. AODV, LEACH and OLEACH has shown using metrics Energy consumption, Delay, PDR, Throughput and Jitter.

REFERENCES:

[1] Bhabani Sankar Gouda, Ashish Kumar Das, K. Lakshmi Narayana, "A Comprehensive Performance Analysis of Energy Efficient Routing Protocols in different traffic based Mobile Ad-hoc Networks", IEEE Transactions, 2013.

[2] Er. Pragati, Dr. Rajender Nath, "Performance evaluation of AODV, LEACH, & TORA protocols through simulation", IJARCSSE, Volume 2, Issue 7, July 2012.

[3] Parul kansal, Deepali Kansal, Arun Balodi, "Comparison of various Routing Protocol in Wireless Sensor Network", International Journal of Computer Applications, Volume 5- no. 11, August 2010.

[4] R.U.Anitha, P. Kamalakkannan, "EEDBC-M: Enhancement of Leach-Mobile protocol with Energy Efficient Density-based Clustering for Mobile Sensor Networks (MSNs)", International Journal of Computer Applications (0975 – 8887) Volume 74– No.14, July 2012.

[5] M. Mohammed, "Energy Efficient Location Aided Routing Protocol for Wireless MANETs", International Journal of Computer Science and Information Security, vol. 4, no. 1 & 2, 2009.

[6] Vinay Rishiwal, Mano Yadav, Shekhar Verma, "Power Aware Routing to support Real Time Traffic in Mobile Ad-hoc networks" ,First International Conference on Emerging Trends in Engineering and Technology, (IEEE Computer Society), 2008.

[7] Network Simulator, http://www.isi.edu/nsnam/ns.

[8] Swapnil Singh, Sanjoy Das, "Survey on Energy Efficient Routing Protocols in Mobile Ad Hoc Networks", International Journal of Computer, Information, Systems and Control Engineering Vol:8 No:2, 2014.

[9] Parul Bakaraniya, Sheetal Mehta, "K-LEACH: An improved LEACH Protocol for Lifetime Improvement in WSN", International

Journal of Engineering Trends and Technology (IJETT), Volume 4 Issue 5, May 2013.
[10] L. Malathi and R. K. Gnanamurthy, "Cluster Based Hierarchical Routing Protocol for WSN with Energy Efficiency", International Journal of Machine Learning and Computing, Vol. 4, No. 5, October 2014.
[11] Meena Malik, Dr. Yudhvir Singh, Anshu Arora, "Analysis of LEACH Protocol in Wireless Sensor Networks", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3, Issue 2, February 2013.
[12] Reenkamal Kaur Gill, Priya Chawla, and Monika Sachdeva, "Study of LEACH Routing Protocol for Wireless Sensor Networks", International Conference on Communication, Computing & Systems (ICCCS–2014)