S Anantha Lakshmi* et al.
(IJITR) INTERNATIONAL JOURNAL OF INNOVATIVE TECHNOLOGY AND RESEARCH
Volume No.7, Issue No.6, October – November 2019, 9337-9344.

A Novel EE-LEACH Protocol on Multipath Routing with Low Power Transmission

S.ANANTHALAKSHMI

Department of ECE, Chaitanya Institute Of Science and Technology, A.P., India

S.SRIVIDYA B.E,M.Tech.,

Department of ECE, Chaitanya Institute Of Science and Technology, A.P., India

Abstract: MANET is a network consists of set of mobile nodes with no central administration. Mobile Ad hoc networks are the most flexible networks with the collection of verity of wireless mobile host with IP connectivity forming temporary networks without a central administration. In most MANET multipath routing protocols are needed to facilitate efficient connectivity between source and destination. It faces various challenges in routing. Many routing protocols have been evaluated for better performance in terms of delays, throughputs and congestion control in multipath routing. Energy is the main consideration factor on design wireless sensor network. Practically leading is to limited network lifetime of WSN. In order to maximize the lifetime of MANET, traffic should be sent via a route that can avoid node with low energy while minimizing the total transmission power. The proposed protocol is EE-LEACH provides an optimized route by considering the energy of the nodes in the network. The performance of the proposed technique was evaluated by using MATLAB software.

Key terms: MANET, Multipath protocols, WSN, EE-LEACH.

I. INTRODUCTION

A routing protocol specifies how routers communicate with each other, distributing information that enables them to select routes between any two nodes on a computer network. Routers perform the “traffic directing” functions on the Internet; data packets are forwarded through the networks of the internet from router to router until they reach their destination computer. Routing algorithms determine the specific choice of route. Each router has a prior knowledge only of networks attached to it directly. A routing protocol shares this information first among immediate neighbours, and then throughout the network. This way, routers gain knowledge of the topology of the network. The ability of routing protocols to dynamically adjust to changing conditions such as disabled data lines and computers and route data around obstructions is what gives the Internet its survivability and reliability.

Routing Protocol: The routing protocol in an ad hoc wireless network is significant design challenges, especially under node mobility where routes must be dynamically reconfigure to rapidly changing connectivity. There is broad and extensive work spanning several decades on routing protocols for ad hoc wireless networks which is difficult to classify in a simple manner.

There are three main categories of routing protocols. They are

1) Flooding

2) Proactive (centralized, source-driven)

3) Reactive (On demand) routing protocol).

In Flooding a packet is broadcast to all nodes within receiving range. These nodes also broadcast the packet and the forwarding, controlling continues until the packet reaches its destination. It has the advantage that it is highly robust to changing network topologies and requires little routing overhead.

In Centralized approach information about channel condition and network topology are determined by each node and forwarded to a centralized location that computes the routing table for all nodes in the network. These tables are then communicates to the nodes. In Reactive routing where routes are created only at the initiation of source nodes that has traffic to send to a given destination. This eliminates the overhead of maintaining routing tables for routes not currently in use. In this strategy a source node initiates a route discovery process when it has data to send. Many routing protocols have been developed to increase the lifetime of the network.

Low Power dissipation constraints are another big challenge in ad hoc wireless network design. The constraints arise in wireless network node powered by batteries that cannot be recharged, such as sensor networks. Hard Low Power dissipation constraints significantly impact network design considerations. First there is no longer a notion of data rate, since only a finite number of bits can be transmitted at each node before the battery dies. There is also a tradeoff between the duration of a bit and energy consumption. So that sending bits more slowly conserves transmit energy. Standby operation can consume significant energy, so sleep mode must be employed for energy conservation, but having nodes go to sleep can complicate network control and routing. In fact, energy constraints impact almost all of the network protocols in some manner and therefore energy consumption must be optimized over all aspects of the network design.

Various approaches are there to minimize the transmitter power while maintaining connectivity by aggregation techniques by using mobility of sinks. Several routing protocols are consider to improve the network lifetime of the ad hoc network by choosing routes, that avoid node with low battery and by balancing the traffic load.

The main goal of this thesis is to propose a parametric model which can be used to find out the current residual energy in any part of the network. The information regarding the residual energy of the network should be available in centralized manner in one dedicated monitoring node, making it easily accessible for other applications.

II. BACKGROUND & RELATED WORK

The routing protocols for the Ad hoc networks have been classified as proactive and reactive protocols. Examples for the proactive routing protocols are Destination sequenced distance vector (DSDV), Optimized link state routing (OLSR) and examples for the Reactive routing protocols are Dynamic source routing protocol (DSR), Ad hoc on demand distance vector routing protocol (AODV), Hybrid Ad hoc routing protocol(HARP).Ad hoc on demand multipath distance vector protocol (AOMDV) is based on AODV. The multipath has guarantee for being loop free and link disjoint. It uses alternative path when a route failure occur during the data transmission in a network. In AOMDV routing protocol, multipath routing is the enhancement of the Unipart route which leads to the advantage is to handle the load in network and avoid the possibility of congestion and increases reliability. It maintenances turn connectivity and fast recovery from failures. It establishes the route on demand and creates loop free nodes. The disadvantage of this protocol is more message overheads during route discovery due to increased flooding. Since it is multipath routing the destination replies to multiple RREQs those results in longer overhead packets in response to single RREQ packet may leads to heavy control overhead.

Fitness function is a optimal technique to find the optimal path from source to destination to reduce the energy consumption in multipath routing. The FF-AOMDV uses the fitness function as an optimized method and it consider two parameters to find the optimal route is energy level of route and the route distance. The drawback of this protocol does not take care of cluster numbers. If one clustered path consists less nodes, while other clustered path have large nodes then occurs non uniform energy distribution implies low life of Wireless network.

Low Energy Adaptive Clustering Hierarchy in this algorithm cluster heads are selected randomly among the nodes in the network. Each low power energy node in the network generates a random number between 0 and 1. If the number is greater than the calculated value using energy equation, the node will appoint itself as a cluster head.

LEACH protocol: This protocol uses the following clustering model some of the node selects them as a cluster head. These cluster head collect the data from other nodes which are near to the cluster head and finally these cluster head sends the data to the base station. Cluster head changed at every round so it provides the balance energy consumption for all nodes and increase the lifetime of the network. This paper proposes a modification of LEACH's cluster head selection on the bases of remaining energy of nodes and distance from base station to reduce energy consumption.

For a micro sensor network we make the following assumptions:

(1) The base station (BS) is located far from the sensors or may be in the center.

(2) All nodes are homogeneous and have limited energy.

(3) All nodes are able to reach BS

(4) Symmetric propagation channel

(5) Cluster-heads perform data compression.

Cluster-heads collect n k-bit messages from cluster nodes and compress the data to cnk-bit messages which are sent to the base station, with c ≤ 1 as the compression coefficient. The operation of LEACH has lots of rounds, where each round is separated into two phases, first is the set-up phase and second is steady-state phase. In the setup phase the clusters are organized, while in the steady-state phase data is delivered to the base station. During the set- up phase, each node decides whether or not to become a cluster head for the current round. This paper presents an improvement of LEACH's cluster-head selection and the formation of clusters.

Low - Power Adaptive Clustering Hierarchy (LEACH) is a self-organizing and adaptive clustering protocol proposed by Heinemann. The operation of LEACH is divided into rounds, where each round begins with a setup phase for cluster formation, followed by a steady-state phase, when data transfers to the sink node occur. Though LEACH uses random election of cluster heads to achieve load balancing among the sensor nodes, LEACH still has some deficiencies which are listed as follows

• In LEACH, a sensor node is elected as the cluster head according to a distributed probabilistic approach. No cluster nodes decide which cluster to join based on the signal strength. This approach insures lower message overhead, but cannot guarantee that cluster heads are distributed over the entire network uniformly and the entire network is partitioned into clusters of similar size, and the load imbalance over the cluster heads can result in the reduction of network lifetime.

• LEACH assumes that all nodes are isomorphic, and all nodes have the same amount of energy capacity in each election round which is based on the assumption that being a cluster head results in same energy consumption for every node. Such an assumption is impractical in most application scenarios. Hence, LEACH should be extended to account for node heterogeneity.

• LEACH requires source nodes to send data directly to cluster heads. However, if the cluster head is far away from the source nodes, they might expend excessive energy in communication.

Furthermore, LEACH requires cluster heads to send their aggregated data to the sink over a single-hop link. However, single-hop transmission may be quite expensive when the sink is far away from the cluster heads. LEACH also makes an assumption that all sensors have enough power to reach the sink if needed which might be infeasible for energy constrained sensor nodes. To address the deficiencies listed above, a clustering based algorithm called ECHC (Energy and Node Concentration Hierarchical Clustering Algorithm) is used.

In ECHC, node concentration and the residual energy of sensor nodes is considered in cluster-head election, and non-cluster node choose its cluster head according to the residual energy of the cluster head and the size of the cluster.

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 neighborhood 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-state 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 the data received, 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.

III. PROPOSED ALGORITHM

Energy Efficient low power adaptive clustering hierarchy (EE-LEACH) employs the distributed clustering approach as compare to LEACH protocol. The total sensor field is divided into the equal sub-region. The choice of the cluster head (CH) from each sub-region is determined by the threshold approach as in LEACH protocol.

The sensor nodes in WSN are having with limited battery life so the main point of improvement of lifetime of wireless sensor networks directly focus on the factor of energy conservation. The networks based on clustering mainly divide the sensing area in the number of clusters and from each cluster one cluster head is selected. Other nodes in the cluster are called as cluster members. LEACH that is first energy efficient protocol used in WSN improves the life time of the network efficiently.

This is a clustering based approach with the number of advantages LEACH protocol also comes with some disadvantages like while choosing cluster head this protocol does not take into account the residual energy of the sensor nodes and also the cluster head distribution is non uniform.

The EE-LEACH MIMO scheme provides an improvement over the LEACH protocol. In this scheme the network is divided into sectors of equal angles and the residual energy of sensor nodes also considered while choosing cluster head and cooperative nodes for MIMO system. The clustering is done only for one time. The network is divided into clusters by cutting it from center using an angle of $2\pi/Kopt$ Sink inform the nodes to join the cluster nearest to them. The value of is K opt is 5 for implementation of EE- LEACH MIMO scheme. All the operations are managed in rounds. For each round the selection of cluster head and cooperative nodes takes place.

Following is the algorithm for the EELEACH protocol 1: Let Ni or Nj denote a common node

2: S(Ni) = (N1, N2 Nn) denote the set of n nodes

3: E(Ni) denote energy in a node

4: Nxyz denote node location

5: Ci denote a cluster ID

6: CH (Ni) denotes a cluster head node.

7: dij denote distance measured from node Ni to Nj

8: thresh (Ni) denote the threshold value of node Ni Initialization 9: Create node Ni

10: Set node position Nxyz Clusters formation

11: Divide the sensor field into equal sub-region Ri

12: Select CH from the each sub-region Ri based on threshold value. 13: if Ni =Ri&& thresh(Ni) < T threshold&&has not been CH yet then 14: Ni = CH (Ni) for sub-region Ri

15: else

16: Ni =Nj (normal node)

17: end if Send Data to Base station

18: CH(Ni) sends data to Base station Repeat the steps 12 to 18 for different rounds End of algorithm.

IV. EE-LEACH PROTOCOL

To evaluate the performance of the proposed protocol EE-LEACH, we can vary the three simulation parameters called node speed, packet size, simulation time and show the effect on packet delivery ratio, throughout put, energy consumption, end to end delay, routing overhead ratio. The following table shows the simulation parameters.

Parameter	Value	Units
Number of runs	1	
Number of nodes	100	
Node speed	(0,5,10,15,20,25,30)	Meter/second
Packet size	(0,5,10,15,20,25,30)	Bytes
Simulation time	(2,4,6,8,10,12,14,16, 18,20,22)	Seconds
Throughput	(0,2,4,6,8,10,12,14,1 6,18)	Kbps
End to End Delay	(0,5,10,15,20)	ms
Energy consumption	(0,2,4,6,8,10,12,14)	Joules
Transmission Range	250	Meters
Mobility Type	Random type	
Routing Protocols	AOMDV,FF-AOMDV,EE-AOMDV	

Simulation Parameters:

The following parameters are used to know the performance of the protocols use in this paper.

Packet Delivery Ratio:

PDR means that the ratio of data packets received by the destination to those generated by the sources. Mathematically it can be defined as

PDR=S1/S2

End to End Delay:

It refers to the time taken for a packet to be transmitted across a network from source to destination. This includes all possible delays caused by buffering during route discovery latency, queuing at interface queue, propagation and transfer time. This metric is calculated by subtracting time at which first packet was transmitted by source from time at which first data packet arrived to destination. Mathematically it can be defined as

Avg EED=S/N

N= number of packets received by the all destination nodes

S= the sum of the time spent to delivery packet for each destination

Throughput:

In data transmission network it is defined as the amount of data moved successfully from source to destination. The total numbers of packets delivered over the total simulation time and typically measures in bits per second.

Energy Consumption:

It means the total energy consumed by the network nodes to perform transmission, reception and data aggregation. It can also refer as the amount of energy that is spent by the network nodes within the simulation time.

Routing Overhead Ratio:

In a network when nodes exchange, routing information using the same bandwidth used by data packets incur overhead to the network referred to as routing overhead. As this information packets are exchanged periodically in certain interval of time.

V. RESULTS

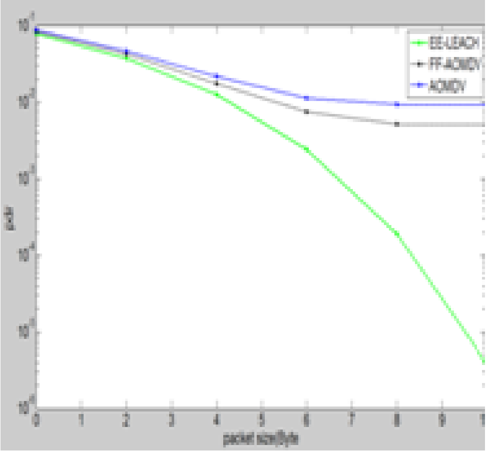

Fig.1. Simulation

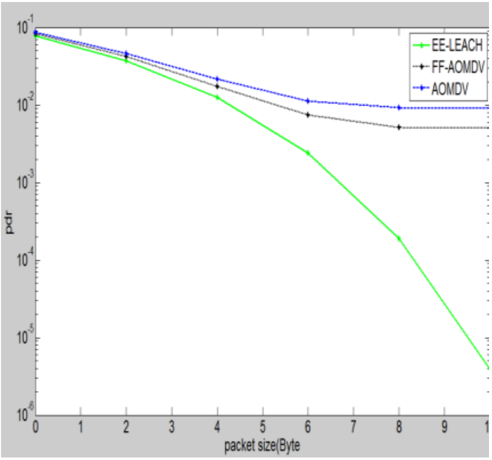

Fig. 2 Packet Delivery Ratio (%) vs Packet Size (Byte)

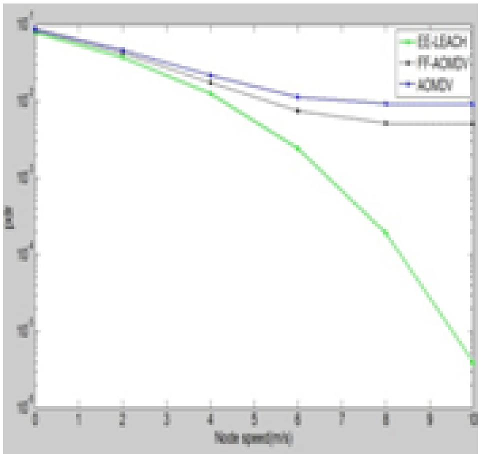

Fig. 3 Packet Delivery Ratio (%) vs Node Speed (m/s)

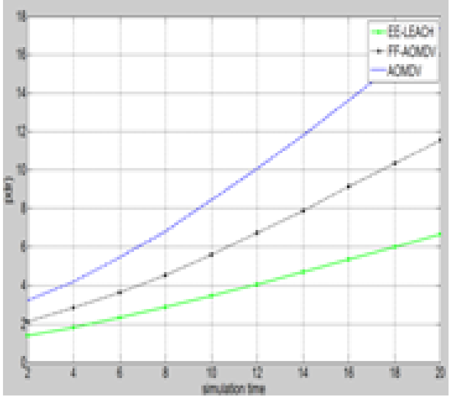

Fig. 4 Packet Delivery Ratio (%) vs Simulation Time (Seconds)

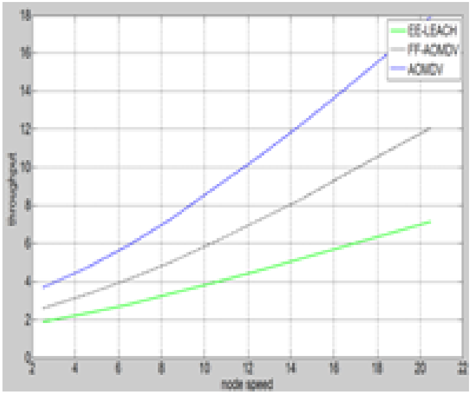

Fig. 5 Throughput (Kbps) vs Node Speed (m/s)

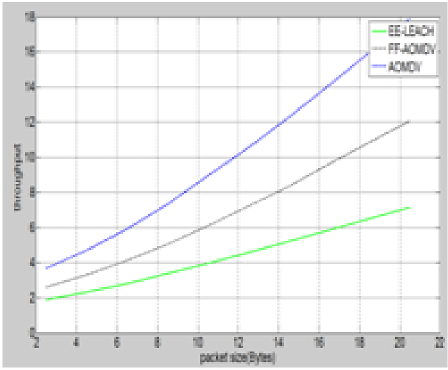

Fig. 6 Throughput (Kbps) vs Packet Size (Bytes)

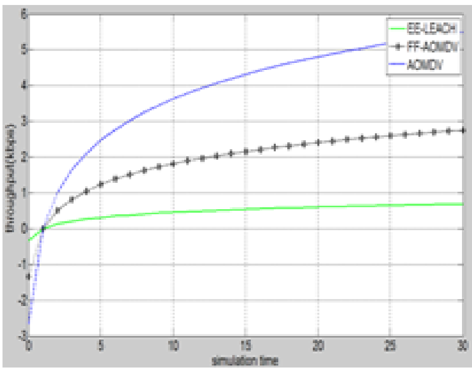

Fig. 7 Throughput (Kbps) vs Simulation Time (Seconds)

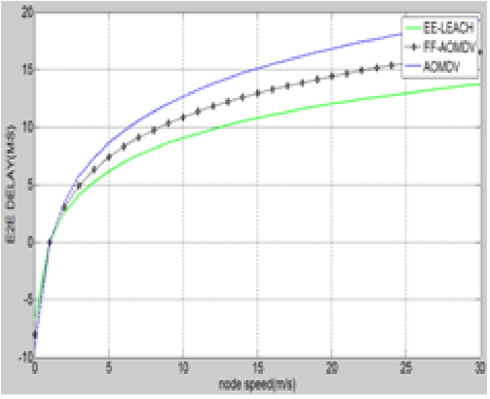

Fig. 8 End-to-End Delay (ms) vs Node Speed (m/s)

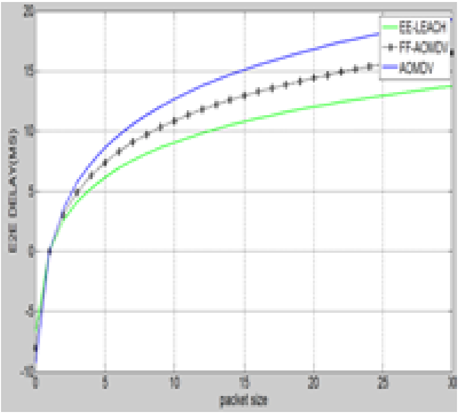

Fig. 9 End-to-End Delay (ms) vs Packet Size (Bytes)

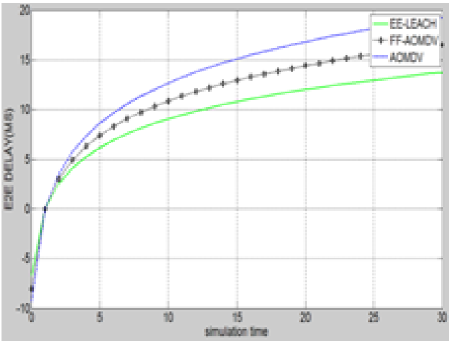

Fig. 10 End-to-End Delay (ms) vs Simulation Time (Seconds)

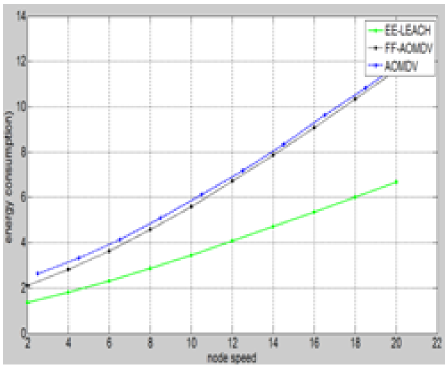

Fig. 11 Energy Consumption (Joules) vs Node Speed (m/s)

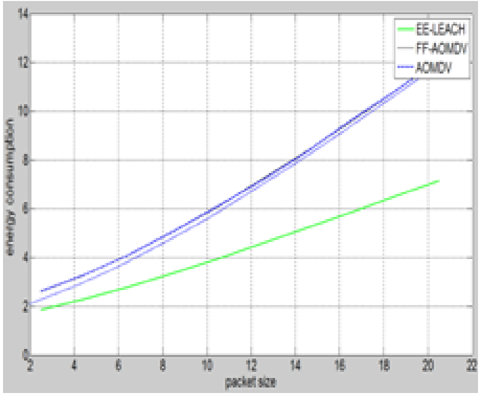

Fig. 12 Energy Consumption (Joules) vs Packet Size (Bytes)

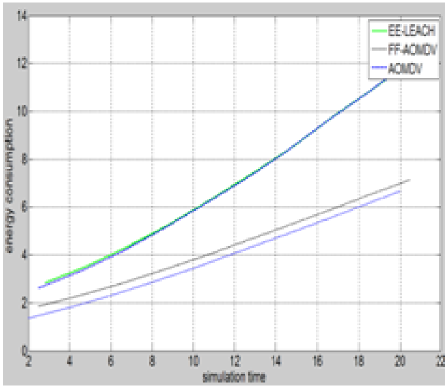

Fig. 13 Energy Consumption (Joules) vs Simulation Time (Seconds)

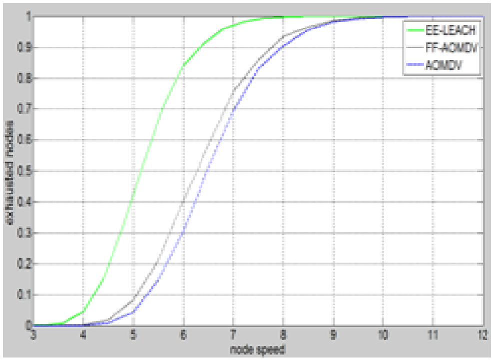

Fig. 14 Exhausted Nodes (Nodes) vs Node Speed (m/s)

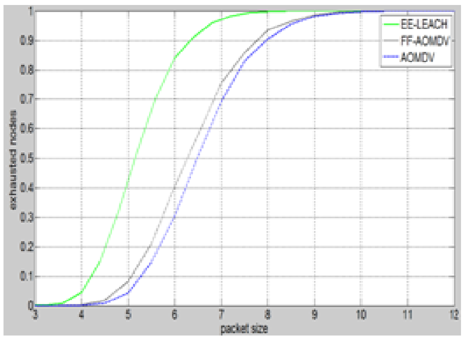

Fig. 15 Exhausted Nodes (Nodes) vs Packet Size (Bytes)

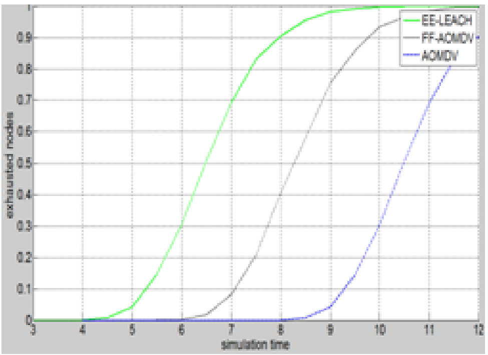

Fig. 16 Exhausted Nodes (Nodes) vs Simulation Time (Seconds)

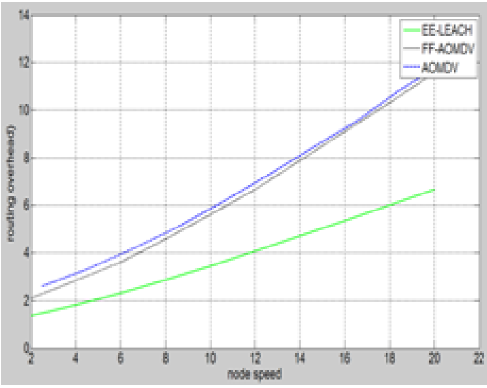

Fig. 17 Routing Overhead Ratio (%) vs Node Speed (m/s)

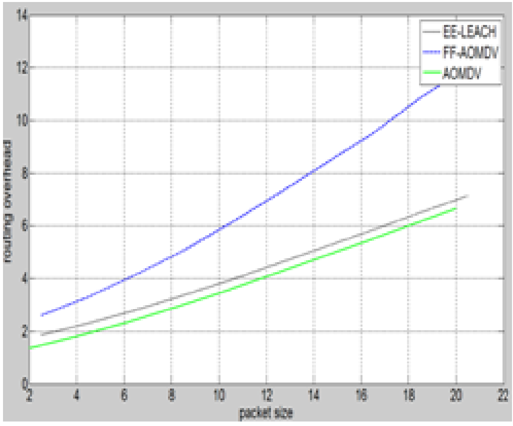

Fig. 18 Routing Overhead Ratio (%) vs Packet Size (Bytes)

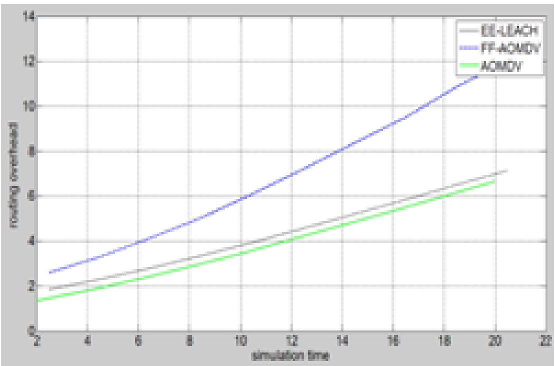

Fig. 19 Routing Overhead Ratio (%) vs Simulation Time (Seconds)

CONCLUSION

Majority of the techniques consider one factor or another to establish QoS paths. But to fulfill all the challenges posed by routing conditions in a MANET our protocol ranks much higher than the cases studied so far, as it attempts to cater all the challenges encountered so far in QoS routing in ADHOC. Mobile ad hoc network is a collection of mobile nodes, forming temporary network, without using any infrastructure and provide cheap communications. This paper has discussed the classification of routing protocols and done comparative analysis for wireless ad hoc networks routing protocols. Finally, EELEACH plays vital role and can be implemented with limited resources for public and private applications such as MANET, IOT, etc.

REFERENCES

[1] Zhan Haawei, Zhou Yun; “Comparison and analysis AODV and OLSR Routing Protocols in Ad Hoc Network”, 2008, IEEE.

[2] “Zone Routing protocol (ZRP),” http://tools.ietf.org/id/draft-ietf-manetzone-zrp-04.txt.

[3] “C. Siva Ram Murthy and B.S. Manoj “Ad hoc Wireless Networks Architecture and Protocols” Prentice Hall 2004.

[4] Charles Perkins, Elizabeth Royer, and Samir Das “Ad hoc on demand distance vector (AODV) routing” IETF RFC No. 3561, July 2003.

[5] E. Bommaiah et al., AMRoute: Ad-hoc Multicast Routing Protocol, Internet draft, August 1998.

[6] Shakkeera “Optimal path selection technique for Flooding in Link State Routing Protocol Using Forwarding Mechanisms in MANET”.

[7] Study of Distance Vector Routing Protocols for Mobile Ad Hoc Networks IEEE International Conference on Pervasive Computing and Comm.

[8] A review of the Ad-Hoc Routing Protocols, Journal of Engineering Science and Technology Review 3 (1) (July 2010).

[9] S.Chen and K.Nahrstedt, ".An Overview of Quality-of-Service Routing for the next Generation High -Speed Networks: Problems and Solutions", IEEE Network Magazine, vol12, 1998, pp. 64 -79.

[10] M. K. Marina and S. R. Das, "On-Demand MultiPath Distance Vector Routing in Ad hoc Networks", Proceedings of the Ninth International Conference on Network Protocols (ICNP}, IEEE Computer Society Press, 2001, pp. 14-23.

[11] J.Park, S.Moht and I.Chung " Multipath AODV Routing Protocol in Mobile Ad Hoc Networks with SINR-Based Route Selection", International Symposium on Wireless Communication Systems, IEEE , 2008, pp:682- 688.