International Journal of Modern Engineering Research (IJMER)
www.ijmer.com Vol.2, Issue.2, Mar-Apr 2012 pp-323-328 ISSN: 2249-6645

Performance Analysis and Enhancement of Routing Protocol in Manet

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ABSTRACT
MANET (Mobile Adhoc Network) is a self organizing and self configuring network without the need of any centralized base station. In MANETs, the nodes are mobile and battery operated. As the nodes have limited battery resources and multi hop routes are used over a changing network environment due to node mobility, it requires energy efficient routing protocols to limit the power consumption, prolong the battery life and to improve the robustness of the system. This paper evaluates the performance of various adhoc routing protocols such as DSDV, AODV, DSR, TORA and AOMDV in terms of energy efficiency and it also proposes a new routing algorithm that modifies AOMDV and it provides better performance compared to all the above protocols. Simulation is done using NS-2(version NS-2.34).

***Key Terms*— AODV, AOMDV, DSR, DSDV, TORA, MANET, Energy efficient routing**

I. INTRODUCTION
MANET is a wireless infrastructure less network having mobile nodes. Communication between these nodes can be achieved using multi hop wireless links. Each node will act as a router and forward data packets to other nodes. Mobile adhoc networks are operating without any centralized base station. It uses multi hop relaying. Since the nodes are independent to move in any direction, there may be frequent link breakage. The advantage of MANET is its instant deployment.

Various protocols have been developed for adhoc networks such as TORA(Temporally Ordered Routing Algorithm), DSDV (Destination-Sequenced Distance Vector), DSR (Dynamic Source Routing),AODV(Ad-Hoc On Demand Routing), AOMDV (Ad hoc On-demand Multipath Distance Vector Routing). These protocols offer varying degrees of efficiency. This paper aims to find out an energy efficient routing protocol. It also aims to limit power consumption of mobile nodes in the network in order to prolong the network life time. The main objective of this paper is to analyze AOMDV protocol for ways it could be improved. This can be done by measuring energy with respect to network size and taking into consideration the remaining battery power. It also proposes further research into more efficient protocols or variants of existing protocols such as AOMDV. This paper also proposes a new routing algorithm based on node residual energy and it is applied on AOMDV so that the new algorithm provides better performance than DSDV, DSR, AODV, TORA and AOMDV.

II. ROUTING PROTOCOLS IN MANET
Routing Protocol is used to find valid routes between communicating nodes. They do not use any access points to connect to other nodes .It must be able to handle high mobility of the nodes. Routing protocols can be mainly classified into 3 categories

-Centralized versus Distributed
-Static versus Adaptive
-Reactive versus Proactive

In centralized algorithms, all route choices are made by a central node, while in distributed algorithms, the computation of routes is shared among the network nodes. In static algorithms, the route used by source destination pairs is fixed regardless of traffic condition. It can only change in response to a node or link failure. This type of algorithm cannot achieve high throughput under a broad variety of traffic input patterns. In adaptive routing, the routes used to route between source-destination pairs may change in response to congestion.

2.1 Proactive (Table-Driven) Routing Protocols
In this family of protocols, nodes maintain one or more routing tables about nodes in the network. These routing protocols update the routing table information either periodically or in response to change in the network topology. The advantage of these protocols is that a source node does not need route-discovery procedures to find a route to a destination node. On the other hand the drawback of these protocols is that maintaining a consistent and up-to-date routing table requires substantial messaging overhead, which consumes bandwidth and power, and decreases throughput, especially in the case of a large number of high node mobility. There are various types of Table Driven Protocols: Destination Sequenced Distance Vector routing (DSDV), Wireless routing protocol (WRP), Fish eye State Routing protocol (FSR), Optimized Link State Routing protocol (OLSR), Cluster Gateway Switch Routing protocol (CGSR), Topology Dissemination Based on Reverse Path Forwarding (TBRPF).

2.2 Reactive (On-Demand) Routing Protocols
For protocols in this category there is an initialization of a route discovery mechanism by the source node to find the route to the destination node when the source node has data packets to send. When a route is

found, the route maintenance is initiated to maintain this route until it is no longer required or the destination is not reachable. The advantage of these protocols is that overhead messaging is reduced. One of the drawbacks of these protocols is the delay in discovering a new route. The different types of reactive routing protocols are: Dynamic Source Routing (DSR), Ad-hoc On-Demand Distance Vector routing (AODV), Adhoc On-demand Multipath Distance Vector Routing Algorithm (AOMDV) and Temporally Ordered Routing Algorithm (TORA).

III. OVERVIEW OF SELECTED ROUTING PROTOCOLS

3.1 TORA: The Temporally Ordered Routing Algorithm (TORA) is a highly adaptive, efficient and scalable distributed routing algorithm based on the concept of link reversal. TORA is proposed for highly dynamic, mobile, multi hop wireless networks. It is a source initiated routing protocol. It finds multiple routes from a source node to a destination node. The main feature of TORA is that the control messages are localized to a very small set of nodes near the occurrence of a topological change. To achieve this, the nodes maintain routing information about adjacent nodes. The protocol has three basic functions: Route creation, Route maintenance and Route erasure. TORA can suffer from unbounded worst-case convergence time for very stressful scenarios. TORA has a unique feature of maintaining multiple routes to the destination so that topological changes do not require any reaction at all. The protocol reacts only when all routes to the destination are lost. In the event of network partitions the protocol is able to detect the partition and erase all invalid routes.

3.2 DSDV: Destination Sequence Distance Vector (DSDV) is a proactive routing protocol and is based on the distance vector algorithm. In proactive or table-driven routing protocols, each node continuously maintains up-to-date routes to every other node in the network. Routing information is periodically transmitted throughout the network in order to maintain routing table consistency. The routing table is updated at each node by finding the change in routing information about all the available destinations with the number of nodes to that particular destination. Also, to provide loop freedom DSDV uses sequence numbers, which is provided, by the destination node. In case, if a route has already existed before traffic arrives, transmission occurs without delay. However, for highly dynamic network topology, the proactive schemes require a significant amount of resources to keep routing information up-to-date and reliable.

In case of failure of a route to the next node, the node immediately updates the sequence number and broadcasts the information to its neighbors. When a node receives routing information then it checks in its routing table. If it does not find such entry into the routing table then updates the routing table with routing information it has found. In case, if the node finds that it has already entry into its routing table then it compares the sequence number of the received information with the routing table entry and updates the information.

3.3 DSR: Dynamic Source Routing DSR is a reactive protocol. This protocol is one of the example of an on-demand routing protocol that is based on the concept of source routing. It is designed for use in multi hop ad hoc networks of mobile nodes. It allows the network to be completely self-organizing and self-configuring and does not need any existing network infrastructure or administration. DSR uses no periodic routing messages like AODV, thereby reduces network bandwidth overhead, conserves battery power and avoids large routing updates. However, it needs support from the MAC layer to identify link failure. The DSR routing protocol discovers routes and maintains information regarding the routes from one node to other by using two main mechanisms: (i) Route discovery – Finds the route between a source and destination and (ii) Route maintenance –In case of route failure, it invokes another route to the destination. DSR has a unique advantage by virtue of source routing. As the route is part of the packet itself, routing loops, either short – lived or long – lived, cannot be formed as they can be immediately detected and eliminated. This property of DSR opens up the protocol to a variety of useful optimizations**.** If the destination alone can respond to route requests and the source node is always the initiator of the route request, the initial route may the shortest. This routing protocol apply the concept of source routing, which means that the source determines the complete path from the source node to the destination node, that the packets have to traverse, and hence ensures routing to be trivially loop-free in the network. The packet in DSR carries all information pertaining to route in its preamble (header) thus permitting the intermediate nodes to cache the routing information in their route tables for their future use.

3.4 AODV: The Ad-hoc On-Demand Distance Vector (AODV) routing protocol builds on the DSDV algorithm, it is an on demand routing algorithm, but in contrast to DSR it is not a source based routing scheme rather every hop of a route maintains the next hop information by its own. Operation of the protocol here is also divided in two functions, route discovery and route maintenance. At first all the nodes send Hello message on its interface and receive Hello messages from its neighbors. This process repeats periodically to determine neighbor connectivity. When a route is needed to some destination, the protocol starts route discovery. The source sends Route Request Message to its neighbors. If a neighbor has no information on the destination, it will send message to all of its neighbors and so on. Once request reaches a node that has information about the destination (either the destination itself or some node that has a valid route to the destination),that node sends Route Reply Message to the Route Request Message initiator. In the intermediate nodes (the nodes that forward Route Request Message), information about source and destination from Route Request Message is saved. Address of the neighbor that the Route Request Message came from is also saved. In this way, by the time Route Request Message reaches a node that has information to answer Route Request Message; a path has been recorded in the intermediate nodes. This path identifies the route that Route Request

Message took and is called reverse path. Since each node forwards Route Request Message to all of its neighbors, more than one copy of the original Route Request Message can arrive at a node. When a Route Request Message is created at the initiator, it is assigned a unique id. When a node receives Route Request Message, it will check this id and the address of the initiator and discard the message if it had already processed that request.

3.5 AOMDV: Ad-hoc On-demand Multi path Distance Vector Routing protocol is an extension to the AODV protocol for computing multiple loop-free and link disjoint paths. The routing entries for each destination contain a list of the next-hops along with the corresponding hop counts. All the next hops have the same sequence number. This helps in keeping track of a route. For each destination, a node maintains the advertised hop count, which is defined as the maximum hop count for all the paths, which is used for sending route advertisements of the destination. Each duplicate route advertisement received by a node defines an alternate path to the destination. Loop freedom is assured for a node by accepting alternate paths to destination if it has a less hop count than the advertised hop count for that destination. Because the maximum hop count is used, the advertised hop count therefore does not change for the same sequence number. When a route advertisement is received for a destination with a greater sequence number, the next-hop list and the advertised hop count are reinitialized.

3.6 MODIFIED AOMDV (ENERGY_ AOMDV):

The concept behind the modified protocol is to find the nodal residual energy of each route in the process of selecting path, select the path with minimum nodal residual energy and sort all the routes based on the descending order of nodal residual energy. Once a new route with greater nodal residual energy is emerging, it is again selected to forward rest of the data packets. It can improve the individual node's battery power utilization and hence prolong the entire network's lifetime.

The steps involved are:

1. Find the nodal residual energy of each route in the route discovery process.
2. Find the path with minimum nodal residual energy.
3. Sort out all the routes based on the descending value of nodal residual energy
4. Select the route with maximal nodal residual energy to forward the data packets.

IV. PROBLEM DEFINITION

The main limitation of adhoc system is the availability of power. Power consumption is governed by no. of processes and overheads required to maintain connectivity in addition to running onboard electronics. Early "death" of some mobile nodes due to energy depletion may cause several problems such as network partition and communication interruption. Therefore it is required to limit the power consumption of mobile nodes, prolong the battery life and to maintain the robustness of the system.

V. METHODOLOGY

In the existing system, different routing protocols in MANETs are compared by many researchers. They compared EE-OLSR with OLSR. Some implemented overhead reduction and efficient energy management for DSR in MANET. Some compared the performance of DSR and DSDV based on the node termination rate as well as the overall throughput of the network. Some researchers compared AODV and DSR in terms of pause time and no. of nodes. These works provide detailed performance analysis on adhoc routing protocols but energy performance was not addressed. It does not reflect the topological change.

In the proposed system, various routing protocols such as AODV, DSR, DSDV, TORA and AOMDV are compared with respect to more metrics and a new routing algorithm based on energy constraint node cache that modifies AOMDV so that it consumes minimum energy compared to AOMDV. Protocol performances are tested in higher mobility situations. This work tries to optimize delay, bandwidth and overhead and reflects much better the topological change. Routing protocols are analyzed in terms of energy efficiency.

VI. RESULTS AND DISCUSSION

The Simulation is carried out in NS2 under LINUX platform. The aim of these simulations is to analyze the AOMDV protocol by comparing it with other protocols (AODV, DSR, TORA and DSDV) for its efficiency in terms of energy consumption, delay, packet delivery ratio, packet lost and throughput. A new protocol is designed based on AOMDV so that the new protocol had better performance than AOMDV in all the above parameters. The following table shows that the important parameters chosen for the NS2 simulation:

Table 6.1 Simulation Parameters

Simulation Time	100s
Topology Size	1000m x 1500m
Number Of Nodes	50
MAC Type	MAC 802.11
Radio Propagation Model	Two Ray Model
Radio Propagation Range	250m
Pause Time	0s
Max Speed	4m/sec-24m/sec
Initial Energy	100J
Transmit Power	0.4W
Receive Power	0.3W
Traffic Type	CBR
CBR Rate	512 bytes x 6 per second
Number of Connections	50

6.1 Simulation parameters

1. Packet delivery ratio

It is the ratio of the data packets delivered to the destinations to those generated by the sources.

2. Energy consumption

This is the ratio of the average energy consumed in each node to total energy.

3. End to end delay

This is the ratio of the interval between the first and second packet to total packet delivery.

4. Throughput

The throughput metric measures how well the network can constantly provide data to the sink. Throughput is the number of packet arriving at the sink per ms.

5. Number of Packets dropped:

This is the number of data packets that are not successfully sent to the destination during the transmission. In this study the time versus number of packets dropped have been calculated.

B. Simulation Results

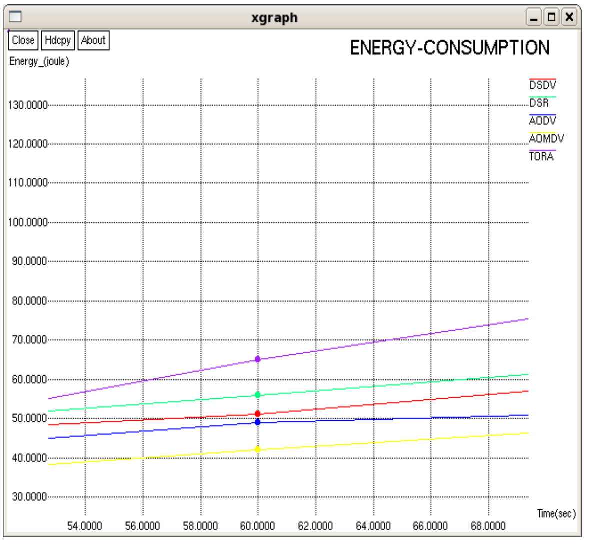

Fig 6.1 Comparison of Energy consumption versus time for DSDV, DSR, TORA, AODV and AOMDV using 50 nodes

Figure 6.1 shows the Comparison of Energy consumption versus time for DSDV, DSR, TORA, AODV and AOMDV using 50 nodes. It shows that the energy consumption of networks using AOMDV is minimum compared to TORA, AODV, DSR and DSDV.TORA is consuming maximum energy. AODV is consuming lesser energy than TORA, DSR and DSDV.

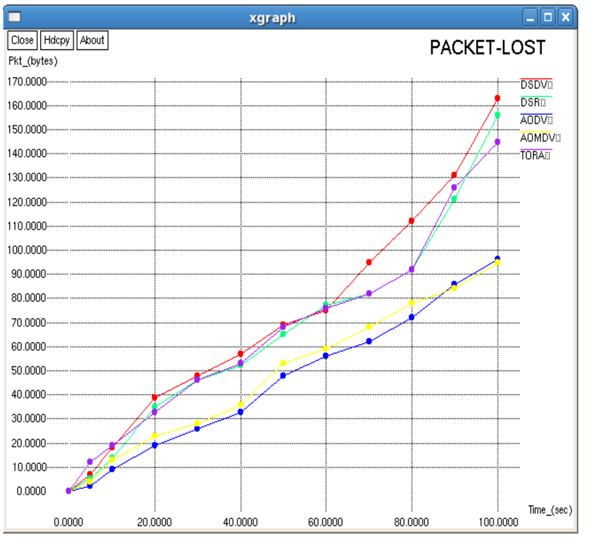

Fig 6.2 Comparison of Packet lost versus time for DSDV, DSR, TORA, AODV and AOMDV using 50 nodes

Figure 6.2 shows the comparison of Packet lost versus time for DSDV, DSR, TORA, AODV and AOMDV using 50 nodes. Packet loss is minimum using AODV compared to DSR and DSDV. It shows that the packet lost is minimum for AODV and AOMDV compared to the other 3 protocols.

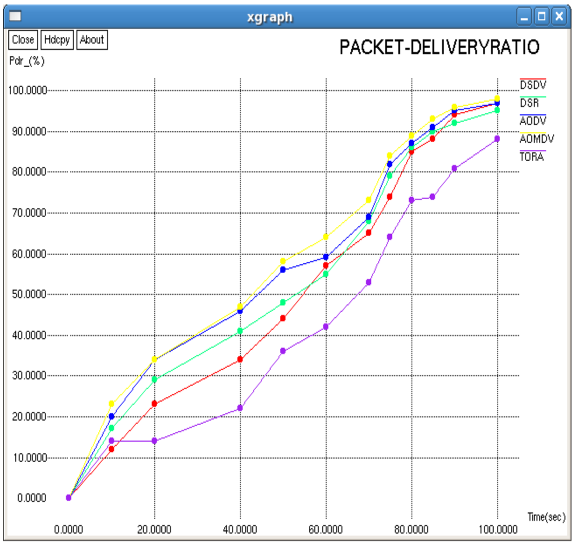

Fig 6.3 Comparison of Packet delivery ratio versus time for DSDV, DSR, TORA, AODV and AOMDV using 50 nodes

Figure 5.4 shows the comparison of Packet delivery ratio versus time for DSDV, DSR, TORA, AODV and AOMDV using 50 nodes. It shows that the packet delivery ratio of networks using AOMDV is better compared to AODV, TORA, DSR and DSDV.TORA has poor packet delivery ratio than all the other protocols.

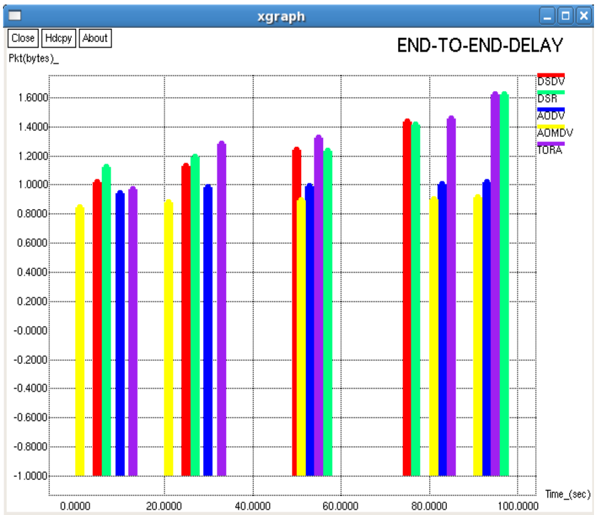

Fig 6.4 Comparison of End to end delay versus time for DSDV, DSR, TORA, AODV and AOMDV using 50 nodes

Figure 6.4 shows the comparison of end to end delay versus time for DSDV, DSR, TORA, AODV and AOMDV using 50 nodes. It shows that the end to end delay is minimum using AOMDV compared to AODV, TORA, DSR and DSDV.TORA is having the highest end to end delay compared to all the other protocols.

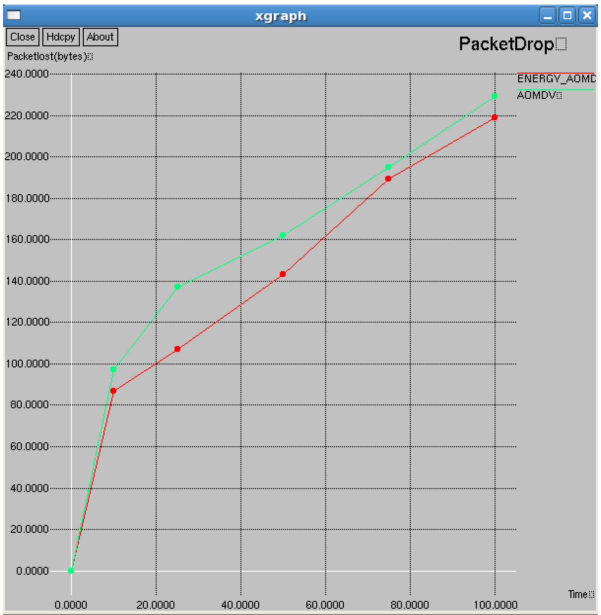

Fig 6.5 Comparison of packet lost for AOMDV and ENERGY_AOMDV using 60 nodes

Figure 6.5 shows the comparison of packet lost for AOMDV and ENERGY_ AOMDV using 60 nodes. It shows that packet lost is minimum for ENERGY_AOMDV compared to AOMDV.

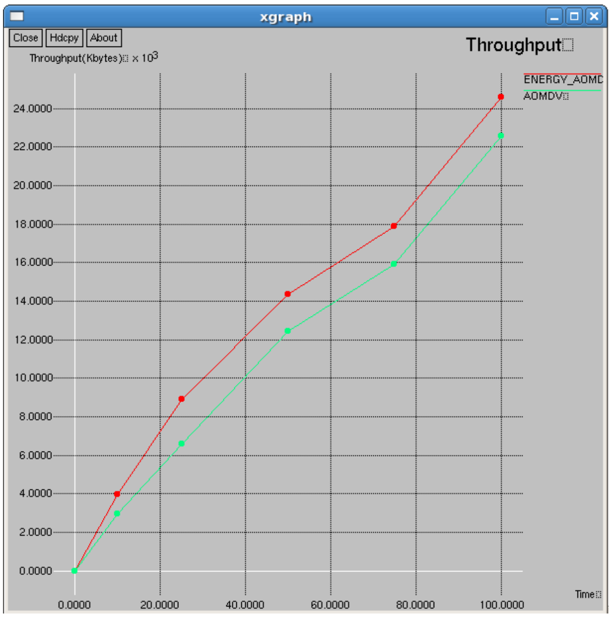

Fig 6.6 Comparison of throughput for AOMDV and ENERGY_AOMDV using 60 nodes

Figure 6.6 shows the comparison of throughput for AOMDV and ENERGY_ AOMDV using 60 nodes. It shows that the throughput is maximum for ENERGY_AOMDV compared to AOMDV.

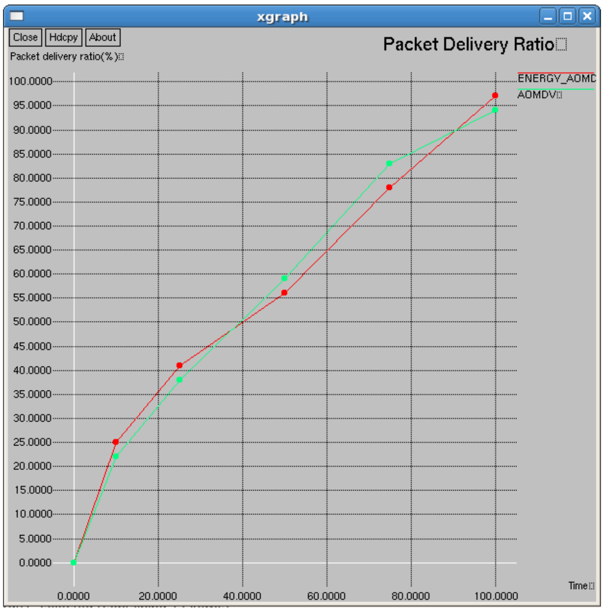

Fig 6.7 Comparison of packet delivery ratio for AOMDV and ENERGY_AOMDV using 60 nodes

Figure 6.7 shows the comparison of packet delivery ratio for AOMDV and ENERGY_ AOMDV using 60 nodes. It shows that the packet delivery ratio is better for ENERGY_AOMDV compared to AOMDV.

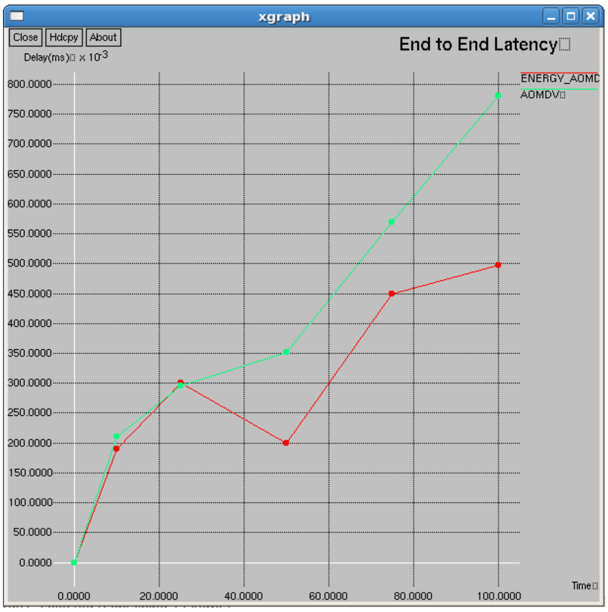

Fig 6.8 Comparison of end to end delay for AOMDV and ENERGY_AOMDV using 60 nodes

Figure 6.8 shows the comparison of packet lost for AOMDV and ENERGY_ AOMDV using 60 nodes. It shows that the end to end delay is minimum for ENERGY_AOMDV compared to AOMDV.

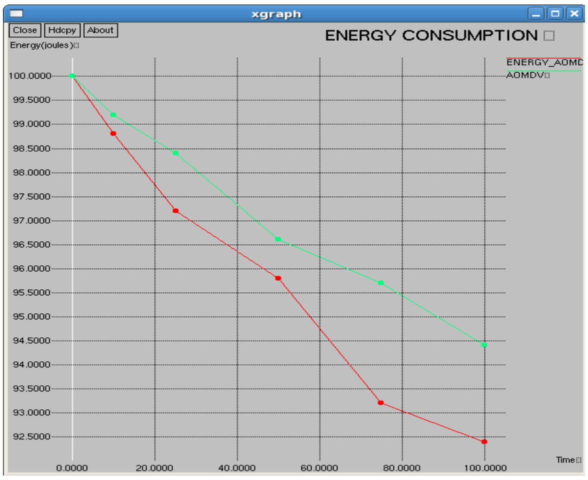

Fig 6.9 Comparison of energy consumption for AOMDV and ENERGY_AOMDV using 60 nodes

Figure 6.9 shows the comparison of packet lost for AOMDV and ENERGY_ AOMDV using 60 nodes. The green colored line indicates AOMDV and the red colored line indicates ENERGY_AOMDV. It shows that the energy consumption is minimum for ENERGY _AOMDV compared to AOMDV.

MANETs. Emphasis is on protocols that could be suitable for the implementation of scalable system in high node density environments such as in manufacturing or product distribution industries.

VII. CONCLUSION

In this paper we have evaluated the performance of different routing protocols such as, AOMDV, AODV, DSDV, TORA and DSR in MANET in different network environments. AOMDV is analyzed as the best protocol compared to AODV, TORA, DSR and DSDV. Then the result will be compared with performance of modified AOMDV. Results will be obtained as modified AOMDV providing better performance compared to AOMDV, AODV, TORA, DSR and DSDV protocols.

VIII. FUTUREWORK

This paper proposes further research into more efficient protocols or variants of existing protocols and network topologies that can improve the performance of

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