International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

Performance Analysis of AODV and AOMDV Routing Protocols for Reducing the Energy Consumption in MANET

Durgashankar Saini[1], G. L. Saini[2]

Abstract: ***In the MANET various nodes are connected in wireless manner a routing mechanism (routing protocols) and required for successful transmission of packets. Many solutions approaches using routing protocols and their modifications were worked out by the researchers. In the MANET the performance of various fields and characteristics components like throughput, average jitter, end-to-end delay for two Routing protocols (AODV and AOMDV) that was analyzed by increasing the number of node in mobility, also applying different MAC layer protocols (CSMA and ALOHA). There are no dedicated path between the nodes a routing strategy is helpful in exploring the shortest path. The IEEE 802.11 achieve completely different pattern in terms of it is energy efficiency when combined with different routing protocols. In this research work it has been decided to do the analysis of various routing protocols to understand that which one performed well in which set of conditions. The Focus is doing on the network parameters like throughput, end to end delay and jitter. This paper contains analysis of results obtained for simulation carried out using Network Simulator NS-3 under two experimental scenarios. The results obtained by the simulation were used to draw graphs to analyze the performance of AODV and AOMDV independently. It also includes comparative performance analysis between AODV and AOMDV under both the scenarios.***

Keywords: Performance Analysis of AODV and AOMDV routing protocols for reducing the energy consumption in MANET

1. Introduction

A group and set of mobile hosts represent to a wireless ad hoc network that is temporary arrangement of network without the help of any pre-established organization or centralized management. The various resource can be handled in an efficient way and group of nodes partitioned into clusters while network population is large. Mobile members in a cluster are often located within a limited coverage area, which is decided by the transmission power. Rapid progression in technology for mobile devices including laptops and handheld computers and the availability of inexpensive wireless networking hardware has resulted in a large interest in wireless connectivity among mobile users. One approach to providing wireless connectivity is through the formation of Mobile Ad Hoc Networks (MANET) [11]. The main focus of ad hoc routing protocols has been to support the wireless multi-hop routing capability.

Typically the wireless links has limited capacity than wired links and routing protocols of MANNET various load balancing capabilities generate main research issues. The overloading causes congestion in the network and also causes packet loss and also dropping of packets. The ad hoc wireless networks offer unique benefits and versatility for certain environments and certain applications. The preexisting fixed infrastructure and base stations are not being prerequisite.

An exhaustive literature review has helped me to understand different routing protocols developed and used by the researchers. Some approaches are discussed below.

a) **Table-driven (proactive) Routing:** In the table driven routing each protocol maintain updated list of destination and their respective routes distributed routing tables in whole network. The main issues of these algorithm are these algorithms cost of data maintenance and of such algorithms are respective amount of data for maintenance and poor reaction on failures and restructuring. Some of the proactive routing protocols are: **Optimized Link State Routing Protocol** (**OLSR**), **Destination-Sequenced Distance-Vector Routing (DSDV) etc.**
b) **On-demand (reactive) Routing:** Reactive (or on-demand) routing protocols find a path between the source and the destination only when the path is needed (i.e., if there are data to be exchanged between the source and the destination). This type algorithm generate various issues like require maximum latency time for suitable route finding and network clogging increases due to excessive flooding. Some of the example of on- demand routing protocols are: **Ad-Hoc On-Demand Distance Vector (AODV), Dynamic Source Routing (DSR).**
c) **Hybrid (both Proactive and Reactive) Routing:** The Hybrid Routing protocols typical combines the features of proactive and reactive routing. Primarily this routing recognized with few proactively prospected routes then serves requirement from additionally motivated nodes through reactive flooding. The choice of one and other procedure involves predetermination for classic cases. The main issues of this type algorithm are the activated nodes are related to features and gradient of traffic volume related to reaction to traffic demand. Some of the hybrid routing protocol is **Zone Routing Protocol.**

Existing Work: Most of the researchers used NS-2 for simulation, in which most of the comparisons among AODV, DSR, DSDV, and TORA protocols was done. TSA delivered an average of 19.65% messages higher than ISR. TSA measures the network traffic in bytes, not in number of packets which gives an accurate traffic load metric [2]. The DOSPR protocol used has a disadvantage as it has hops slightly higher than minimum hops protocol [12].Using RREQ messages causes more messages which can further cause delay or congestion [5]. The reputation based scheme mechanism discusses only one type of situation when there is no collusion. The network will become worse if the attackers decided to collude with each other. The power-cost optimal algorithm approach is not justified properly. The AODVLM protocol is more suitable mobile ad hoc routing protocol for the transmissions that require a link for longer duration of time [1]. AMRIS was effective in a light traffic environment with no mobility, but its performance was susceptible to traffic load and mobility. ZRP was not up to the task and it performed poorly throughout all the simulation sequences when compared with AODV and DSR [7].

2. Proposed Technique

a) AODV (Ad-Hoc On-Demand Distance Vector): This Routing protcol uses some of the similar features of proactive routing protocols. It is also called reactive routing protocol and route also established on-demand when it is require. Whenever a route established once that is maintained as long as it is reuired or till time the route doesn't fails. This technique significantly use to reduce the routing overhead. The network is quit until a connection is required in AODV and at the point network reuires a connection to broadcast a request message. Next AODV nodes forward this message and record the the node which they heard it from, creating an explosion of temporary routes back to the needy node.while a node receive that message and has a path to desired node, it send a backwards message though a tempoaray path to the requesting node.The needy node then begins using the route that has the least number of hops through other nodes. Unused entries in the routing tables *are recycled after a time.When a* link *fails, a routing error is passed back to a transmitting node, and the process repeats.*

Algorithmic Steps: The algorithm which is followed by the AODV protocol the steps are:
Step 1:- Read source and destination ids.
Step 2:- The source node sends RREQ messages to its neighbors which forwards the messages to other nodes till the destination is reached.
Step 3:- If anode receives a RREQ message more than once it replies with RREP message to indicate that it has received RREQ message which means that node is already added to some route to the destination.
Step 4:- The destination then reply via RREP messages which defines the path from source to destination. If RREP message is not received by the source node until a given predefined time it resends RREQ messages.
Step 5:- The routes is selected by the source node and then packets are forwarded to next node which forwards the packet to the next node in the queue this follows till the packet is not delivered to the destination node.

b) Challenges in AODV: The challenges faced in the AODV protocol are:

1) AODV requires more time to establish a connection, and the initial communication to establish a route is heavier than some other approaches.
2) Inconsistent routes can be increases due to intermediate nodes whereas very old source sequence number and the intermediate nodes has higher sequence number but not contain recent destination sequence number thus having stale entries.
3) Unnecessary bandwidth consumption due to periodic beaconing.
4) AODV protocol fails to give better performance when the node density is increased after a certain level.
5) Possible large delay from the moment the route is needed (a packet is ready to be sent) until the time the route is actually acquired.

c) Modifications in AODV: Some of the modifications that are proposed by the researchers in AODV are:

1) Congestion Adaptive AODV Routing Protocol (CA-AODV):- CA-AODV was designed to ensure the availability of primary route as well as alternative routes and reduce the route overhead, DLAR discussed that the destination sends the load information attached in the RREP packet to source, Work Load-Based Adaptive Load-Balancing proposed that the nodes forward or broadcast the RREQ packet on the condition that they do not have a route to the destination. The protocol preserves the multiple paths carrying a higher hop count value and used them as alternate routes in case of link failure and modification will reduce congestion by choosing non congested routes to send RREQ and data packets and to transfer the load to higher hop count alternate paths if the nodes or route turn out to be congested.
2) Ad-hoc On-Demand Multipath Distance Vector (AOMDV):- The node that needs a connection in the network broadcasts a request for connection. The message is being forwarded by another AOMDV nodes also record node which it heard from creating an explosion of temporary link return back to needy node.When a node receives such a message and already has a route to the desired node, it sends a message backwards through a temporary route to the requesting node. The needy node then begins using the route that has the least number of hops through other nodes. When a link fails, a routing error is passed back to a transmitting node and then the source node chooses the other saved path in the memory of the nodes and starts forwarding the packets.
3) AODV with load and mobility (AODVLM):- The AODVLM enhances the basic AODV and uses the load and mobility as the key point to improve the basic AODV protocol. The protocol enhances the route discovery mechanism that ensures shortest routing path with relative to time, so the source sends packets quickly to destination then basic AODV. In the method the source node broadcasts RREQ message to its neighbors. When a neighbor receive RREQ message it will calculate the number of packets in the queue and divide it with the size of the queue and add the value in the reserved field of the RREQ message. This process is done at each node in the route to the destination. Sharing of load decreases the network congestion which directly leads to the decrease of overflowing of queuing buffer and packets loss.

d) Ad-Hoc On-Demand Multipath Distance Vector (AOMDV):

The AOMDV (Ad-Hoc On-Demand Multipath Distance Vector) is one of the modifications of the AODV protocol. AOMDV routing protocol is also a reactive routing protocol that uses some characteristics of proactive routing protocols.

Routes are established on-demand, as they are needed. However, once established a route is maintained as long as it is needed or till the time the route does not fails. Reactive (or on-demand) routing protocols find a path between the source and the destination only when the path is needed (i.e., if there are data to be exchanged between the source and the destination). In AOMDV, the network is silent until a connection is needed. At that point the network node that needs a connection broadcasts a request for connection. The message is being forwarded by another AOMDV nodes also record node which it heard from creating an explosion of temporary link return back to needy node. When a node receives such a message and already has a route to the desired node, it sends a message backwards through a temporary route to the requesting node. The needy node then begins using the route that has the least number of hops through other nodes. When a link fails, a routing error is passed back to a transmitting node and then the source node chooses the other saved path in the memory of the nodes which is the quality and the property of the AOMDV protocol.

Algorithmic Steps:
The algorithm which is followed by the AOMDV protocol the steps are:

Step 1:- Read source and destination ids.

Step 2:- The source node sends RREQ messages to its neighbors which forwards the messages to other nodes till the destination is reached.

Step 3:- If a node receives a RREQ message more than once it replies with RREP message to indicate that it has received RREQ message which means that node is already added to some route to the destination.

Step 4:- The destination then reply via RREP messages which defines the path from source to destination. If RREP message is not received by the source node until a given predefined time it resends RREQ messages.

Step 5:- The routes are kept in the memory with the help of Hop count. More than one routes are selected these routes are shortest path from source to destination. The AODVM also keeps routes with longer paths for backup.

3. Performance Parameters:

The performance parameters are those parameters which help to analyze the performance of the network and the protocols used in the network. The performance parameters used are:

a) Average End to End Delay: End-to-end delay or One-way delay refers to the time taken for a packet to be transmitted across a network from source to destination. The time of a packet spends in travelling across the IP network from A to B and IP Network to measure end to end dealy in between two synchornized points A and B. The transmitted packets need to be identified at source and destination in order to avoid packet loss or packet reordering.

Mathematical Formula for End-to-End Delay is: $d_{end\text{-}end} = N[d_{trans} + d_{prop} + d_{proc}]$
where,

$d_{end\text{-}end}$= end-to-end delay
d_{trans}= transmission delay
d_{prop}= propagation delay
d_{proc}= processing delay

N= number of links (Number of routers + 1)
Note: we have neglected queuing delays.
Each router will have its own d_{trans}, d_{prop}, d_{proc} hence this formula gives a rough estimate.

b) Average Throughput: In the communication channel the successful message delivery over communication channel like Ethernet or packet ratio, throughput or network throughput.The data these messages belong to may be delivered over a physical or logical link or it can pass through a certain network node. Throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second (p/s) or data packets per time slot. The system throughput or average throughput is the sum of the data rates that are delivered to all terminals in a network. Throughput is essentially synonymous to digital bandwidth consumption; it can be analyzed mathematically by applying the queuing theory, where the load in packets per time unit is denoted as the arrival rate (λ), and the throughput, in packets per time unit, is denoted as the departure rate (μ).

c) Packet Delivery Ratio (PDR): Packet delivery ratio is defined as the ratio of data packets received by the destinations to those generated by the sources. This performance metric gives us an idea of how well the protocol is performing in terms of packet delivery at different speeds using different traffic models.

Mathematical formula:
PDR=(receivedPackets /generatedPackets)*100
Where:-
receivedPackets – Number of packets received
generatedPackets – Number of packets generated

4. Experimental Scenarios and Network Variables

a) Experimental Condition 1: -

1) Fixed Parameters:
Number of Nodes: 200 nodes
Mobility: Random Way Point

2) Variable Parameters:
Protocol Type: Varied with two values AODV and AOMDV
Packet Size: Varied with two values 512 and 1024
Simulation Time: 100 - 1000 in step of 50

b) Experimental Condition 2: -

1) Fixed Parameters:
Mobility: Random Way Point.
Simulation Time: 600 ms

2) Variable Parameters
Protocol Type: Varied with two values AODV and AOMDV

Packet Size: Varied with two values 512 and 1024
Number of Nodes: 50-500 nodes in step of 50

c) Comparative Analysis:

1. Comparative Analysis of AODV and AOMDV with Varying Simulation Time and Packet Size 1024: In this part of the scenario we have fixed Nodes to 200, packet size to 1024 bytes and mobility to random way point and the Simulation Time is the variable against which the graphs are plotted. When the simulation time is increased it could be found that E-E Delay randomly varies in values but is increasing by nature. The E-E delay is worst for 100ms simulation time and it is best at 350ms simulation time for AODV and for the AOMDV average throughput is worst for 950ms simulation time and it is best for 150ms simulation time. The AOMDV gives less E-E Delay as compared to AODV for most of the simulation time. PDR also varies randomly in values but is increasing by nature. The PDR is worst for 100ms simulation time and it is best for 750mssimulation time for AOMDV and for the AODV the PDR is worst for 100ms simulation time and it is best for 600ms simulation time. The AOMDV gives better PDR as compared to AODV for most of the simulation time. Average throughput also varies randomly in values but is increasing by nature. The average throughput is best for 1000ms simulation time and it is worst for 100ms simulation time for AOMDV and for AODV average throughput is best for 500ms simulation time and it is worst for 100ms simulation time. The AOMDV gives better average throughput as compared to AODV for most of the simulation time.

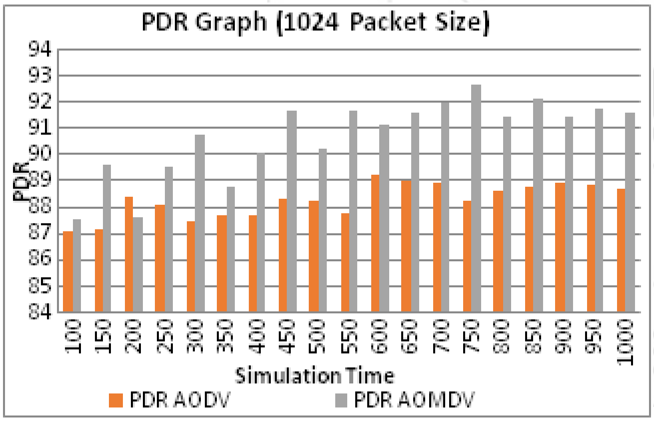

Figure 1: PDR vs Simulation Time 1024 Packet Size

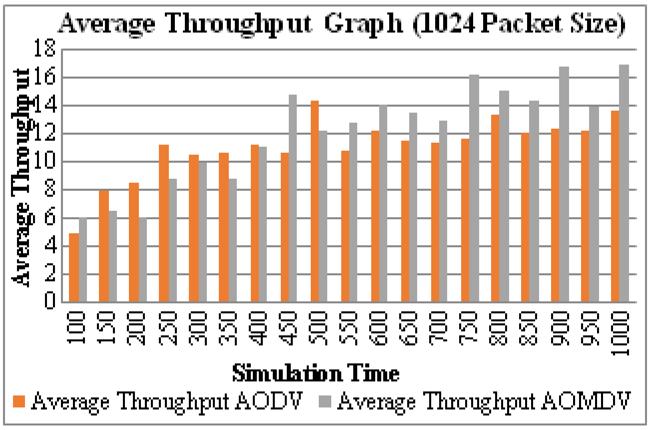

Figure 2: Average Throughput vs Simulation Time 1024 Packet Size

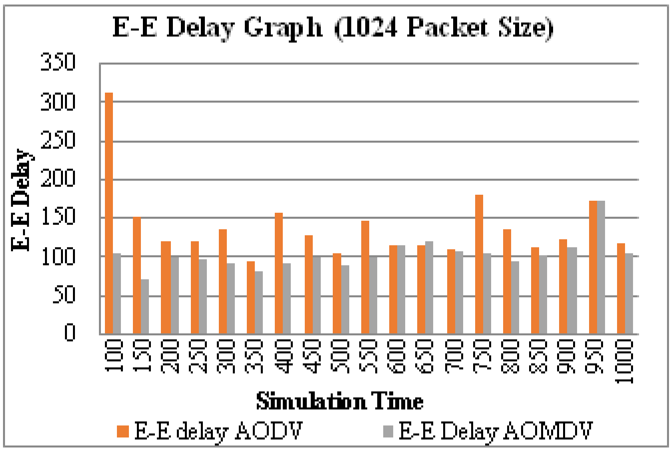

Figure 3: E-E Delay vs Simulation Time 1024 Packet Size

2. Comparative Analysis of AODV and AOMDV with Varying Simulation Time and Packet Size 512: In this part of the scenario we have fixed Nodes to 200, packet size to 512 bytes and mobility to random way point and the Simulation Time is the variable against which the graphs are plotted.As the simulation time is increased it could be found that PDR randomly vary in values but is increasing by nature. The PDR is worst for 150ms simulation time and it is best for 900mssimulation time for AOMDV and for the AODV the PDR is worst for 100ms simulation time and it is best for 950ms simulation time. The AOMDV gives better PDR as compared to AODV for most of the simulation time.Average throughput also varies randomly in

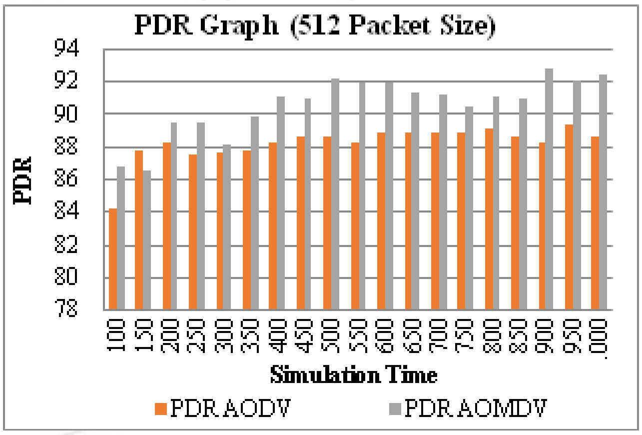

Figure 4: PDR vs Simulation Time 512 Packet Size

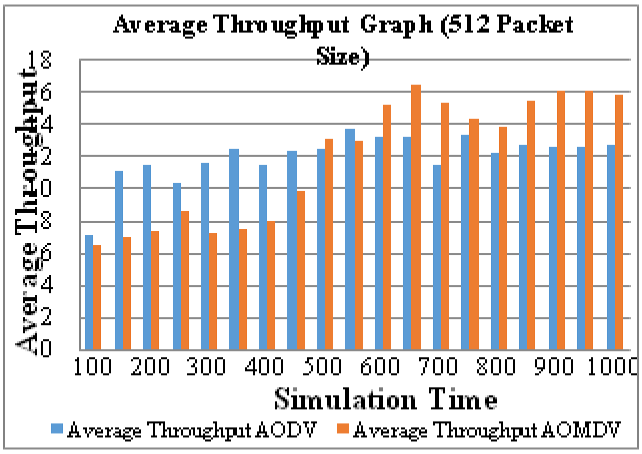

Figure 5: Average Throughput vs Simulation Time 512 Packet Size

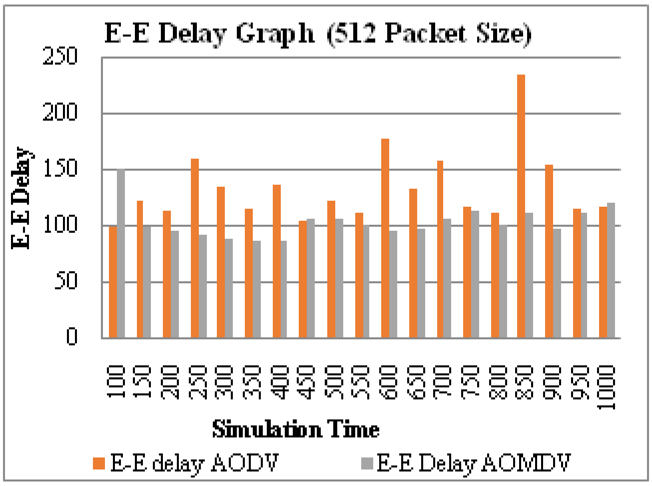

Figure 6: E-E Delay vs Simulation Time 512 Packet Size

values but is increasing by nature. The average throughput is best for 650ms.simulation time and it is worst for 100ms simulation time for AOMDV and for AODV average throughput is best for 550ms simulation time and it is worst for 100ms simulation time. The AOMDV gives better average throughput as compared to AODV for most of the simulation time. E-E Delay also randomly varies in values but is increasing by nature. The E-E delay is worst for 850ms simulation time and it is best for 100ms simulation time for AODV and for the AOMDV average throughput is worst for 100ms simulation time and it is best for 400ms simulation time. The AOMDV gives less E-E Delay as compared to AODV for most of the simulation time.

3. Comparative Analysis of AODV and AOMDV with Varying Number of Nodes and Packet Size 1024: In this part of the scenario we have fixed simulation time to 600ms, packet size to 1024 bytes and mobility to random way point and the number of Nodes is the variable against which the graphs are plotted. As the number of nodes is increased it could be found that PDR randomly vary in values but is decreasing by nature. The PDR is worst for 500 nodes and it is best for 50 nodes for AODV protocol and for the AOMDV PDR is worst for 300 nodes and it is best for 50 nodes. The AOMDV gives better PDR as compared to AODV for all the nodes. Average throughput also varies randomly in values but is decreasing by nature. The elay average throughput is best for 50 nodes and it is worst for 500 nodes AODV and for the AOMDV the average throughput is best for 50 nodes and it is worst for 500 nodes. The AOMDV gives better average throughput as compared to AODV for all the nodes E-E Delay also randomly varies in values but is increasing by nature. The E-E delay is worst for 300

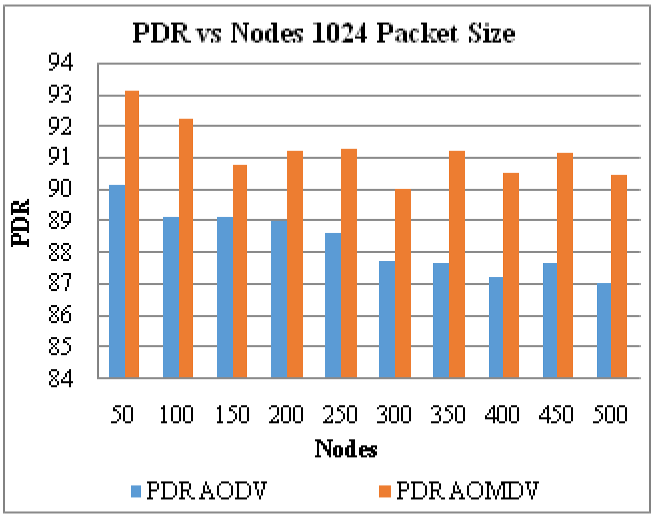

Figure 7: PDR vs Nodes 1024 Packet Size

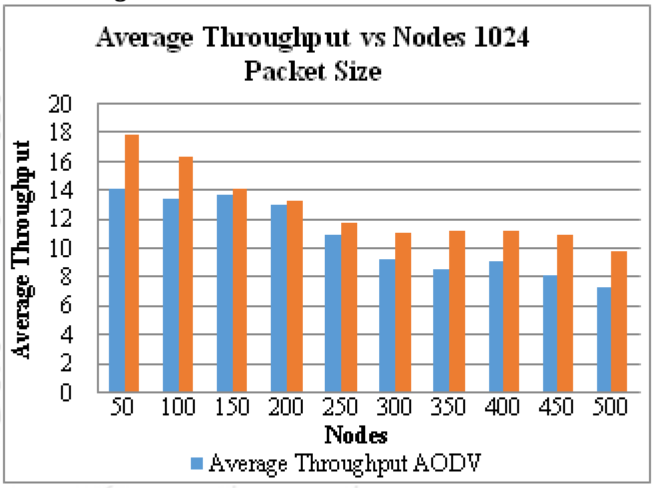

Figure 8: Average throughput vs Nodes 1024 Packet Size

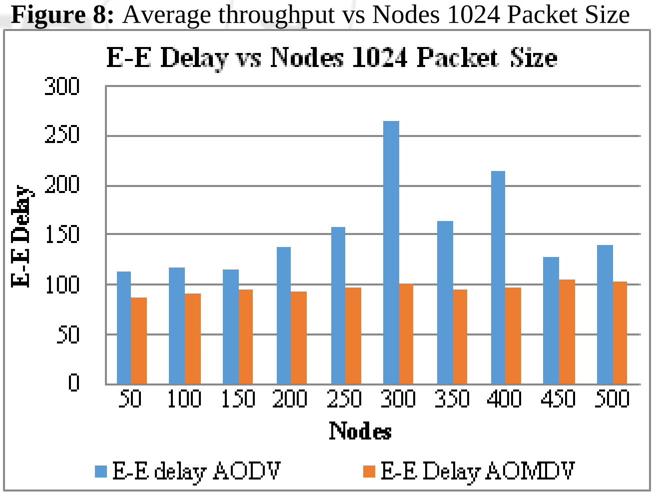

Figure 9: E-E Delay vs Nodes 1024 Packet Size

and it is best for 50 nodes for AODV and for the AOMDV E-E delay is worst for 450 nodes and it is best for 50 nodes. The AOMDV has less E-E delay as compared to AODV for all the nodes.

4. Comparative Analysis of AODV and AOMDV with Varying Number of Nodes and Packet Size 512: In this part of the scenario we have fixed simulation time to 600ms, packet size to 512 bytes and mobility to random way point and the number of Nodes is the variable against which the graphs are plotted. As the number of nodes is increased it could be found that PDR randomly vary in values but is decreasing by nature. The PDR is worst for 450 nodes and it is best for 50 nodes for AODV protocol and for the AOMDV PDR is worst for 450 nodes and it is best for 50 nodes. The AOMDV gives better PDR as compared to AODV for all the nodes. Average throughput also varies randomly in values but is decreasing by nature. The average throughput is best for 50 nodes and it is worst for 500 nodes AODV and for the AOMDV the average throughput is best for 50 nodes and it is worst for 500 nodes. The AOMDV gives better average throughput as compared to AODV for all the nodes. E-E Delay also randomly varies in values but is increasing by nature. The E-E delay is worst for 350 and it is best for 50 nodes for AODV and for the AOMDV E-E delay is worst for 300 nodes and it is best for 50 nodes. The AOMDV has less E-E delay as compared to AODV for all the nodes.

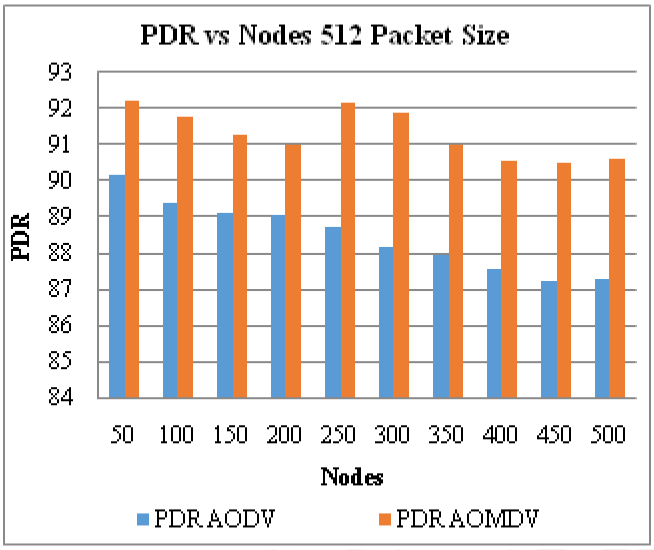

Figure 10: PDR vs Nodes 512 Packet Size

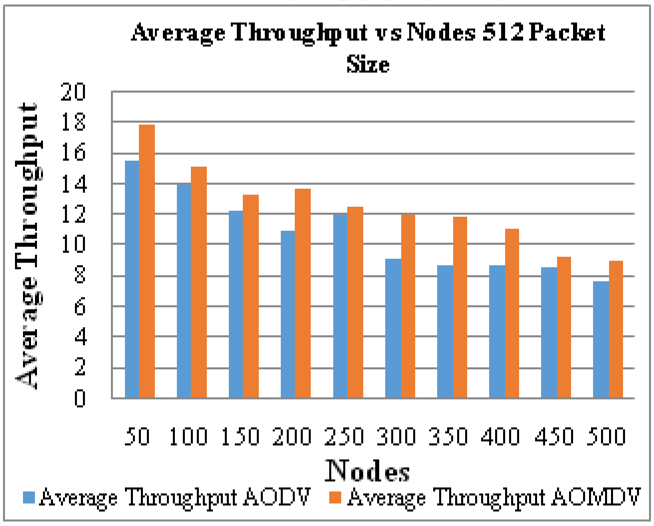

Figure 11: Average throughput vs Nodes 512 Packet Size

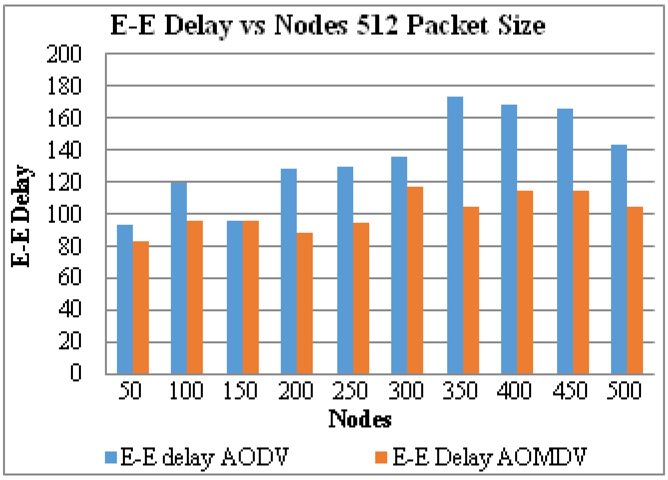

Figure 12: E-E Delay vs Nodes 512 Packet Size

5. Comparative Analysis of Overall Results

In order to compare the results of AODV and AOMDV comparison are shown in the experimental work for 512 packet size and 1024 packet size respectively. The results in the graphs indicate that while comparing the performance of the two protocols AOMDV has performed better than AODV with respect to variation in Simulation time, Number of nodes as well as for variable packet size. All the performance parameters such as PDR, Throughput and the Delay were found better in case of AOMDV than AODV protocol.

6. Conclusion

For the final research work comparative performance analysis of two protocols AODV and AOMDV with reference to different network parameters was carried out. For the selected network parameters and their variations simulation was carried out using NS-3 and the performance parameters PDR, Average Throughput, End to End Delay were analyzed. The performance analysis was done by comparing the various results obtained by the simulation. The results were analyzed for AODV for the experimental scenarios and then for AOMDV for the same scenarios. In the last step AODV and AOMDV are compared with each other for the performance analysis. It could be found that AOMDV performs better than AODV.

References

[1] Ahmad, I.; urRehman, M., "Efficient AODV routing based on traffic load and mobility of node in MANET," Emerging Technologies (ICET), 2010 6th International Conference, pp.370,375, 18-19 Oct. 2010 doi: 10.1109/ICET.2010.5638459.

[2] Altalhi, A.H.; Richard, G.G., III, "Load-balanced routing through virtual paths: highly adaptive and efficient routing scheme for ad hoc wireless networks," Performance, Computing, and Communications, 2004 IEEE International Conference, pp.407, 413, 2004 doi: 10.1109/PCCC.2004.1395045.

[3] B. Ramesh, and D. Manjula (2007)," An Adaptive Congestion Control Mechanism for Streaming Multimedia in Mobile Ad-hoc Networks" IJCSNS

International Journal of Computer Science and Network Security, VOL.7 No.6, June 2007.

[4] BhavyeshDivecha, Ajith Abraham, CrinaGrosan and SugataSanyal, “Impact of Node Mobility on MANET Routing Protocols Models”,2007 Journal of Digital Information Management ‰ Volume 5 Number 1 pp. 19-24.

[5] Lee, Y.J.; Riley, G.F., "A workload-based adaptive load-balancing technique for mobile ad hoc networks," Wireless Communications and Networking Conference, 2005 IEEE , vol.4, pp.2002,2007 Vol. 4, 13-17 March 2005 doi: 10.1109/WCNC.2005.1424826 .

[6] Lianfang Zhang; Zenghua Zhao; Yantai Shu; Lei Wang; Yang, O.W.W., "Load balancing of multipath source routing in ad hoc networks," Communications, 2002. ICC 2002. IEEE International Conference, vol.5, pp.3197,3201 vol.5, 2002 doi: 10.1109/ICC.2002.997425.

[7] SreeRangaRaju, M.; Mungara, J., "ZRP versus AODV and DSR: A Comprehensive Study on ZRP Performance Using QualNet Simulator," Wireless Communications Networking and Mobile Computing (WiCOM), 2010 6th International Conference pp.1,10, 23-25 Sept. 2010 doi: 10.1109/WICOM.2010.5600909.

[8] Mbarushimana, C.; Shahrabi, A., "Congestion Avoidance Routing Protocol for QoS-Aware MANETs," Wireless Communications and Mobile Computing Conference, 2008. IWCMC '08. International, pp.129,134, 6-8 Aug. 2008 doi: 10.1109/IWCMC.2008.23.

[9] Min-Hua Shao; Ji-Bin Lin; Yi-Ping Lee, "Cluster-based Cooperative Back Propagation Network Approach for Intrusion Detection in MANET," Computer and Information Technology (CIT), 2010 IEEE 10th International Conference, pp.1627,1632, June 29 2010-July 1 2010 doi: 10.1109/CIT.2010.288.

[10] P. P. Tandon and BibhudattaSahoo,” A Novel Congestion Avoidance Based Load Balanced Routing with Optimal Flooding in Mobile Ad hoc Network”, Proceedings of 2nd National Conference on Challenges & Opportunities in Information Technology (COIT-2008) RIMT-IET, March 29, 2008, pp. 184-188.

[11] S. Corson and J. Macker, “Mobile Ad hoc Networking (MANET): Routing Protocol Performance issues and Evaluation Considerations”, Network Working Group, RFC2501, January 1999.

[12] Shiann-TsongSheu; Chen, T., "A novel delay-oriented shortest path routing protocol for mobile ad hoc networks," Communications, 2001. ICC 2001. IEEE International Conference, vol.6, pp.1930,1934, 2001 doi: 10.1109/ICC.2001.937126.