Comparison and Study of AOMDV and DSDV Routing Protocols in MANET Using NS-2

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***Abstract*— A mobile ad hoc network (MANET) is a collection of wireless mobile nodes communicating with each other using multi-hop wireless. One of the main challenges of MANET is the design of robust routing algorithms that adapt to the frequent and randomly changing network topology. A variety of routing protocols have been proposed and several of them have been extensively simulated or implemented as well. In this paper, we compare and evaluate the performance metrics of two types of routing protocols - Ad-hoc On-demand Multipath Distance Vector (AOMDV) routing protocol , which is a multipath routing protocol and Destination sequence distance vector (DSDV) routing protocol based on various simulations like varying pause time and varying maximum speed of the moving nodes.**

Keywords- Ad-hoc networks; routing protocols ; AOMDV; DSDV; Simulation

I. INTRODUCTION

A mobile ad-hoc network or MANET is a collection of mobile nodes sharing a wireless channel without any centralized control or established communication backbone. They have no fixed routers with all nodes capable of movement and arbitrarily dynamic. These nodes can act as both end systems and routers at the same time. When acting as routers, they discover and maintain routes to other nodes in the network. The topology of the ad hoc network depends on the transmission power of the nodes and the location of the mobile nodes, which may change from time to time [1]. Normal routing protocol which works well in fixed networks does not show same performance in Mobile Ad Hoc Networks. In these networks routing protocols should be more dynamic so that they quickly respond to topological changes [2]. Various applications of MANET are defined which include military battle fields, commercial sector like emergency rescue operations, local levels like conferences or classrooms, personal area network(PAN) and many more applications.

In Topology based approach, routing protocols are classified into three categories, based on the time at which the routes are discovered and updated.

a. Proactive Routing Protocol (Table Driven)
b. Reactive Routing Protocol (On-Demand)
c. Hybrid Routing Protocol

The Proactive routing approaches designed for ad hoc networks are derived from the traditional routing protocols. These protocols are sometimes referred to as table-driven protocols since the routing information is maintained in tables. Proactive approaches have the advantage that routes are available the moment they are needed. However, the primary disadvantage of these protocols is that the control overhead can be significant in large networks or in networks with rapidly moving nodes.

Proactive routing protocol includes Destination-Sequenced Distance-Vector (DSDV) protocol, Wireless Routing Protocol (WRP), Optimized Link State Routing Protocol (OLSR) etc.

Reactive routing approaches take a departure from traditional Internet routing approaches by not continuously maintaining a route between all pairs of network nodes. Instead, routes are only discovered when they are actually needed. When a source node needs to send data packets to some destination, it checks its route table to determine whether it has a route. If no route exists, it performs a route discovery procedure to find a path to the destination. Hence, route discovery becomes on-demand. The drawback to reactive approaches is the introduction of route acquisition latency. That is, when a route is needed by a source node, there is some finite latency while the route is discovered. In contrast, with a proactive approach, routes are typically available the moment they are needed. Hence, there is no delay to begin the data session. Reactive routing protocol includes

Dynamic Source Routing (DSR) protocol, Ad hoc On-demand Distance Vector (AODV) protocol, Ad hoc On-demand Multiple Distance Vector (AOMDV) protocol etc.

Hybrid protocols seek to combine the Proactive and Reactive approaches. An example of such a protocol is the Zone Routing Protocol (ZRP).

This paper presents a performance comparison of three prominent routing protocols in MANET based on results analysis obtained by running simulations with different scenarios in Network Simulator version 2 (NS-2) [5]. Scenarios differ in duration of pause times, and maximum movement speed. Parameters based on which the comparison is performed are Packet Delivery Ratio (PDR), End to End Delay and Normalized Routing Load. A description of considered routing protocols is given in Section II. Scenarios and simulation parameters are described in Section III. Simulation results and analysis are presented in Section IV. Section V concludes this paper.

II. BACKDROUND

A. Ad-hoc On-demand Multi path Distance Vector Routing (AOMDV)

Ad-hoc On-demand Multi path Distance Vector Routing (AOMDV) [3] protocol is an extension to the AODV protocol for computing multiple loop-free and link disjoint paths [1]. 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 [1]. 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. AOMDV can be used to find node-disjoint or link-disjoint routes. To find node-disjoint routes, each node does not immediately reject duplicate RREQs. Each RREQs arriving via a different neighbour of the source defines a node-disjoint path. This is because nodes cannot be broadcast duplicate RREQs, so any two RREQs arriving at an intermediate node via a different neighbour of the source could not have traversed the same node. In an attempt to get multiple link-disjoint routes, the destination replies to duplicate RREQs, the destination only replies to RREQs arriving via unique neighbours. After the first hop, the RREPs follow the reverse paths, which are node disjoint and thus link-disjoint. The trajectories of each RREP may intersect at an intermediate node, but each takes a different reverse path to the source to ensure link disjoint ness [1]. The advantage of using AOMDV is that it allows intermediate nodes to reply to RREQs, while still selecting disjoint paths. But, AOMDV has more message overheads during route discovery due to increased flooding and since it is a multipath routing protocol, the destination replies to the multiple RREQs those results are in longer overhead.

B. Destination Sequence Distance Vector Routing (DSDV)

The DSDV described is a table-driven proactive protocol, based on the classical Bellman-Ford routing mechanism. The basic improvements made include freedom from loops in routing tables, more dynamic and less convergence time. Every node in the MANET maintains a routing table which contains list of all known destination nodes within the network along with number of hops required to reach to particular node. Each entry is marked with a sequence number assigned by the destination node. The sequence numbers are used to identify stale routes thus avoiding formation of loops. To maintain consistency in routing table data in a continuously varying topology, routing table updates are broadcasted to neighbour's periodically or when significant new information is available. In addition to it time difference between arrival of first and arrival of the best route to a destination is also stored so that advertising of routes, which are likely to change soon, can be delayed. Thus avoiding the advertisement of routes, which are not stabilized yet, so as to avoid rebroadcast of route entries that arrive with node is supposed to keep the track of settling time for each route so that fluctuations can be damped by delaying advertisement of new route to already known and reachable destination thus reducing traffic. Fluctuating routes occurs as a node may always receive two routes to a destination with same sequence number but one with better metric later. But new routes received which take to a previously unreachable node must be advertised soon. Mobiles also keep track of the settling time of routes, or the weighted average time that routes to a destination will fluctuate before the route with the best metric is received. By delaying the broadcast of a routing update by the length of the settling time, mobiles can reduce network traffic and optimize routes by eliminating those broadcasts that would occur if a better route was discovered in the very near future.

III. SIMULATIONS USING NS-2

We have used Network Simulator (NS)-2 in our evaluation. The NS-2 is a discrete event driven simulator developed at UC Berkeley. NS-2 is suitable for designing new protocols, comparing different protocols and traffic evaluations. It is an object oriented simulation written in C++, with an OTcl interpreter as a frontend.

Simulation of protocols is performed on Linux operating system using ns-2.35.We have different simulations run in all over. Every simulation runs from 0s to 100s. Random waypoint mobility in a rectangular field of 500m *500m is used. Traffic and mobility files are imported in TCL script at the time of execution. AOMDV and DSDV maintain send buffer of packets. All the data packets waiting for route are kept in send buffer. Interface queue maximum size is 50 packets. IFQ holds all the routing packets until MAC layer transmit them. The steps of simulation are shown in the below “Fig.1”

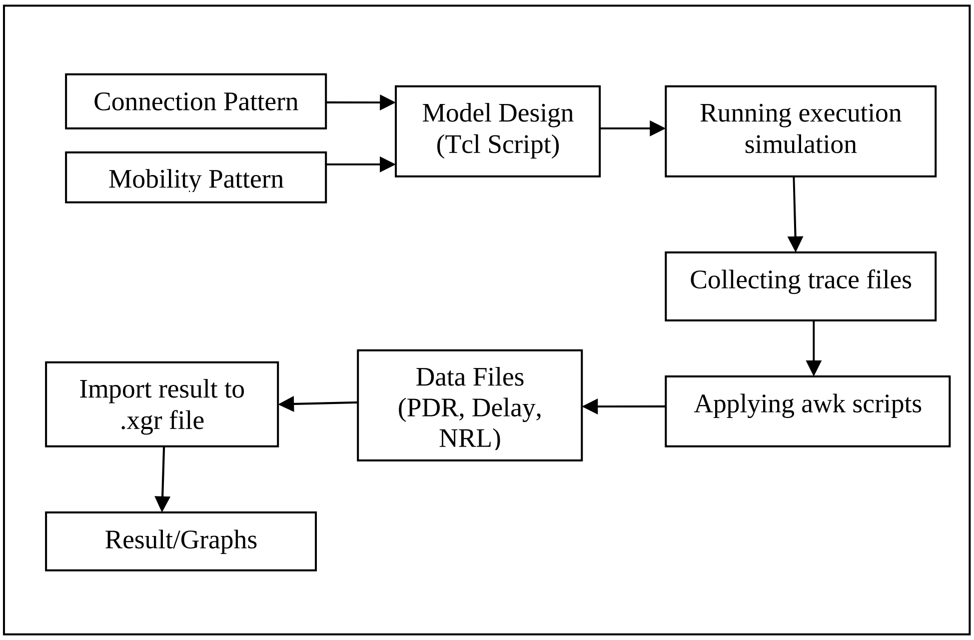

Figure 1. Simulation Process

A. Steps of Simulation

Following steps are performed to carry out simulation process of above mentioned protocols.

Step 1 - Scenarios are generated using the setdest utility mentioned above which uses random waypoint mobility model_.Here in this simulation 25 scenarios are generated varying the pause time and maximum speed. Example to generate scenario is given as:

Setdest -v1 -n 50 - p5 - m 4 -t 100 -x 500 -y 500 > scene5-5

Where -v : version 1 or 2 , -n: number of nodes , -p : pause time , -m : maximum speed , -x and - y : area of simulation, -t : simulation time , scene-5-5 : output file.

Step 2 - Traffic pattern is generated using the cbrgen.tcl file given in the indep utilities. In this simulation only one traffic pattern is generated using the following method:

ns cbrgen.tcl - type cbr -nn 50 - seed 1 - mc 10 - rate 0.25

Where - type: type of traffic cbr or tcp, - nn: number of nodes, - seed: seed value, -mc: maximum connection sources, -rate: rate of sending packets.

Step 3 - After generating traffic patterns and scenarios a *tcl script* is written for generation of trace files. These generated traffic patterns and scenarios are fed in to the tcl script and then executed. On the execution of *tcl script* trace files are generated. In this simulation two protocols namely AOMDV and DSDV are used to generate trace files which are saved with the extension *.tr which are old trace file formats. There are two trace file formats available one is old trace file format and other is new trace file format. With the generation of trace file a *.nam file is also generated which shows the animation of the moving nodes and routing of packets. Routing of packets and movement of nodes can be easily depicted by *.nam files.

Step 4 – When trace files are generated then it is needed to analyse these files using the *awk* or *perl script.* To analyse the files awk or perl scripts are written according to the performance metrics which are to be used in the performance evaluation. This simulation is performed to evaluate the performance based on the three metrics namely Packet delivery ratio, Average and to end delay and Normalized routing load. So three awk files are used for this Simulation.

Step 5 – After analysis of trace files the obtained results are stored in a text file or excel file then presented by the graphs using Matlab or Xgraph utility of ns-2. Here analysed result is stored in a text file and then graphs are plotted between both models and performance metrics which are packet delivery ratio, end to end delay and normalized routing load using Matlab.

B. Performance Metrics

- Packet delivery ratio – It is the ratio of data packets delivered to the destination to those generated by the sources. It is calculated by dividing the number of packet received by destination through the number packet originated from source.

PDR = (Total number of Packets received/Total number of Packets sent)*100

- Average end to end delay - This includes all possible delay caused by buffering during route discovery latency, queuing at the interface queue, retransmission delay at the MAC, propagation and transfer time. It is defined as the time taken for a data packet to be transmitted across an MANET from source to destination.

D = (Receive time – Sent time) / total number of data packets received

- Normalized routing load - The number of routing packets transmitted per data packet delivered at the destination. Each hop -wise transmission of a routing packet is counted as one transmission.

C. Testing Models and Simulation Parameters

Two different types of models are used for simulation, which are defined below

- Pause time model – varying pause time but node's speed, transmission rate, number of flows and number of nodes are kept constant.
- Speed model - varying node's speed but pause time, transmission rate, number of flows and number of nodes are kept constant.

Simulation parameters used for these two models are shown in "table 1".

TABLE I. SIMULATION PARAMETERS

Parameters	***Values***
Routing Protocols	AOMDV,DSDV
Number of nodes	50
Simulation Time	100sec
Pause Time	0,5,10,15,20 ms
Environment Size	500*500
Transmission range	250m
Traffic Type	CBR(Constant Bit Rate)
Packet size	512 Bytes
Packet Rate	4 packets/sec
Maximum Speed	2,4,6,8,10m/s
Queue Length	50
Mobility Model	Random waypoint
Antenna Type	Omni-Directional

IV. SIMULATION RESULT AND ANALYSIS

Results for the above mentioned simulation is presented here with help of graphs using Matlab. Graphs are generated for both pause time model and speed model. There are three graphs generated for each model using performance metrics packet delivery ratio, average end to end delay and normalized routing load.

A. Pause Time Model

In this model pause time is varied and rests of the parameters are kept constant. The value of pause time is varied from 0 to 20ms and maximum speed of node movement is kept constant at 10m/sec. Graphical results are obtained for packet delivery ratio versus pause time, Average and to end delay versus pause time and normalized routing load versus pause time.

1) Packet Delivery Ratio: Here in this Fig.2 it is shown that the packet delivery ratio of AOMDV protocol is more than the DSDV.As AOMDV is the multipath routing prtotocol it adopts a new route when the link is broken but this is not with the DSDV.

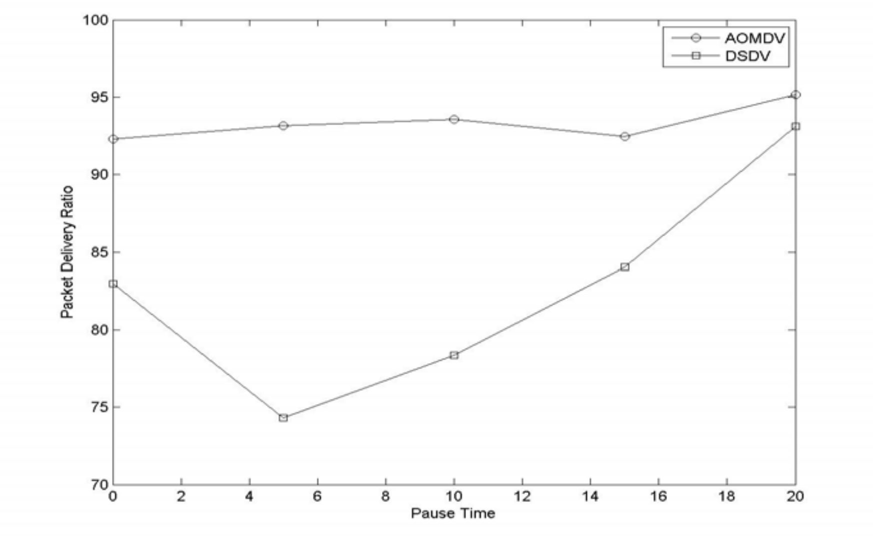

Figure 2. PDR Versus Pause Time

2) End to End Delay: In Fig.3 AOMDV shows more delay than the DSDV protocol as the pause time is varied except at the 10seconds pause time DSDV shows more delay than the AOMDV. But at an average the delay shown by AOMDV is more than the DSDV. Delay is more in AOMDV due to the fact that if a link break occurs in the current topology, it would try to find an alternate path from among the backup routes between the source and the destination node pairs resulting in additional delay to the packet delivery time. Whereas this is not with the DSDV.

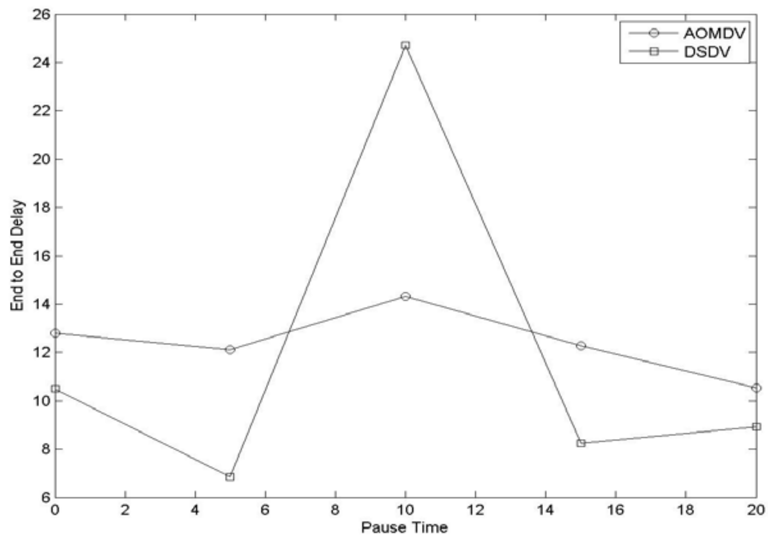

Figure 3. Average Delay Versus Pause Time

3) Normalized routing load: From Fig.4 it is clear that AOMDV has more normalized routing load as compared to the DSDV on varying the pause time values. As AOMDV is the multipath routing protocol so as the link breaks it starts searching for new path for the packet delivery by flooding the request packets so Normalized routing load is more in AOMDV as compared to DSDV.

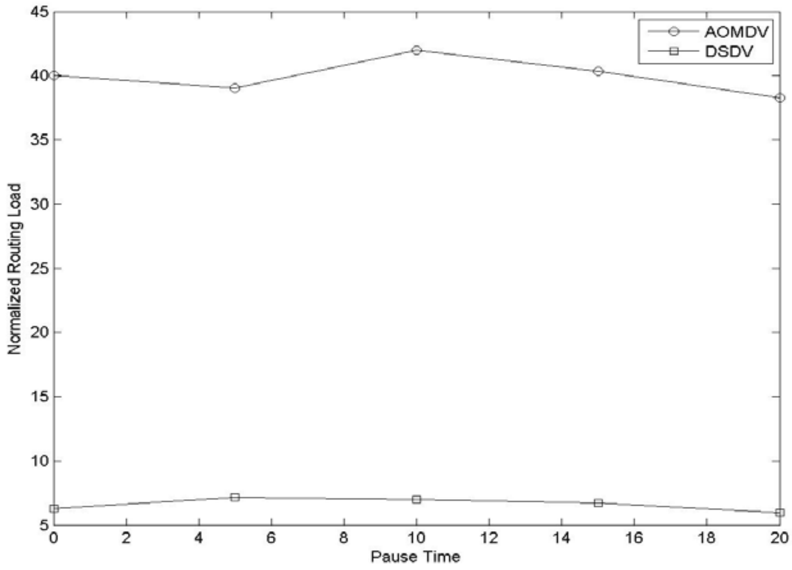

Figure 4. Normalized Routing Load versus Pause Time

B. Speed Model

In this model maximum speed of moving node is varied and rests of parameters are kept constant. The value of speed is varied from 2 to 10m/sec and Pause time is kept constant at 0sec. Graphical results are obtained for packet delivery ratio versus maximum speed, Average and to end delay versus maximum speed and normalized routing load versus maximum speed.

1) Packet Delivery ratio: It is clear from the Fig. 5 that in speed model also AOMDV shows better packet delivery ratio as compared to DSDV routing protocol.As the speed of moving nodes is varied from 2 to 10m/sec the AOMDV protocol shows 100% packet delivery at beginning and then there is variation but DSDV protocol is faile dto achieve better PDR then AOMDV.

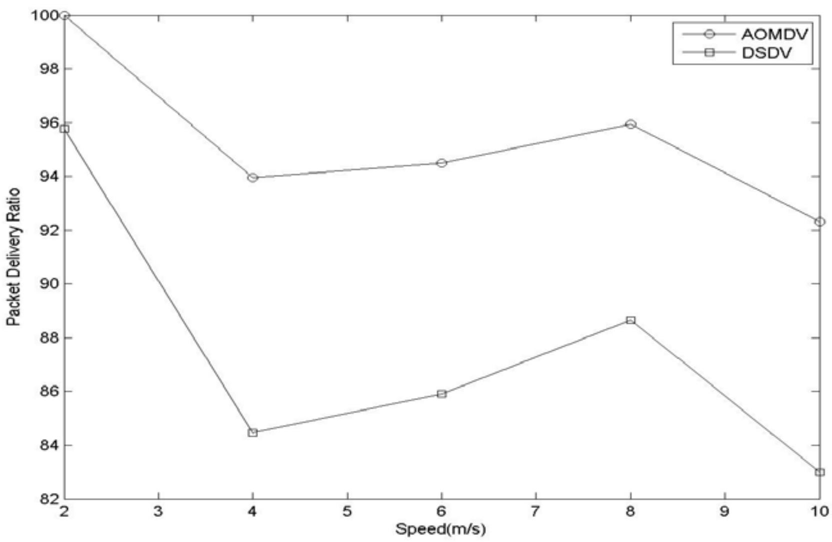

Figure 5. PDR versus Speed

2) End to End Delay: In case of delay a change is noticed in Fig. 6 as comapred to pause time model.As the speed of node is varied from 2 to 10m/sec the delay shown by AOMDV protocol is lower than the DSDV protocol.But we noticed in precious model that AOMDV shows more delay than the DSDV.There is great variation in the result.

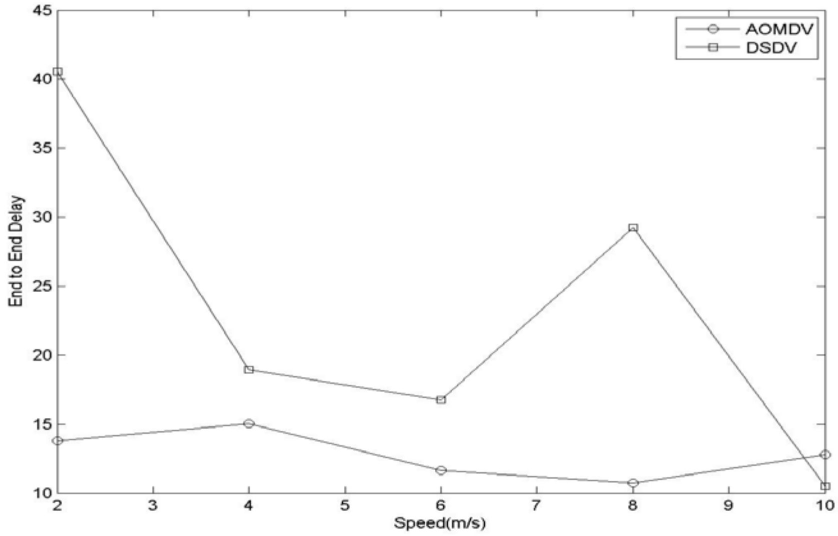

Figure 6. Average Delay Versus Speed

3) Normalized rouitng loady: From Fig.7 it is clear that AOMDV has more normalized routing load as compared to the DSDV on varying maximum speed of moving node. As AOMDV is the multipath routing protocol so as the link breaks it starts searching for new path for the packet delivery by flooding the request packets so Normalized routing load is more in AOMDV as compared to DSDV.

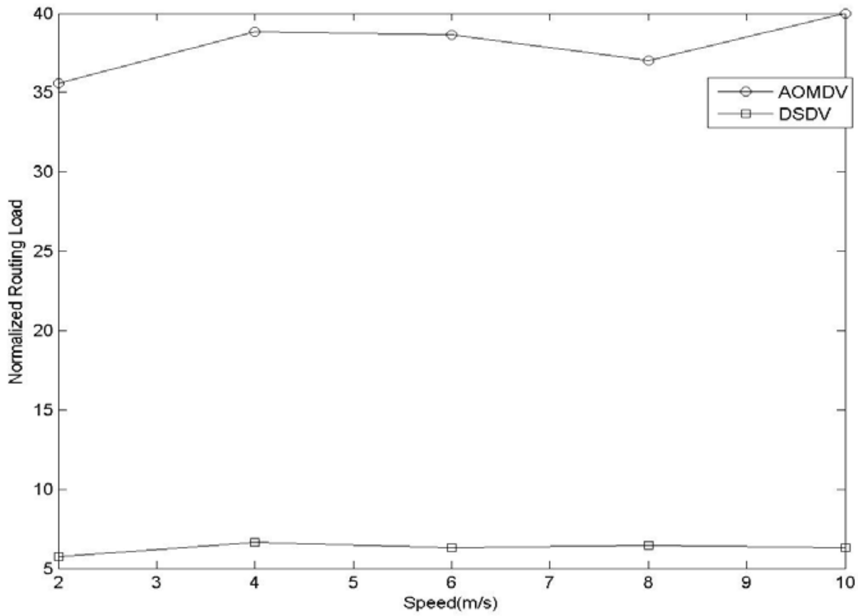

Figure 7. Normalized Routing load Versus Speed

V. CONCLUSION

This paper evaluated the performance of AOMDV and DSDV routing protocol using ns-2.35.Comparison was based on packet delivery ratio, normalized routing load and average end to end delay .we conclude that AOMDV performs better than DSDV in both models when it comes to packet deliver ratio. In case of average end to end delay DSDV gives better result when pause time is varied but a different result is obtained on varying maximum speed of nodes, that is AOMDV performs better .When normalized routing load is evaluated DSDV performs better in both models.

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REFERENCES

[1] H.D.Trung, W.Benjapolakul, P.M.Duc, “Performance evaluation and comparison of different ad hoc routing protocols”, Department of Electrical Engineering, Chulalongkorn University, Bangkok, Thailand, May 2007.

[2] Nitin H. Vaidya,”Mobile Ad Hoc Networks: Routing, MAC and Transport Issues”, University of Illinois at Urbana-Champaign, Tutorial presented at: INFOCOM 2004 (IEEE International Conference on Computer Communication).

[3] M.K.Marina and S.R.Das, “On-Demand multipath distance vector routing in ad hoc networks” in: Proceedings of the 9th IEEE International Conference on Network Protocols (ICNP), 2001.

[4] T.Fujiwara, T.Watanbe, “An ad hoc networking scheme in hybrid networks for emergency communication”, Information Technology Lab, Eugene Co. Ltd, Hamamatsu, Shizuoka, Japan

[5] Network Simulator version 2 (NS-2) webpage. Available at: http://www.isi.edu/nsnam/ns, accessed at May 1st, 2010.

[6] P.P.Pham, S.Perreau, “Increasing the network performance using multi-path routing mechanism with load balance”, Institute of Telecommunications Research, University of South Australia,Australia, September 2003.

[7] C.S.R.Murthy, B.S.Manoj, Ad hoc Wireless Networks, Architecture and Protocols, 6th Edition.

[8] C.E. Perkins & P. Bhagwat, “Highly Dynamic Destination Sequence-Vector Routing (DSDV) for Mobile Computers”, Computer Communication Review, vol. 24, no.4, 1994, pp. 234-244.

[9] D. Kim, J. Garcia and K. Obraczka, “Routing Mechanisms for Mobile Ad Hoc Networks based on the Energy Drain Rate”, IEEE Transactions on Mobile Computing. Vol 2, no 2, 2003, pp.161-173

[10] The *ns* Manual, formerly *ns* Notes and Documentation.