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A Comparative Exploration and Analysis of AODV, DSDV and DSR for MANET

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Abstract – Collection of mobile nodes forms Mobile Ad hoc network. It has the property to change according to changing topology due to the lack of centralized control. The nodes act as a sender and receiver both and communicate with each other through various protocols. Thus there is a need to analyse the pre-existing MANET protocols to find the best suited one for the application purpose. As in paper [1] we have also analyse and simulated the three protocols namely Ad hoc On-Demand distance vector (AODV), Dynamic source routing (DSR) and Destination sequenced distance vector routing (DSDV) on various parameters as specified and analysed in [1] and we have analysed and simulated the protocols on parameters such as energy, speed and pause time which were not defined in paper [1].

Keywords- MANET, Routing protocol, AODV, DSDV, DSR

I. INTRODUCTION

MANET is a collection of independent mobile nodes that can communicate to each other via radio waves shown in Figure 1.Thus there is no centralizes control .Every node act as a client, server and router. The other nodes in the network helps source to find the path to destination. MANET's are mainly useful at the places where the communication cannot be done easily or through the wired networks [1]. This is one of the main advantages of using MANET. Due to the lack of centralised control, topology of the network is undefined .Therefore we need such routing protocol that can work even in the changing topology. There are many predefined routing protocols available. Some of these are AODV, DSR, DSDV. We have simulated these protocols on NS2.34 and have examined the results on various parameters. MANET provide less security as compared to wired networks due to moving nodes. Power consumption becomes considerable due to changing topology. There is limited bandwidth available. The area or zone within which a node can send the data is limited.

MANET protocols are of different types like table driven and on demand. In table driven, each node maintains a routing table for the whole network. A periodic update is done so that any change in the topology can be forwarded to all the nodes in the network. This is basically done through flooding technique that is the each node sends the copy of its routing table to all the nodes in the topology [1]. Thus if any node wanting to send the data, runs an appropriate path finding algorithm. Some already present algorithms like link state and distance vector are not suitable for wireless networks due to the changing topology in ad-hoc networks. While in on demand protocols, route is found only when they are needed. When sender wants to send the data then route discovery is done. Due to this large control message is send to discover the route. Example of such type of algorithm is DSR and AODV. This algorithm is better than proactive algorithms due to less overhead to maintain routing information while it lacks behind proactive due to the large control message traffic.

The protocols considered for simulation are AODV, DSDV and DSR.AODV protocol is one of the reactive protocol, the route is determined only when source wants to send message to destination. It has combined property of DSR and DSDV. The property of sequence number is acquired from DSDV. To find a new route to destination, source broadcast RREQ message. Route is determined if either RREQ reaches destination or one of the intermediate node[2]. The destination on receiving the packet sends RREP message to the source .The unicasting is done in this case .Each intermediate node cache the information .AODV has the property of link beak detection. If any node does not get the control packet from its neighbours the link is said to be broken. A RRER packet is flooded to notify all nodes about the broken link and again path discovery is done to find the alternate path.

DSDV is the proactive protocol based on distributed Bellman ford algorithm. Each node has routing table which maintain list of all possible destination and the number of hops to reach the destination. This table is constructed at the time of route finding. Sequence number is generated by the destination node [2]. The node sequencing minimizes the looping in the route. The table is updated periodically, due to this control message, lot of traffic is generated. This minimizes the efficient utilization of network. DSDV have the property of maintaining only single path to the destination instead of multiple path [3]. Thus reduces the size of space required for storage at each node but avoiding the multi path routing.

DSR is a pure reactive routing protocol. DSR does not use hop to hop route finding method. This reduces the traffic in the network. The source nodes already have the route to the destination [3]. The packet being transferred contains the entire intermediate node from source to destination. Thus it uses same nodes as the intermediate nodes to the destination. There is no periodic route advertisement packet in the network. Initially RREQ is used to determine the path shown in Figure 2. On receiving the packet, node checks its cache to check whether the route to destination is present already or else it will ask the neighbour. If not then it will add its own address to the RREQ packet and forward it to their neighbour. A RREP (route reply packet) is generated that is sent back to the source. The DSR supports multiple paths to destination thus providing robustness to the networks [8].

MANET has certain application in various fields like military to maintain synchronization among vehicles, soldiers and head quarter. In rescue operations due to natural disaster. As bandwidth of MANET is very less therefore it can be easily used to create Personal Area network.

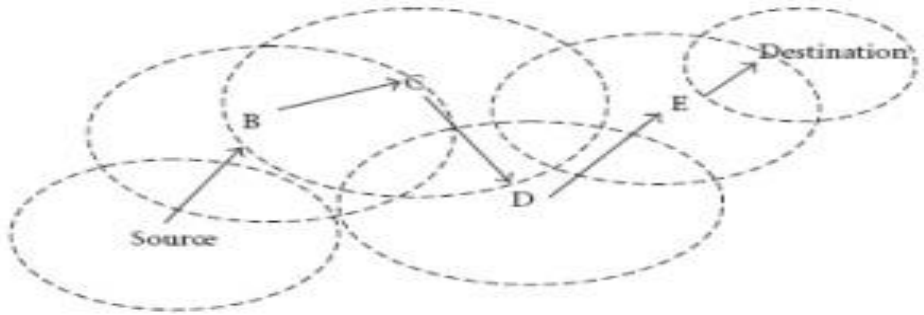

Figure 1: Mobile Ad Hoc network

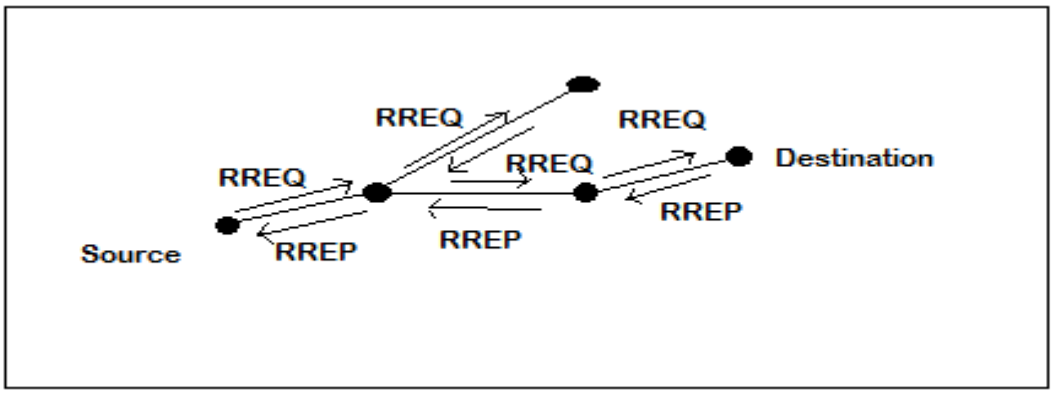

Figure 2: Route discovery in AODV and DSR

II. LITERATURE REVIEW

V.Ramesh, Dr. P.Subbaiah, N. Koteswar Rao, and M.Janardhana Raju [1], found packet delivery ratio of AODV to be independent of sources while it suffers from end-to-end dely. Whereas DSDV packet delivery fraction is very low for high mobility scenario. They conclude in this paper that AODV is the ideal choice for communication when the communication has to be happened under UDP protocol as the base.

Singh Annapurna, Mishra Shailendra [2] have done detail analysis of the performance of MANET protocol as AODV,DSR and TORA based on some important matrices such as traffic sent and received, route discovery time and number of hops per route, load and throughput is calculated. Authors have shown the result that AODV and DSR preforms better than TORA and AODV performs better than other protocols in all respects.

V.K.Taksande, Dr. K.D Kulat [3],studied three protocols DSR,AODV and DSDV and simulated them using CBR traffic .Packet delivery ratio, average end to end delay and routing overhead under changing number of nodes has been considered as parameter. Authors have found that DSR outperforms other protocols in terms of end to end delay and dropped packets. While AODV outperforms in average end to end delay.

Ajay Kumar, Ashwani Kumar Singla [4] have studied the three MANET protocol namely DSDV, AODV and DSR and evaluated the performance based on TCP traffic pattern. They found that DSDV performs better as compare to AODV and DSR in terms of TCP traffic pattern. And also concluded that performance of these three MANET protocols is more affected while subject to change in pause time than change in number of connections.

Nishi Yadav, P.M. Khilar [5], simulated the protocol in MATLAB.The experiments were conducted for the network of varying sizes of 8, 16, 32, 64,128 nodes. Authors have taken Diagnostic Latency, Message Complexity, and Hop Count Ratio as parameters and observed that the diagnostic latency depends on number of messages exchanged and the network parameters such as transmission and propagation delay and directly proportional to the number of messages exchanged in the network to achieve diagnosis. They have proposed a hierarchically adaptive distributed diagnosis algorithm for diagnosing crash and value faulty nodes in MANET based on Hi-ADSD.

Santosh Kumar Soni [6], found DSDV protocol to be best protocol under small scale considering horizontal and vertical Topology. CBR traffic has been considered for simulation. Packet size has been taken as 1000 bytes.

Prof. B.N. Jagdale, Prof. Pragati Patil, Prof. P. Lahane, Prof. D. Javale [7], found AODV to be better than DSDV because DSDV consumes more bandwidth as it is proactive protocol while on AODV there is no need to maintain route table which results in less bandwidth consumption . DSDV performs well in small network while AODV performs well in large network. And the throughput of DSDV is lee than AODV.

Ammar Odeh, Eman Abdelfattah, Muneer Alshowkan [8], studied the two MANET reactive routing protocol namely AODV and DSR. DSR has shown better performance in terms of packet size less than 700 byte.

K. Prabu , Dr. A. Subramani [9] ,have simulated the AODV,DSR and TORA protocols on the basis of parameters such as high mobility high traffic and low mobility and low traffic .In case of low mobility low traffic author have found DSR and AODV to have low routing overhead average end to end delay and high Packet delivery ratio and in case of high mobility high traffic ,average routing overhead ,end to end delay and packet delivery fraction ,and AODV to have very high routing overhead .

V.Rajeshkumar, P.Sivakumar [10], showed the performance of three routing protocol of MANET namely DSDV, AODV and DSR. They found that AODV has best performance in network having large number of nodes, while DSR performance is better when the number of nodes is slight. Also they found that average end-to-end delay of DSDV is minimum and does not increased with the nodes.

Kumar Prateek, Nimish Arvind, Satish Kumar Alaria[11], evaluated the performance of the three routing protocol namely DSDV,AODV and DSR and found that reactive protocol performs well in high mobility scenario than proactive. The final result of this paper is DSR has performed well compared to all other protocol in terms of Delivery ratio while AODV performed well in terms of average delay.

Nabil Nissar, Najib Naja, Abdellah Jamali [12], have studied and compared DSDV, DSR, AODV, OLSR protocols taking number of nodes as 30 and found the results that no protocol

outperforms other in terms of all parameter. DSDV gives best end to end delay while DSR and AODV gives better throughput and packet delivery fraction.

Nidhi Singh, Ajay Kumar, Chandra Prakesh Sahu [13],in their paper have taken AODV, OLSR and ZRP for simulation. CBR traffic has been considered under Two Ray ground model .Simulation has been done by varying number of nodes and pause time .Authors have found average throughput of AODV as best .

Ashraf Abu-Ein, Jihad Nader [14], proposed a new protocol PH-AODV. It is modified version of AODV which combines the power coefficient and the hop count parameter to improve the performance of AODV. The new protocol is better than AODV in terms of throughput, end-to-end delay and number of drop packets.

Charles E Perkins, Pravin Bhagwat [15], have explained the internal working of DSDV protocol.

III. PROPOSED WORK

DSR, AODV, DSDV protocol has been considered for simulation. Software used for the simulation is NS2.34, gawk, and NSG2.1. NSG2.1 has been used for creating the .tr file. The .tr file has been run on NS2.34.NS2.34 already contain the protocol that has been used for the simulation. The trace file generated form this simulation has been read using GAWK. Changing environment has been considered for every simulation. Changing the no of nodes, changing the packet size, changing speed, changing pause time and then energy has been considered for the simulation. No of nodes taken is 20, 30, and 40. And packet size taken as 500, 750, 1000 bytes. Transport layer protocol that has been used is UDP and application taken is CBR. Simulation has been done for 500 seconds. After simulation packet delivery ratio, end to end delay, throughput, Routing Overhead and energy left has been calculated considering the following definition.

1) ***Packet delivery ratio:*** It is the ratio of packet delivered to the destination to the packet generated from the source. This parameter determines how well any protocol works in delivering the packet.i.e. it shows how many packets has been lost by the protocol while transmitting the data.
2) ***Average end to end delay:*** Packets are transferred to the destination with some delay. These delay may be due to queuing the packet in the queue, retransmission delay due to packet loss, transmission and propagation delays. The averages of all these delays are calculated.
3) ***Energy loss:*** Energy of the nodes is lost due to several factors like idle time, movement time, transmission time etc. The final left energy of the nodes is considered.
4) ***Throughput:*** It is the number of bytes received by the receiving node per unit time. As packet may get lost during transmission, it is one of the parameter which measures the efficiency of the protocol.
5) ***Routing Overhead:*** Number of Packets generated during route finding except the CBR packets.

For the simulation part we have considered [1] as our base paper. We have defined the energy parameter that was not defined in that paper. We have calculated the performance of the DSDV, DSR and AODV protocols and found the results on different parameters .The simulation environment have been shown in TABLE 1.

TABLE 1

Simulation environment

Simulator	NS 2.34
Protocols	AODV,DSDV,DSR
No of Nodes	20,30,40
Speed	70,80,90 m/sec
Pause time	2,4,6
Topology	Random
Simulation time	500 sec
Traffic type	CBR
Propagation model	Two ray ground
Max packet in queue	50
Initial Energy	800.4J
Packet Size	500,750,1000 Bytes
Time Interval	0.005 sec

Results

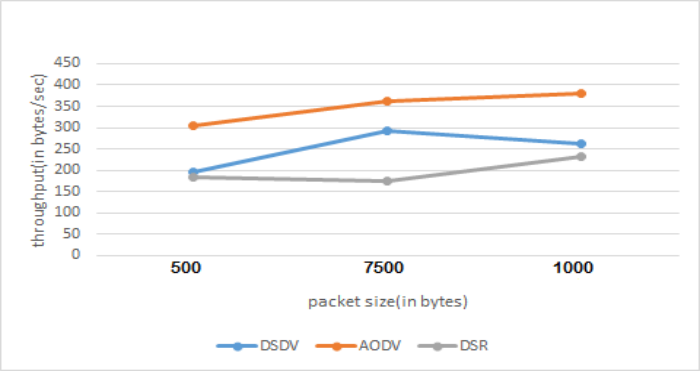

Figure 3: Throughput with varying packet size

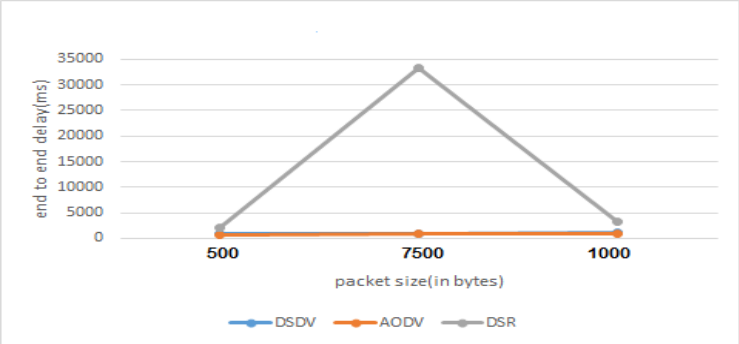

Figure 4: End to end delay with varying packet size

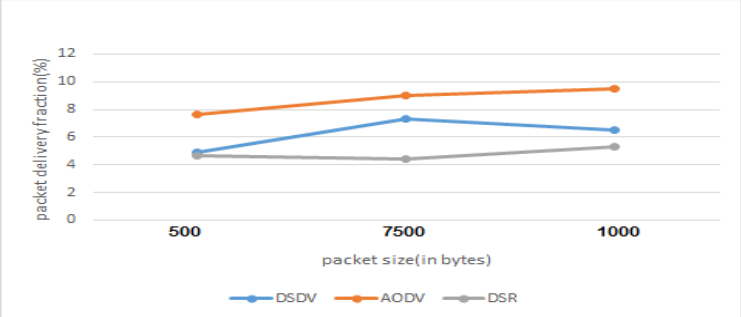

Figure 5: Packet delivery fraction with varying packet size

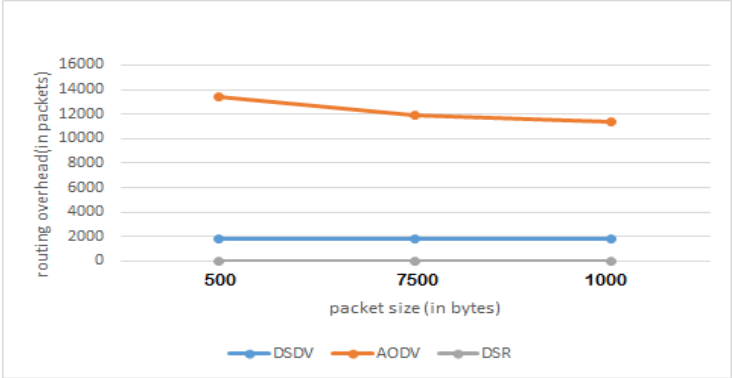

Figure 6: Packet delivery fraction with varying packet size

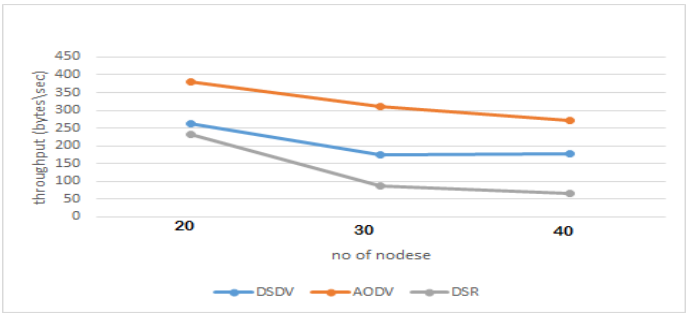

Figure 7: Throughput with varying no of nodes

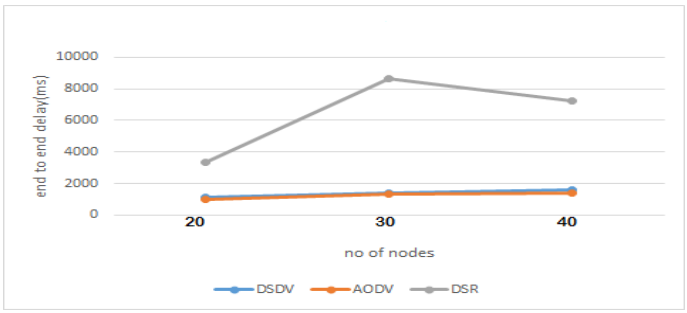

Figure 8: End to end delay with varying no of nodes

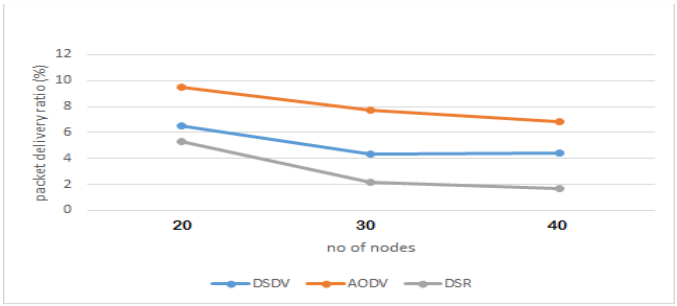

Figure 9: Packet delivery fraction with varying no of nodes

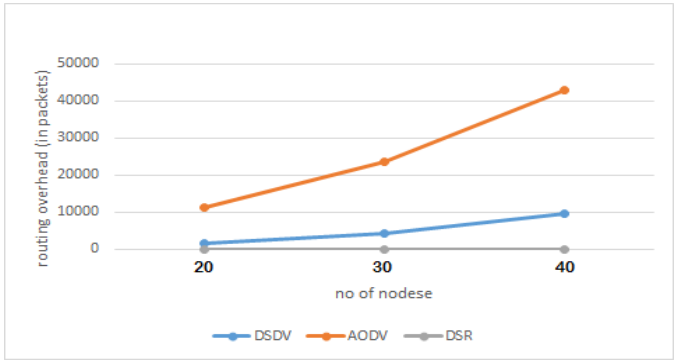

Figure 10: Routing Overhead with varying no of nodes

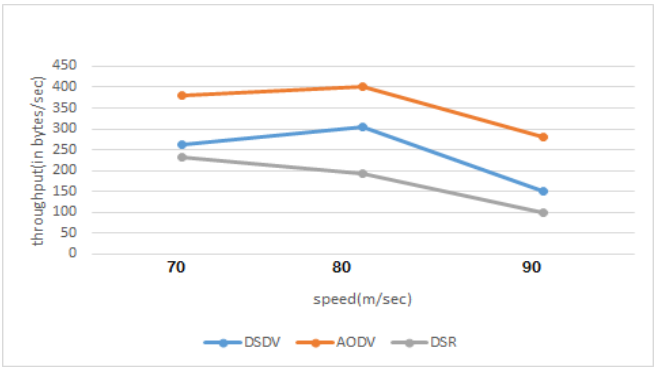

Figure 11: Throughput with varying speed

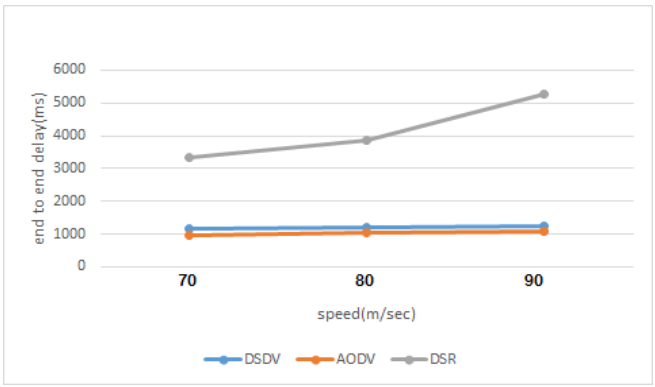

Figure 12: end to end with varying speed

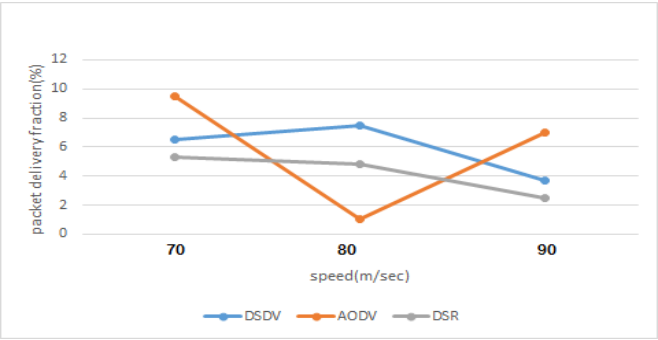

Figure 13: Packet delivery fraction with varying speed

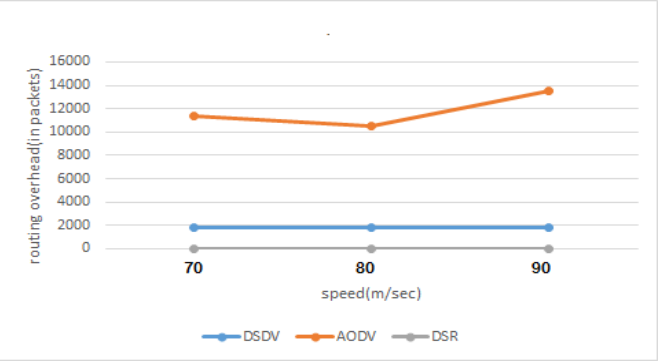

Figure 14: Routing Overhead with varying speed

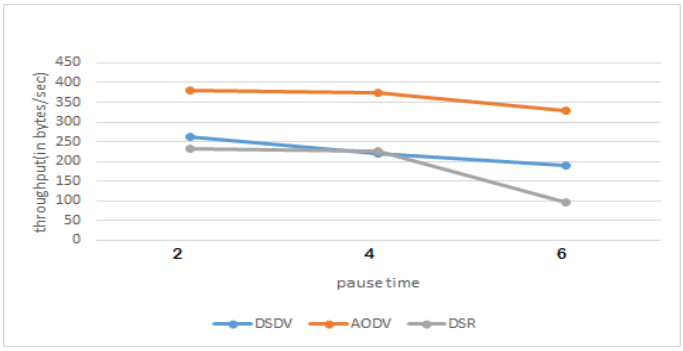

Figure 15: Throughput with varying pause time

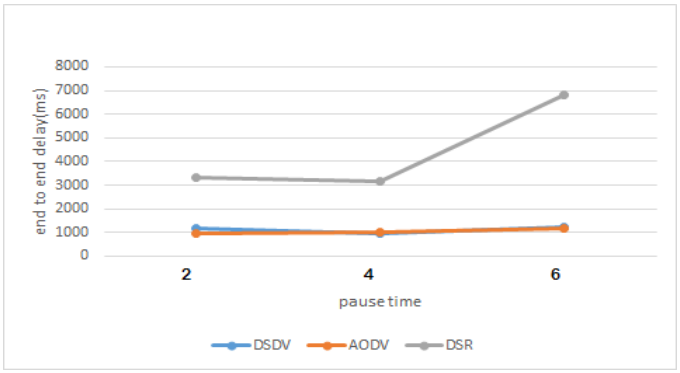

Figure 16: end to end delay with varying pause time

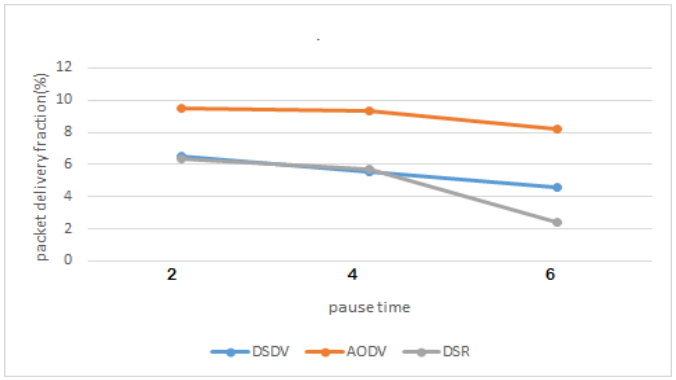

Figure 17: Packet Delivery Fraction with varying pause time

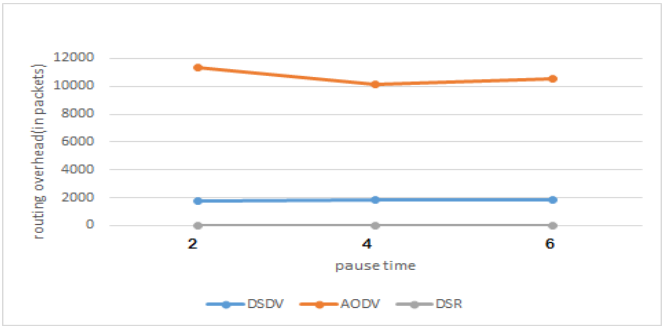

Figure 18: Routing Overhead with varying pause time

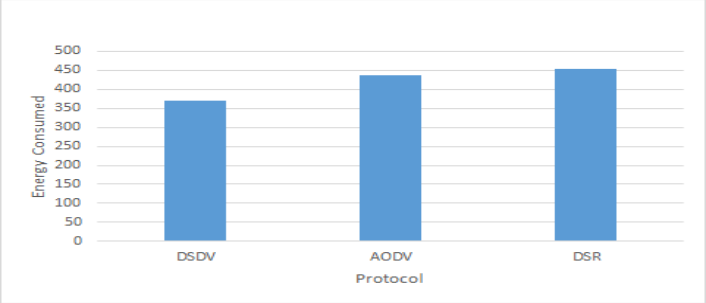

Figure 19: Energy consumed in simulation

TABLE 2

Characteristics comparison of AODV, DSR, and DSDV

Category	**DSDV**	**DSR**	**AODV**
Energy efficient	Yes	No	No
Throughput	Average	Low	Highest
End to end delay	Average	Highest	Low
PDF	Average	Low	Highest
Routing Overhead	Average	Low	Highest

Combining all the varying parameter we found that AODV gives highest throughput, DSDV gives average while DSR gives least throughput, shown in Figure 3, 7, 11, 15. From Figure 4, 8, 12, 16, we found that AODV gives lowest end to end delay, DSR gives highest end to end delay and DSDV gives average end to end delay. Figure 5, 9, 13, 17 gives the result of packet delivery fraction. It can be found that AODV gives highest Packet delivery fraction, while DSR has the least. DSDV gives average result in this case. Figure 6,10,14,18 gives the result of routing overhead of the protocols under consideration. The graph shows that AODV gives highest Routing Overhead while DSR has least .DSDV again gives average result. In case of energy consumed by each protocol, shown in Figure 19, DSDV gives the best result. Energy consumption by DSR and AODV is almost same but more than DSDV.

IV. CONCLUSION

After analysing the result we have concluded that DSDV is more energy efficient than DSR and AODV.AODV gives the best throughput as compared to DSR and DSDV.DSDV gives the least throughput. DSR has highest end to end delay and least Packet delivery fraction as compared to other protocol under consideration. AODV have highest Routing Overhead and DSDV have average overhead. Thus DSDV can be used as a best protocol considering average values for the parameter shown in TABLE 2. In future we will propose a better protocol combining the best properties of these protocols.

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