A Critical Analysis of Performance Evaluation of Packet Delivery in MANETS

Noufal. K. P[1], Dr. A. Yesu Babu[2]
[1]*Research & Development Centre, Bharthiar University, Coimbatore*
[1]*N.A.M. College, Kallikkandy, Kannur, Kerala*
[2]*Professor & Head, Department of Computer Science & Engineering, Sir C.R. Reddy College of Engineering, Eluru, Andhra Pradesh*

Abstract - Ad-Hoc networks are wireless networks in which devices share information with each other using multi-hop links. There are lots of protocols developed for accomplishing this task. In MANETS there is no base station or internet involved in forwarding of data which decides the path through which the data will be forwarded. Every node in MANET acts as a router for forwarding the data. The biggest challenge involved in MANET is routing; that is how data is forwarded from source to destination node. The main objective is to analyze the performance reactive protocol AODV, DSDV and DSR. Simulation is done under CBR (constant bit rate) traffic so the performance of these protocols is best evaluated under this traffic. The impact of this work will be helpful for choosing which protocol is best under different circumstances lets at the increasing of nodes which protocol performs best also placement of the nodes at different distances i.e. 400x400m2 which is categorize as small, 700x700 m2 which is medium and 1000x1000 m2 which is specifies as large coverage area.

Keywords - *Ad hoc on Demand Distance Vector Routing Protocol (AODV), Destination sequenced Distance Vector (DSDV), Dynamic Source Routing (DSR)*

I. INTRODUCTION

Wireless networking is an emerging technology that will allow users to use and access many kind of information and services electronically, regardless of their geographical position. In the modern era especially in the current decade the use of mobiles by the users while communicating wirelessly has become increasingly popular due to the advancement in wireless technologies. This current advancement has also led to lower price while delivering high data rates, which are also the two main reasons of the increasing popularity of mobile computing. Ad-hoc networks are also beneficial in a way that are independent of infra structure which is pre-established so it can be deployed in areas with no such facility. Similarly many conferences can also be conducted easily which use only temporary network and preexisting network is unreliable.
Mobile Ad-Hoc Networks (MANETS) is a multi-hop network and has emerged as one of the most promising network. The most attractive feature of MANETs is that it does not need a network infrastructure. A MANET network is formed when a large number of mobile devices work together to communicate with each other without support of any base station, router or any other external framework. In a MANET network the nodes are mobile and these mobile nodes configure themselves based on the information they receive from the neighboring nodes and all this process is carried out without the need of a base-station. It is critical for mobile nodes to be able to determine the path using which the nodes are to forward the packets from source to destination and most importantly all this has to take place in the absence of any base-station. Hence to ensure efficient data transmission the routing scheme used in such networks is quite important to be understood.

A. MOTIVATION

Mobile ad-hoc network (MANET) is similar to simple ad-hoc networks but differ in terms of mobility and architecture. In a MANET nodes are mobile and can move randomly in any direction while still being able to efficiently communicate with other nodes. In such a network the base station and the mobile nodes should not necessarily be connected to each other instead the base station can communicate with a node over multiple hops. Such networks find their application in vehicular networks where vehicles are mobile and still able to communicate with each other as shown is Figure 1.

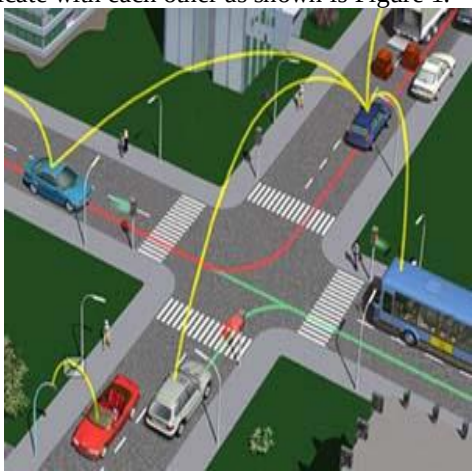

Fig.1: A mobile vehicular network

Multi-hop Cellular Networks can be classified as a class of MANET. In such a network as evident by the name communication between base station and mobile cell phone takes place over multi-hops instead of a single hop.

B. PURPOSE

In the field of wireless communication, wireless Ad-Hoc networks have received a lot of attention. The nodes in Ad hoc networks act as router and forward the data to each other intelligently so that data can reach to destination node. Due to mobility of nodes in these networks routing is highly complex job and hence many protocols have been developed. There are many protocols that have been proposed, implemented, and evaluated. The aim of our project is to evaluate the three different protocols specifically (DSR, DSDV, and AODV) by using the NS-2. The three different protocols will be implemented by varying the number of nodes and other such parameters to evaluate the final result. Simulation analysis will be conducted to investigate the performance of DSR. DSDV, AODV routing protocols for different networks like the small network which will consist of about 200 nodes, medium network consisting of about the 300 nodes and large network consisting of about 400 nodes and analyze their effect on the parameters like average throughput and packet delivery ratio.

II. LITERATURE SURVEY

This section briefly outlines the existing performance comparison of Ad-Hoc routing protocols. In [1] the authors compared performance of three routing protocols that are DSDV, AODV, and DSR. Furthermore, it is observed that AODV among all performs better due to its reactive nature. In [2] another comparison of different routing protocols both for (reactive and proactive) of mobile Ad-Hoc network is presented. The simulations for both the routing protocols were done through network simulator (ns-2).The protocols AODV and DSDV were tested for TCP congestion. Another performance evaluation is done in [5]. According to [5] the basic and the primary characteristic that differentiates the Ad-Hoc network from other guided or unguided network is mobility discussed in detail. In this article the researcher performs the comparison between different routing protocol that are AODV, DSDV, DSR and OLSR against different mobility models. Some other [3, 4] have also been evaluated the performance of aforementioned MANET routing protocols. Also, a recent research paper [6] present a depth simulation analysis to investigate the performance of different MANET protocols mostly AODV, DSDV and DSR where the UDP is used as a transport protocol and for traffic generator they used CBR. The result of the article showed that reactive DSR and AODV perform best than proactive protocols DSR and DSDV.

AODV [7], AODV is reactive in nature and an energy efficient protocol best suited for large networks. It is on demand routing algorithm which means that whenever the node needed a node it built a route.

A. CLASSIFICATION OF DYNAMIC ROUTING PROTOCOLS

The Classification of dynamic routing protocols are depends on what router tells their neighbors routers and the usage of information for forming their routing tables. They are known as distance vector protocols and link state protocols in these two categories mostly one is fitted in the network [3].

B. CLASSIFICATION OF ROUTING PROTOCOLS IN MANET's

The classification of routing protocols in Mobile Ad hoc Networks are done according to network structure and routing strategy [10, 11].. In the case of routing strategy the routing protocols are diving in to source initiated and Table driven routing protocols. The routing protocols depending on network structure can be called as hierarchical routing, geographic routing, assisted routing and flat routing [10]. The source initiated and Table-drive both comes under the category of flat routing.

C. TABLE DRIVEN ROUTING PROTOCOLS [PROACTIVE]

Proactive routing protocols have the ability to maintain the routing information whenever they need it [12]. Every node has its updated routing table in which the information of its neighbor and every other node is stored. The routing information is periodically updated after a certain amount of time. These routing protocols come under the category of link state routing [10]. There are certain differences between certain routing protocols that come under this category due to routing information being updated .The drawback of proactive protocols is that these are not suitable for large networks because maintaining routing table for a lot number of nodes is very difficult. Congestion can arise in the networks and bandwidth is not utilized efficiently. So these kind of routing protocols are good for small networks.

D. ONDE*MAND ROUTING PROTOCOLS [REACTIVE]*

This category of routing protocol does not have to update the periodic table after a regular interval so the problem of congestion can be solved in this category of routing. The nodes search for a route on demand whenever it wants to send the packet to destination node. The process of route discovery occurs by flooding the route request packets in the network. So in this category of routing is done on demand and the problem of congestion is improved [11].

III. METHODS

A wireless ad-hoc network is a temporary network of mobile nodes independent of any preexisting infra structure. Each node communicates through radio or infrared. Laptop computers and personal digital assistants are examples of this network as they that communicate directly with each other. These nodes can be mobile, semi mobile or stationary. Ad-hoc network can be categorized into the many protocols like given in the figure 2:

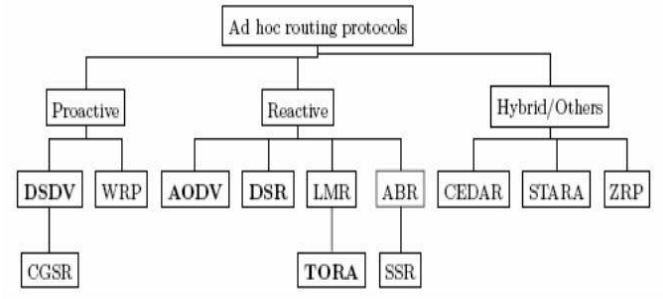

Fig.2: Categorization of the ad-hoc network protocols

A. Ad Hoc ON-DEMAND DISTANCE VECTOR PROTOCOL (AODV)

AODV is reactive in nature and an energy efficient protocol best suited for large networks. It is on demand routing algorithm which means that whenever the node needed a node it built a route. It uses different messages from source to destination i.e. route request (RREQ) and from destination to source i.e. route reply (RREP). Whenever, a source node wants to send a data a RREQ is caused. This RREQ packet contains IP address, current sequence number (SN) of destination node. This message will be passed through different nodes and routes and reaches to the destination node. The path which is followed by the message to reach to the destination is recorded into the message. Then this message is send back to source node from the destination node the process is known as root reply (RREP) which contain different routes information, from which the shortest path will be chosen by the source node. If in case the link failure occurs in AODV than it uses the route error (RERR) message which is send to source and destination. In AODV nodes will always choose a route of greater sequence number to communicate with the destination.

B. DYNAMIC SOURCE ROUTING PROTOCOL (DSR)

Dynamic Source Routing is a reactive routing protocol. DSR protocol uses a source routing technique rather by making decisions by each node. In this protocol, DSR can create a route with request if require route is not already current. In source routing, the network transmits the complete well-ordered list of nodes through which the packet has to pass. DSR uses two mechanisms: "Route Discovery and Route Maintenance". In order to deliver a data packet from source to destination the nodes checks for the pre-establish route. If not found the node transmits request message which is obeyed by all intermediate nodes within the range. Once a new route is established and recognized by the nodes, signals are sent and node function by following this new route to reach the destination.

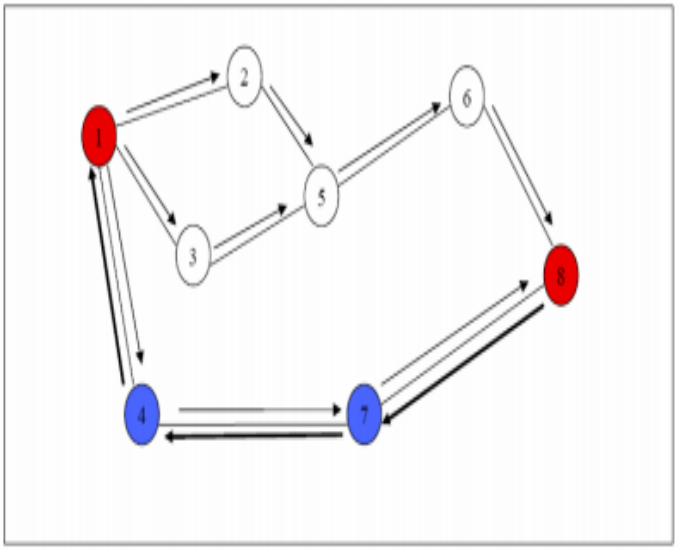

Fig.3: AODV Route discovery

C. DESTINATION SEQUENCED DISTANCE VECTOR (DSDV)

DSDV was one of the early available algorithms suitable for creating ad hoc networks with a small number of nodes. The main feature of DSDV is that it requires its routing tables to be updated regularly; this uses the battery's power and a small amount of bandwidth, even when the network is idle. DSDV is not suitable for highly dynamic networks because whenever there is a change in topology, the connection needs to be re-established. This, in turn, requires a new sequence number to be generated. The transmission of packets from one node to another is accomplished according to the routing table. The routing table, maintained by each node, has an entry for each of the nodes of the network. This protocol guarantees loop-free paths. Instead of maintaining multiple paths to every destination, DSDV maintains only the best path available to the destination, thus reducing the amount of space of the routing table. If any node detects that a particular route to a destination node is broken, then its hop number is set to infinity and the sequence number is updated. This shows that there is freshness of route in this protocol".

IV. RESULTS

Different routing protocols are reviewed and then selected three routing schemes from the existence literature of MANET network i.e. DSDV, AODV, and DSR. These

protocols are known as reactive routing protocols. The simulator used for analyzing the above routing protocols is NS2 (Network Simulator).This simulator is used for simulation and modeling of wireless networks. The first step is to install the NS2 (Network simulator) on Linux or Ubuntu. After installing the NS2 the three different routing protocols patches will be configures and will be analyzed under Constant Bit rate traffic by doing programming in NS2.

A. SMALL SIZED NETWORK

All the networks are categorically divided according to the number of nodes. The small network has about 200 nodes while the medium network has about 300 nodes and the large network has about 400 nodes in the network. The small sized network considered consists of about 200 nodes with random motion of some of the nodes in the network. A snapshot of the small sized network during the simulation is shown in the figure 4.

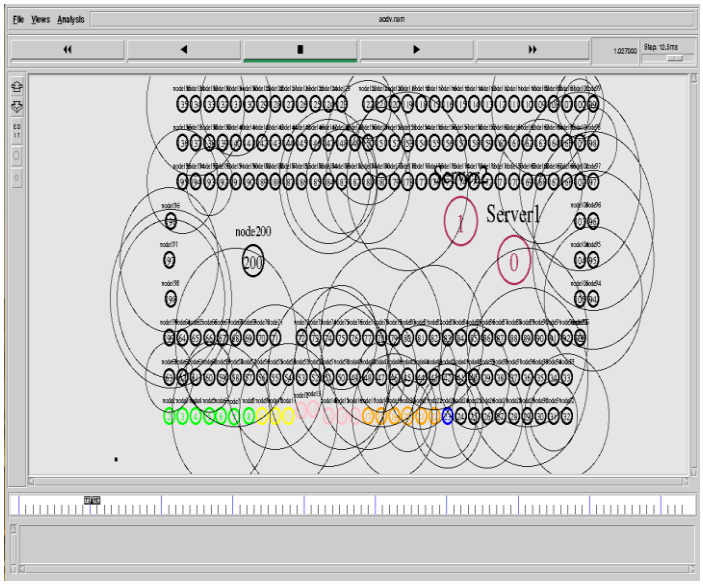

Fig4: Small Sized Networks

B. MEDIUM SIZED NETWORK

All the networks are categorically divided according to the number of nodes. The small network has about 200 nodes while the medium network has about 300 nodes and the large network has about 400 nodes in the network. The medium sized network considered consists of about 300 nodes with random motion of some of the nodes in the network. A snapshot of the small sized network during the simulation is shown in the figure 5.

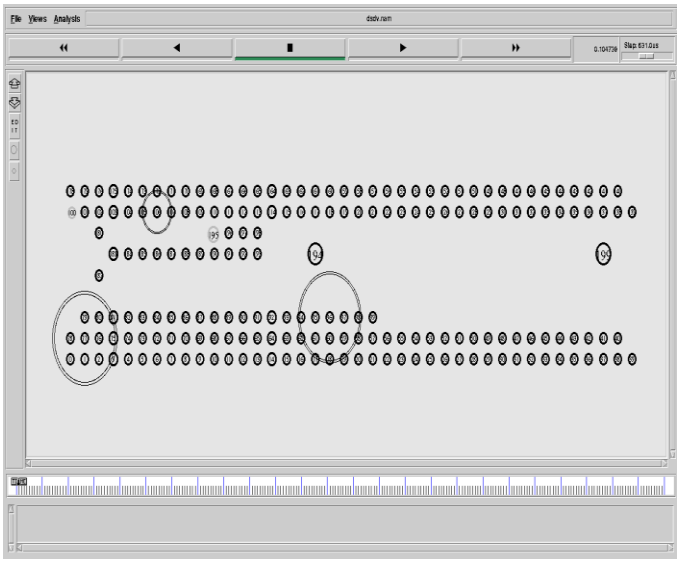

Fig.5: Medium sized network

C. LARGE SIZED NETWORK

All the networks are categorically divided according to the number of nodes. The small network has about 200 nodes while the medium network has about 300 nodes and the large network has about 400 nodes in the network. The Large sized network considered consists of about 400 nodes with random motion of some of the nodes in the network. A snapshot of the small sized network during the simulation is shown in the figure 6.

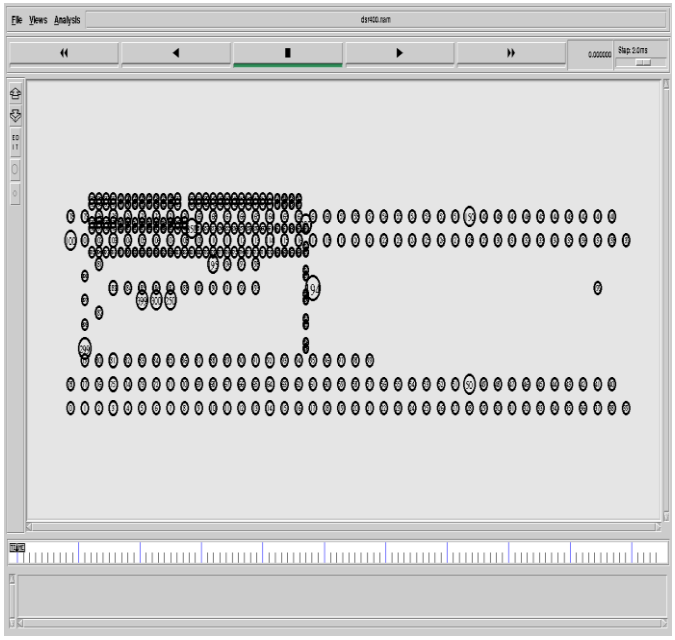

Fig.6: Large sized network

D. PERFORMANCE ANALYSIS

VARYING SPEED

The numbers of nodes are still kept fixed at 50 while the speed is varied and the parameters are compared for varying speeds. Table 1 shows all the parameters for this scenario. In order to consider case of max mobility the pause time is set to 0. The results are than replicated for varying speed and comparison is performed.

TABLE 1: SIMULATION SETUP

Parameters	Value
Simulation Time	200 seconds
Environment Size	670 x 670
Packet Size	512 bytes
Traffic type	CBR
Packet rate	4 packets/second
Mobility model	Random Way-point model
CBR sources	10
Maximum Speed	1, 2, 5, 10, 20, 50 m/s
Pause Time	0
Protocols	AODV, DSR, DSDV, OLSR
Number of nodes	50

Packet fraction is calculated for varying speed and from the results it is observed that DSR outperforms all other schemes in this case too for all values of speed and shows a packet reception rate of 100%. AODV's shows close performance of approx. to 98%. DSDV shows 96% performance but it degrades significantly with increasing speed the reason being the connection failures and link changes becoming more frequent. The ratio drops to as low as 51% on high speeds.

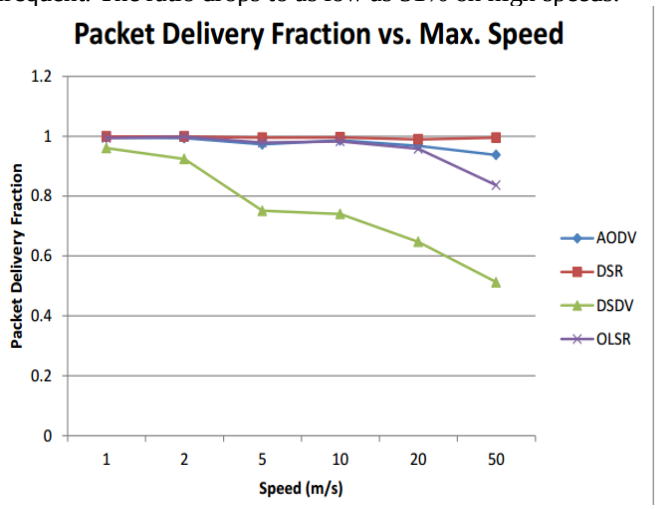

Fig.7: Packet Delivery Fraction

Figure 8 shows the packets dropped by varying speed. It is observed that DSR outperforms other schemes as the number of packets dropped for DSR is lower as compared to other schemes and is maintained for all speed values. It is found that performance of AODV and OLSR is better for small speed values but degrades as speed is increased. The number of packets drop for DSDV are quite high and as high as 4000 for a max speed of 50 meter/second.

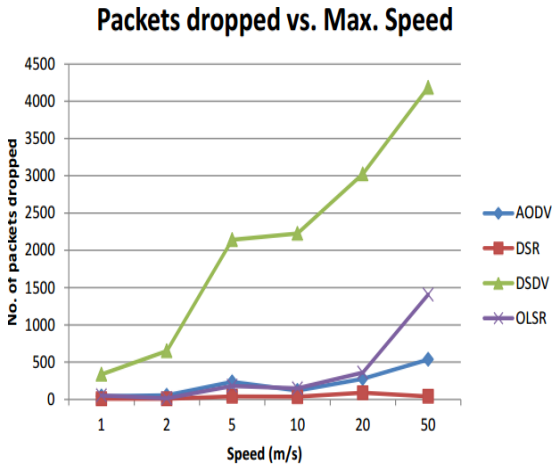

Fig.8: Packets dropped by varying speed

The results from the figure show clearly that here DSDV is once again performing better than the rest of the two protocols and is followed by the DSR protocol. It means that DSDV performs better in all of the three cases for the average throughput of small network, medium network and for the large network. For the smaller network which comprises of about 200 nodes the packet delivery ration for the DSDV and DSR were 100 % whereas for the AODV very low value was observed in Fig. 9.

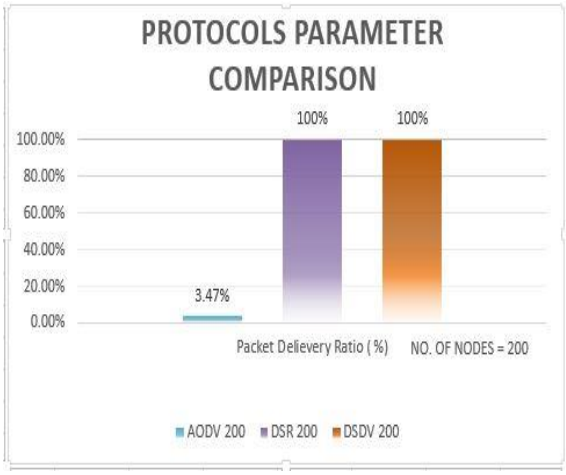

Fig.9: Packet Delivery Ratio Comparison for 200 nodes

Similarly from the results of the Fig.10 we can draw the conclusion that DSDV and DSR performed the best whereas AODV was found to have a little positive change than the previous results.

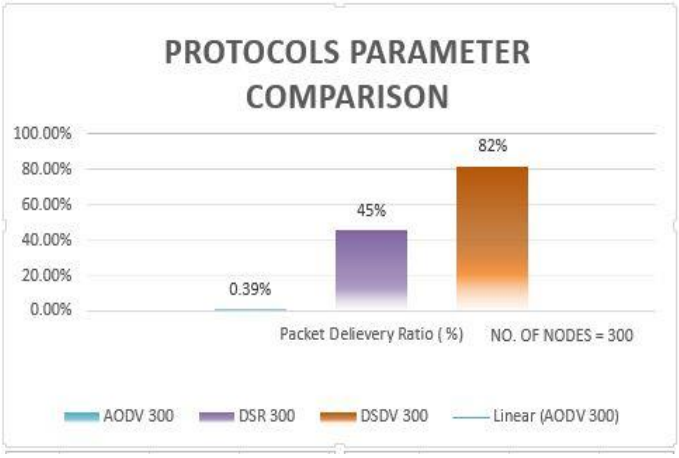

Fig.10: Packet Delivery Ratio Comparison for 300 nodes

In Fig. 11 it was observed that although the DSDV has a slight fall in its value but the overall results show that DSDV performs the best following the DSR na dthan the AODV.

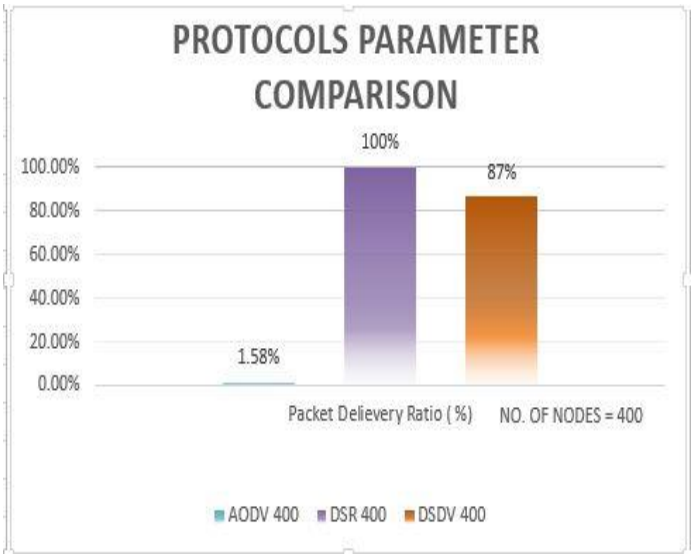

Fig.11: Packet Delivery Ratio Comparison for 400 nodes

From the results of the Fig. 12 it can be concluded that DSR performed the best by its full data delivery ratio than the other two protocols following by DSDV and than AODV protocols in this large network.

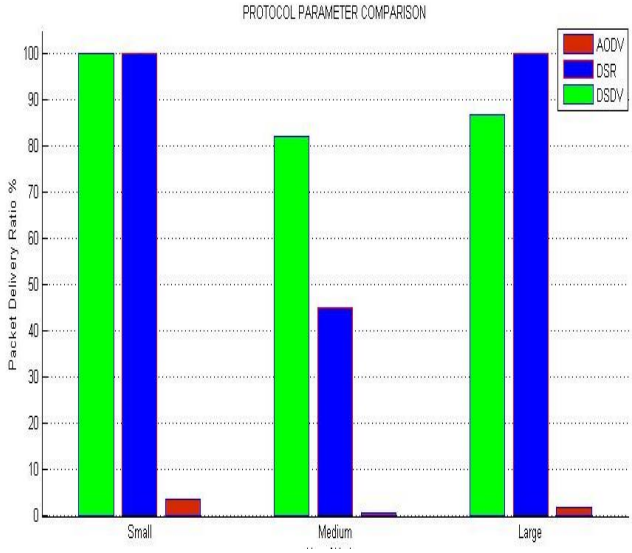

Fig.12: Comparative study w.r.t Packet delivery ratio

In the figure above it is found that that in the small network DSDV protocol performs better than the DSR and AODV. DSR performs better than AODV. For the matter of the medium network still DSDV is performing better in delivering the packets from source to the destination followed by the DSR and AODV. Here it is found that AODV is still the least in this case. In the case of large network with no. of nodes of about 400, the figure shows that DSR performs better than the rest of the two protocols. DSR is followed by DSDV and then the AODV routing protocol of the mobile ad-hoc network.

V. CONCLUSION

From the results obtained indicate DSR to be most efficient as far as mobility and speed are concerned in small scale networks. However it loses the spark in cases where network load is high. In such scenarios AODV is much better which shows similar results irrespective of the network load, mobility and speed. Although it lack from DSR in smaller networks but performs much better in large networks where network load is high. The observations of all the results were analyzed in the simulation which was performed during the simulation conducted for the MANET routing protocols under CBR traffic. So finally it is established that for small networks the obvious choice would be DSR for any parameter of speed and mobility. AODV can be used for larger networks where network load is quite higher. The average delay and overhead associated with AODV and OLSR are the major factors that need to be kept in mind when using them for larger networks.

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