Journal of Zankoy Sulaimani- Part A, Vol. 16 (4), 2014.

The Impact of Reactive Routing Protocols for Transferring Multimedia Data over MANET

Ako Muhammad Abdullah[1] and Roza Hikmat Hama Aziz[2]

Computer Science Department, Faculty of Physical & Basic Education, Sulaimani University
Kurdistan Region-Iraq, E_mail: [1] ako.abdullah@univsul.edu.iq , [2] roza.hamaaziz@univsul.edu.iq

Received: 3 Aug. 2014, Revised: 5 Sep. 2014, Accepted: 16 October 2014
Published online: 30 November 2014

Abstract:

A Mobile Ad-hoc Network (MANET) is a collection of wireless nodes that can be dynamically set up anytime and anywhere without requiring existing infrastructure. In the network each node works as a router to discover and maintain the routes form the source to destination. Nowadays, demanding for transferring multimedia traffic over MANET is increased while the different factors that effect in MANET to maintain real-time communication in the presence of a dynamic network topology. One of the factors that affect the ability of MANET to transfer multimedia traffic from source to destination is routing protocol. The main goal of this paper is the study, selection and evaluation the performance of two reactive routing protocols: Adhoc On Demand Distance Vector (ADOV) and Dynamic Source Routing (DSR) in a high mobility case under low, medium, and high density scenarios in order to transfer video conferencing application by using an OPNET simulator. While AODV and DSR share similar On Demand behavior, the protocols internal mechanism leads to significant differences in performance. The metrics used for performance analysis are average end-to-end delay, network load and throughput. As a result of our studies that the performance varies widely across different network sizes and results from once scenario cannot be applied to those from the other scenario. In all three scenarios, we concluded that performance of the DSR protocol is not good as throughput is very low and the routing load is very high when compared to AODV protocols. AODV exhibits a better performance than DSR protocols in terms of end-to-end delay. This study proves that AODV performs well in terms of end-to-end delay, network load, and throughput with increasing number of mobile nodes.

Keywords— Mobile Ad hoc Network, Ad hoc On Demand Distance Vector, Dynamic Source Routing Protocol, Video Conferencing Application, Route Discovery and Route Maintenance

I. Introduction

A Mobile Ad hoc Network (MANET) is a system of wireless mobile nodes which can freely and dynamically self-organize and self-configure, and cooperates with temporary and arbitrary network topologies, permitting users and nodes to communicate without any fixed infrastructure. Additionally, in a MANET each node has the ability to move independently without requiring a specific direction and it can change the routs to other routes frequently. Also, the topology of MANET can be considered as extremely dynamic by this reason the transmission between two nodes may be interrupted several times. The reestablishment of a new connection for transferring data from source to destination requires the discovery of any available path in the ad hoc networks [1]. In these networks, each mobile node acts not only as a host, but also as a router which is capable to forward data packets for other nodes, utilizing either multi-hop wireless or direct wireless links. This means that links between the mobile nodes can be changed during time, new nodes can join the network and other nodes can leave it.

In resent year, with developing the technical communication, services and mobility have a vital role for users to create a communication at anytime and anywhere. For different types of applications MANET is very appropriate and flexible because of it is able to establish the temporary communication between nodes without requiring preexisting fixed network infrastructure or centralized administration. The quality of the links is one of the most important factors that effect on nodes to change the links during the communication occurs between nodes by this reason, nodes are necessary to route the traffic through a multi-hop path to give two nodes the ability to communicate [2]. A central challenge in the design of MANET is the development of routing protocols that can be efficiently found in the transmission path between two communicating nodes. Furthermore, MANET routing protocols can assist mobile nodes to send and receive packets. Hence, routing protocol runs on every node and is therefore subject to the limit of the resources at each host.

A good routing protocol has the ability to provide minimizing computing loads on the mobile node as well as the traffic overhead on the network. MANET developed routing protocols are directly affecting data transmission, the performance of network applications, and the end user experience. To discover a routing path between two nodes, each protocol uses a routing strategy. The performance varies, relying on network conditions such as the density of nodes in a specific area, their speed, and their direction [3].

Nowadays, MANET is required to support increasing demand for multimedia communications and maintain real-time traffic. For this reason, MANET is an emerging topic with many possible applications. In this research, the performance of two reactive routing protocols will be investigated: the Ad hoc On Demand Distance Vector (AODV) and Dynamic Source Routing (DSR). The objective will be to identify which routing protocol can provide the best performance when transmitting multimedia data in a multi-hop mobile network. Different performance parameters aspects investigated in this study include average End-to-End Delay, Network Load, and Throughput. These performance parameters will measure the performance of AODV and DSR protocols when varying density in nodes in the Mobile ad hoc Network. For experimental purposes, increasing the number of wireless nodes in the network will be considered. The rest of this research is organized as follows: Section 2 presents the related work, Section 3 presents the description of the AODV and DSR routing protocols that are utilized in the performance evaluation process, Section 4 presents the simulation environment. Performance evaluation metrics are described in Section 5. In Section 6 the results of the investigations are presented and discussed. The final Section presents conclusions and future work.

II. RELATED WORK

The routing protocols that have been developed for MANET are directly affecting data transmission, the performance of network applications, and the end user experience. To discover a routing path between two ends, each protocol has its own routing strategy. The performance for each routing protocol varies depending upon network conditions such as the density of nodes in a specific area, their speed and direction, etc.

In the field of MANET routing protocols, extensive research has been conducted. In different simulations, various routing protocols were applied. Several research papers will be discussed concerning the performance of MANET routing protocols. In [22] the author gave different conclusions about MANET routing protocols i.e. AODV, DSR, and OLSR that deployed over MANET by using FTP traffic and analyzing their behavior with respect to three parameters: end-to-end delay, network load, and throughput. The study of these routing protocols shows that the OLSR is better in MANET according to their simulation results, but it is not necessarily true that OLSR will consistently perform better in all the networks, its performance may differ by varying the network and data types.

In reference [18] S. Gowrishanker et al performed the analysis of OLSR proactive routing protocol and AODV reactive routing protocol by using a NS-2 simulator. For each scenario the simulation period was 900 seconds and the simulated mobility network area was 800m x 500m. The nodes were initially located at the center of the simulation region in each simulation scenario. After the first 10 seconds of simulated times the nodes started moving. In it, IP is used as a network layer protocol and CBR traffic is used as an application to generate. According to the results, the OLSR protocol is more efficient in networks with high density and highly sporadic traffic; however, the best situation is when there is a large number of hosts. OLSR requires that it continuously has some bandwidth in order to receive the topology update messages. Both protocols scalability is restricted due to their proactive or reactive characteristics. In the AODV protocol there is flooding overheard in the high mobility networks. In the OLSR protocol it is the size of the routing table and topological update messages, and their performance that depends primarily on the network environment.

In another research [19] this study evaluated the performance of AODV and DSR to transfer CBR traffic over MANETs and also provides a classification of these protocols according to the routing strategy, such as table driven, on-demand, and hybrid routing protocols. A comparison of these routing protocols was shown under a variation of the number of nodes and pause time, while at the same time measured performances under two metrics including end-to-end delay and throughput. From a different analysis of simulation and graphs, it can be concluded that DSR performs better than AODV to transfer CBR traffic. In measuring end-to-end delay and throughput the DSR protocol shows better results than the AODV protocol.

In considering other approaches to evaluate the traffic impact on the network performance while using DSR, D. Rajendra et al [20] evaluated the impact of multiple HTTP and multimedia flows with and without background traffic on each other. More specifically, they evaluated the capabilities of MANETs in supporting multiple, simultaneous HTTP and multimedia streaming flows. No information is provided on the mobility model. In [21] D.O. Jorg studied the conduct of different routing protocols for the changes of network topology which resulted from node movement, link breaks, etc. In this study, by varying the number of nodes the performance of routing protocols was evaluated. However, D.O. Jorg did not investigate the performance of protocols under a large number of traffic sources, high mobility, and a larger number of nodes in the network which may lead to congestion situations.

III. AD HOC ON DEMAND DISTANCE VECTOR ROUTING

Ad hoc On Demand Distance Vector (AODV) routing is a reactive routing protocol which is the most popular routing protocol and designed for mobile ad hoc network and other wireless ad hoc networks. This protocol has the ability to find the route between nodes and is capable of both **unicast** and **multicast** routing [4]. These routes can be established between mobile nodes only as desired by source nodes when it has a packet to transmit. At each destination AODV uses a sequence number to identify current routing information and avoid routing loop problems that may occur during the routing calculation process. These sequence numbers are carried by all routing packets. For any possible destination in the network, AODV does not explicitly maintain a route. However, for any route that has been recently used, its routing table maintains routing information, thereby avoiding flooding the network with a new route request message since a node is able to send packets to any destination that exists in its routing table [2].

A. *Route Discovery in AODV*

The route discovery is established whenever a source node wants to communicate with another node in the network; a node seeks for a route in its routing table. The communication starts immediately if it has found a route. When a route is not available to send a packet from the source to its destination, the source node initiates a discovery path by broadcasting a **Route Request (RREQ)** packet to its neighbors. If a neighbor knows the route to the destination, it replies with a **Route Reply (RREP)** control message that propagates through the reverse path, otherwise, the neighbor will rebroadcast the RREQ. The broadcast of a RREQ and a RREP across the network is shown in Fig. 1.

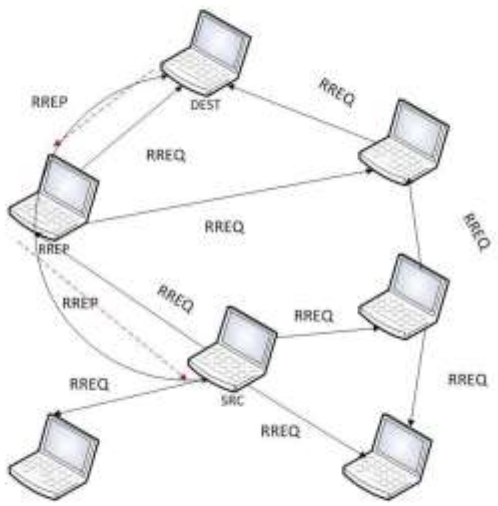

Fig. 1. Process of RREQ & RREP

The process will not continue indefinitely. To control the broadcast RREQ packet across the network, the source node utilizes an ***"Expanding Ring Search"*** technique. The search is controlled by the **Time-To-Live (TTL)** field in the IP header of the RREQ packets to set limits on RREQ [10]. In this technique, every RREQ carries a TTL value that states for how many hops this packet should be forwarded. At the first transmission, TTL value is set at retransmission. Retransmission occurs if no reply is received. The packet that initiates the RREQ is waiting to transmit.

Two separate counters are maintained by every node, they are the Sequenced Number and the Broadcast ID. Broadcast ID is incremented if the receiving node has a destination route for a RREP packet. This will send back a unicast message to the source node or rebroadcast the RREQ to its own neighbors after increasing the hop count [12] as shown in Fig. 1. Furthermore, the replying node creates a reverse route entry in its routing table that contains the address of the source node, number of hops to the source, and the next hops address as shown in Table 1 & 2. Additionally, to prevent the same request from being broadcast repeatedly, every request is uniquely identified by Host-ID and Broadcast-ID. Every host also keeps a record for their neighbor to report the proceedings [6].

TABLE 1: ROUTE REQUEST (RREQ) PARAMETERS

Source Address	Request ID	Source Sequence Number	Destination Address	Destination Sequence Number	Hop Count

TABLE 2

ROUTE REPLY (RREP) PARAMETERS

Source Address	Destination Address	Destination Sequence Number	Hop Count	Life Time

B. *Route Maintenance in AODV*

A route established between source and destination is maintained as long as needed by the source. During an active session, if the source node has moved, it can reinitiate path discovery to establish a new path to reach the destination node. However, some intermediate or destination node may move. The moved nodes neighbor realizes the link failure and a **Route Error (RERR)** packet is sent to the affected source nodes. Intermediate nodes update their routing table by receiving RERR and setting the distance of the destination to infinity [8]. When the source node receives the RERR, it can reinitiate path recovery if the path is still required [16]. By periodically broadcasting a Hello packet, neighborhood information is obtained. Two methods can be utilized for the maintenance of the routes: a) Hello Messages in the network layers or b) ACK Messages in MAC level [6].

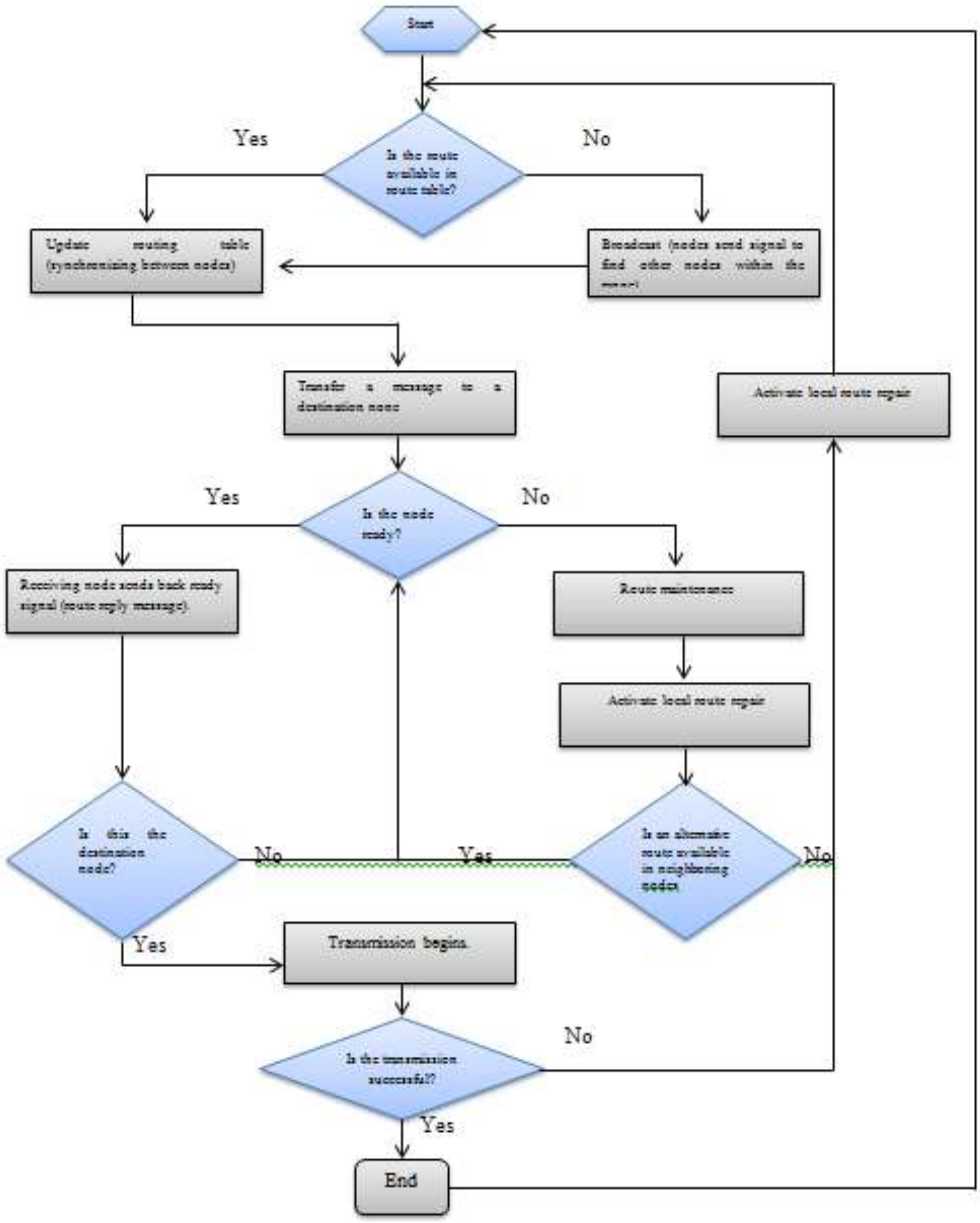

Fig. 2 Flow Chart of AODV Routing Protocol

IV. DYNAMIC SOURCE ROUTING

Dynamic Source Routing (DSR) is a reactive routing protocol that determines the proper route only when a packet needs to be forwarded. This protocol is similar to AODV in that it establishes a rout on-demand, but DSR utilizes source routing instead of depending on the routing table at each intermediate node. DSR permits the network to be completely self-configuring and self-organizing without requiring a network administrator or existing infrastructure. Every mobile node in a wireless ad hoc network using a DSR protocol needs to maintain a route cache where it caches source routes. For the successful delivery of data packets from the source to the destination node, the source node first checks its route cache for the source route to the destination. In this case, if a route is found the source node utilizes this route to propagate the data packet, otherwise it starts the process to find a new route. In the wireless ad hoc network DSR is dependent upon two main mechanisms to discovery and maintenance of the source route [17].

A. Route Discovery in DSR

For route discovery, DSR is relying on **Route Request (RREQ)** and **Route Reply (RREQ)** packets, when the source node wants to send a packet to a destination node. The source node checks its rout cache to find any routing information related to that destination. If routing information is not found, the source node starts a route discovery process by broadcasting a RREQ packet to all neighbor nodes in its wireless transmission range in order to dynamically discover a new route [11]. The neighboring nodes add their ID in the RREQ packet and rebroadcast the packet. The broadcast packet will reach the destination node or to the intermediate nodes which contain the route to the destination node. A route cache is maintained by each node, and before rebroadcasting the RREQ packet node checks its cache [13]. The overhead generated through the route discovery is reduced by maintaining the routed cache. In the cache of node, if a route was available, it will be sent the RREP packet instead of the RREQ. When the destination node gets the first packet, it contains the complete information regarding the route. In DSR protocol, the route obtained is considered the shortest route. An RREP packet sends to the source node that contains the path to the destination. The source node should have saved this path in its cache [14]. When a route between a source and destination is broken, the RREP is utilized to notify the source node and the source node removes any route using this link from its cache and a new mechanism of route discovery is initiated by the source node if there is still a path required. DSR uses a source path and path catching in an efficient way that does not require a particular mechanism to find routing loops [7].

.

B. Route Maintenance in DSR

Two types of packets are utilized in these mechanisms, called a **Route Error (RERR)** packet and an **Acknowledgement (ACK)** packet. The existence of the route is verified by the DSR on the basis of an ACK packet that is received from the neighboring nodes, describing that the packet has been delivered to the next hop. The ACK packet contains a passive acknowledgement. Furthermore, when a node has failed to receive an ACK packet, an RERR packet is generated. If the redundant route to the destination is not available, the RERR packet is sent to the source to again initialize the route discovery phase. Also, when the node has received the RERR packet, it removes the route entries from their route cache which utilizes these failed links [17]. In addition, DSR supports the flow state to establish in intermediate nodes to reduce the overhead. This flow state provides the facility of hop by hop forwarding with the same source based routes as provided by the original source route

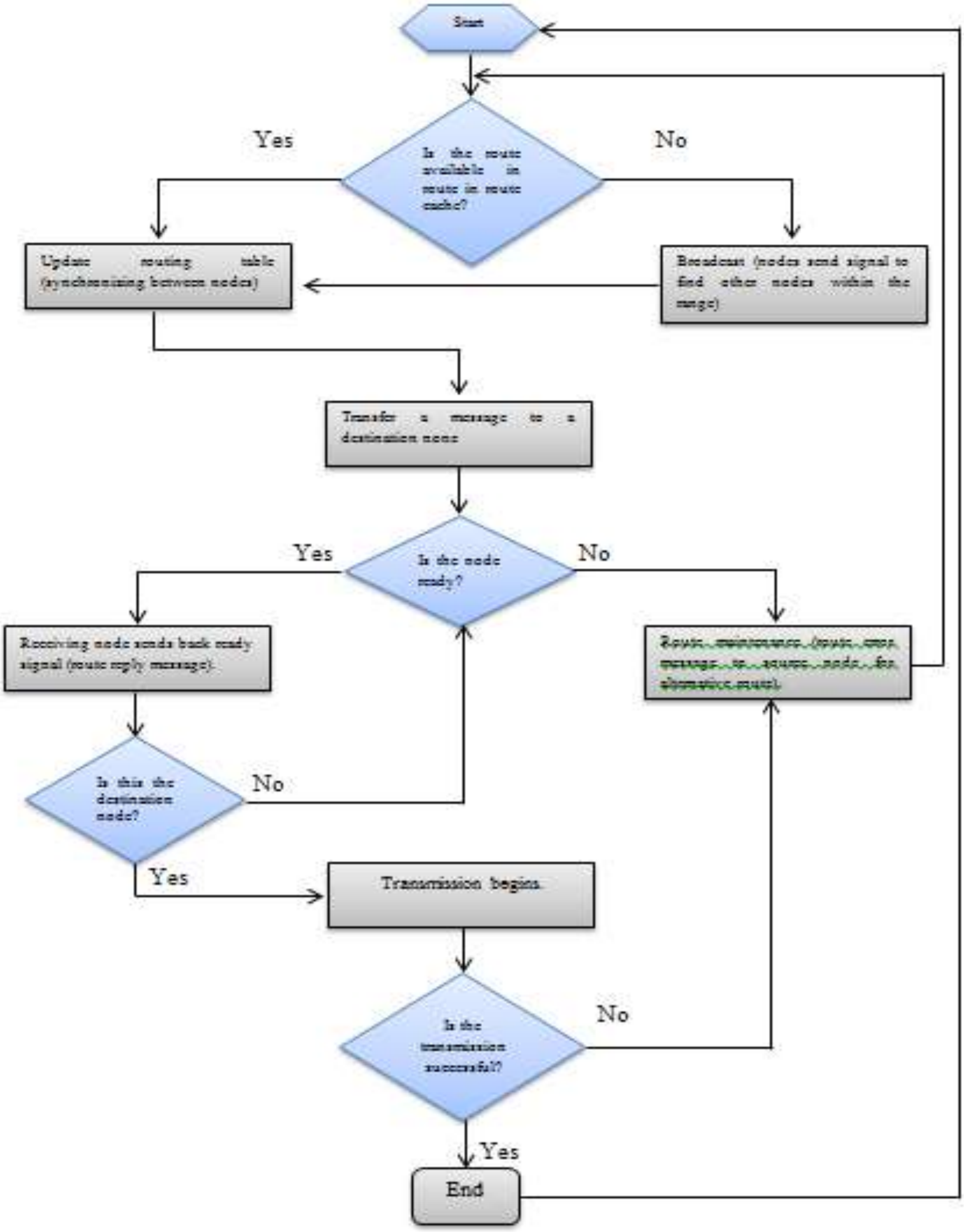

Fig. 3 Flow Chart of DSR Routing Algorithm

V. SIMULATION ENVIRONMENT

We employed OPNET for the simulation of two reactive routing protocols. OPNET is one of the most popular network simulators capable of simulating large communication networks with detailed protocol modeling and performance analysis. Its features include the graphical specification of models, a dynamic, event-scheduled Simulation Kernel, integrated data analysis tools, and hierarchical, object based modeling. It is a network simulation tool that allows the definition of a network topology, the nodes, and the links that go towards making up a network. The processes that may happen in a particular node can be user defined, as can the properties of the transmission links. A simulation can then be executed, and the results analyzed for any network element in the simulated network. A simulation study was carried out to investigate and evaluate the performance of two reactive routing protocol (AODV and DSR) based on an Average End-to-End delay, Network Load, and Throughput to identify which routing protocol has the ability to provide the best performance to transfer multimedia traffic.

For this purpose, three scenarios for different number of nodes are generated by varying number of nodes from 20, 30 and 60 as shown in Fig. 4, and the data traffic loads is 10 Frames per second are used to investigate the performance of AODV and DSR routing protocols. Furthermore, the nodes were spread over an area of 1000m x 1000m. In all three scenarios, the participating nodes were considered as wireless mobile nodes with one fixed WLAN server, and the same procedure was applied to all three scenarios. For all scenarios the application utilized was a video conferencing (High Resolution Video) and each scenario was simulated for 1200 seconds. After that to all the nodes IPv4 addressing was assigned. The simulation parameters are shown in Table 3.

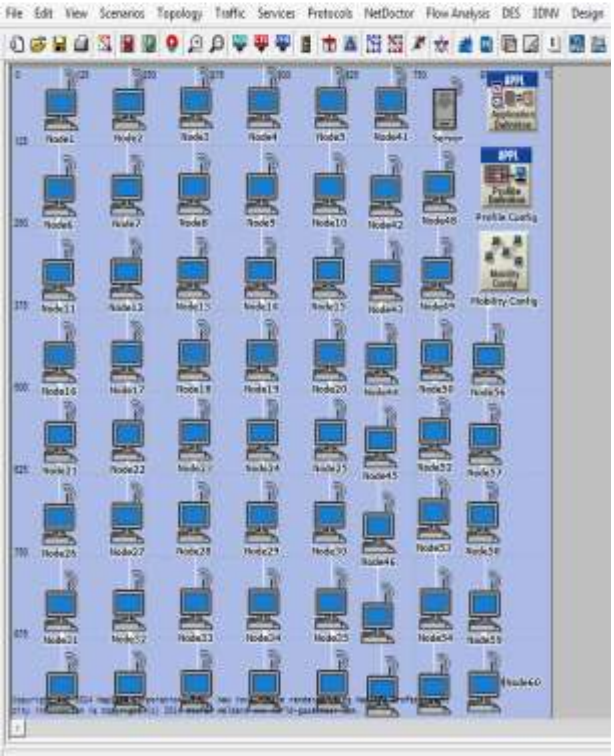

Fig. 4 Simulating 60 Nodes

Table 3: Simulation Parameters

Parameters	Value
Routing Protocols	AODV and DSR
Number of Nodes	20, 30 and 60
Simulation Area	1000m x 1000m
Simulation Time	1200 Sec
Application Name	Video Conferencing (High Resolution Video)
Channel Frequency	2.4 Ghz
Data Rate	10 Frames
Mobility Model	Random Waypoint
Antenna Type	Omni Antenna
Performance Parameters	End-to-End delay, Network Load, Throughput
Simulator	OPNET

VI. METRICS FOR PERFORMANCE REACTIVE ROUTING PROTOCOLS

In a routing algorithm, metric is a standard measurement used to determine the best possible, efficient, and effective route to a destination. The performance metrics are used to measure the performance of routing protocols. In this study, the following metrics have been considered to investigate and evaluate the performance of AODV and DSR routing protocols to transfer video conferencing applications by varying the number of mobile nodes.

A. End – to – End Delay

This metric includes average end-to-end delay. The end-to-end delays are all possible delays in the network to transfer the packet from the source node until packet delivery to the destination node. In the network, this delay adopts all possible delays caused by routing discovery latency retransmission by the intermediate nodes, processing delay, queuing, and propagation delay. This metric is one of the most significant parameters to investigate and evaluate the ability of routing protocols to make efficient use of network resources. Furthermore, when the packet end-to-end delay is low, the performance is better [15].

Delay mathematically can be defined as follows:

D end-to-end = N [D trans + D prop + D proc]

D trans = Transmission Delay

D prop = Propagating Delay

D proc = Processing Delay

N = Number of nodes

B. Network Loading

When there is excessive data coming into the network such that it is not easy for the network to deal with the total amount and difficulty is created, the situation is called network load [9]. Nowadays, a number of techniques and methods have been introduced to handle the large traffic that is coming onto the network to provide the best network communication. The routing packet in the network can be affected by high network load and the delivery of the packet will be delayed in accessing the channel because of increased collisions on the network. Consequently, routing packets may be slow to achieve stability.

C. Throughput

Throughput refers to the ration of the total amount of packets that are delivered successfully from one node to another node over a communication network. It is measured as *bit per second* and sometimes in *data packet per second.* Throughput measures the effectiveness and efficiency of routing protocols usage over the network in delivery data packets from a source to a destination node. It also evaluates the quality of routes and the capacity of the routing algorithm to a data flow and those associate with an active session or in a specific timeframe. In every network throughput with a higher value is more often an absolute choice. Moreover, in MANET a number of factors are affected on throughput such as an unreliable connection, frequent topology changes, limited energy, and limited bandwidth [17].

By the following formula, mathematically throughput can be calculated:

Throughput = [Number of delivery packets * Packet size) / Total duration of simulation.

VII. RESULTS AND DISCUSSIONS

A. End-to-End Delay

To evaluate the performance of AODV and DSR protocols we took three scenarios. During the simulation we have increased the number of mobile nodes and recorded the performance of both the protocols. Fig. 5 shows the end-to-end delay ratio of AODV and DSR protocols. The AODV and DSR protocols take some time to establish the route from source to destination so in all the three scenarios the delay starts at different times. The first scenario consists of 20 wireless mobile nodes. The DSR delay was 0.009 seconds. When the network is made more complex by increasing the mobile nodes to 30, there is a jump in the delay from 0.009 seconds to 0.023 seconds as shown in Fig. 6. The last analysis is based on varying the number of mobile nodes from 30 to 60 in an area 1000m x 1000m. The end-to-end delay shown in Fig. 7 reveals that DSR delay slightly increased into 0.032 seconds. Moreover, all three scenarios using AODV showed a varying nature in delay with the increase of nodes density; the AODV delay peak value when the number of nodes was 60 is 0.0046 seconds. When the number of mobile nodes was 20 and 30, the AODV delay peak value is 0.0023 seconds and 0.0032 seconds respectively. The AODV delay value for 60 nodes is slightly higher than the delay in network of 20 or 30 nodes as shown in Fig. 8. The reason for the increasing the delay is that when the number of nodes is increased, the data which is needed to deliver to the specific destination. Thus, the data has to pass through many nodes, which causes more delay.

From the results it is evident that the end-to-end delay in AODV is less and varies compared with DSR. The reason of a low delay is AODV have replied to the first reached RREQ packet and discards other RREQs which reach later from other sources which automatically favors the least congested route instead of the shortest path while the delay in DSR increases with the growth of the network due to the DSR replies to all the RREQs that reached and it will be difficult for the protocol to select the least congested path which results in increasing delay of packets. Furthermore, DSR routing protocol uses cached routes and sending more of the traffic onto stale routes this causing retransmission and leads in excessive delay. The increased number of cached routes with a high traffic worsens the delay in network. Through the use of multiple paths, DSR is trying to minimize the impact of stale routes.

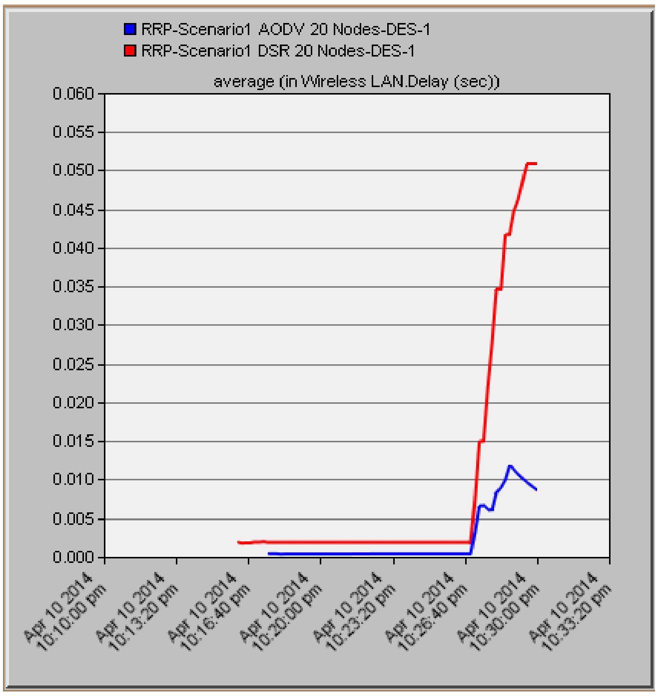

Fig.5 End-to-End Delay of AODV vs DSR for 20 Nodes

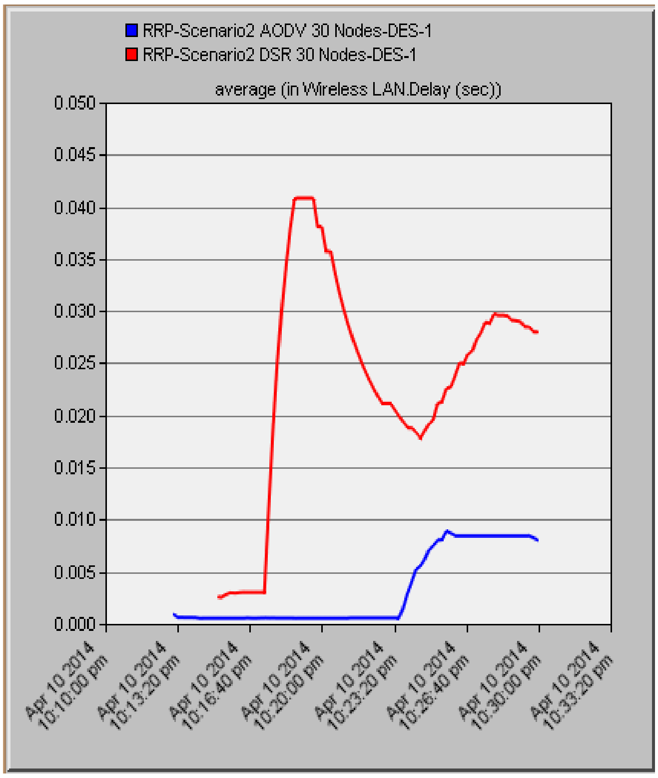

Fig.6 End-to-End Delay of AODV vs DSR for 30 Nodes

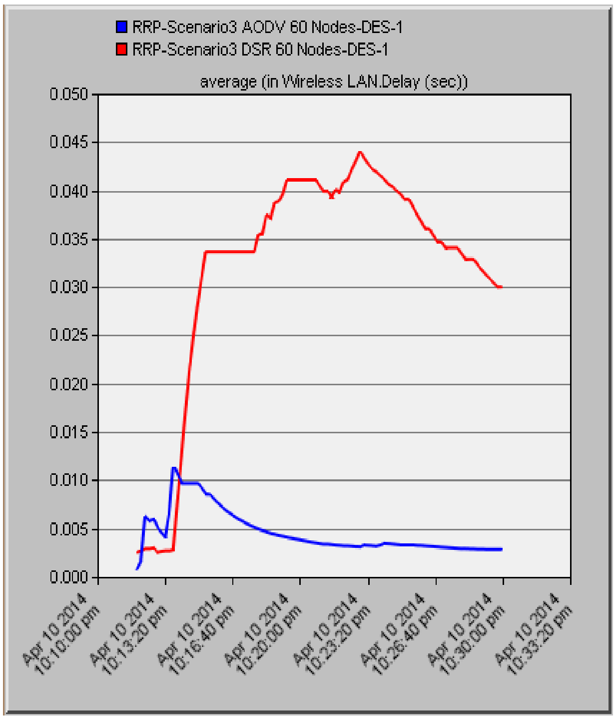

Fig.7 End-to-End Delay of AODV vs DSR for 60 Nodes

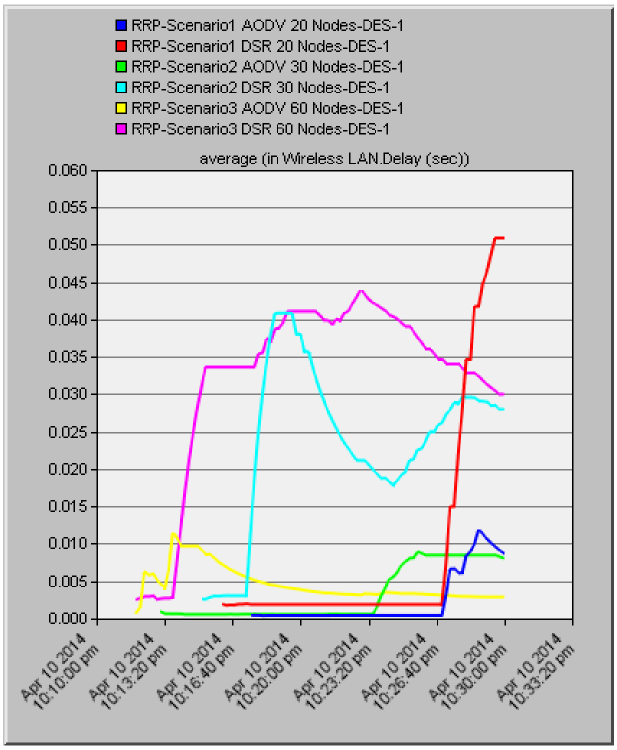

Fig.8 End-to-End Delay of AODV vs DSR for 20, 30 and 60 Nodes

B. Network Loading

The second analysis is based on network load. Network load plays a vital role in the scalability of Mobile Ad hoc Network routing protocols. High network load is one of the important factors that affect the MANET routing control packets and slow down the delivery by competing for access to the channel and it results in increasing the collisions of the control packets. Thus, routing packets may be slow to stabilize.

In Fig. 9 to 12, we present the comparison and evaluation of the performance of the AODV and DSR routing protocols at various network loads. Fig. 9 shows the graphs for AODV and DSR when the number of mobile nodes is 20. In this scenario, we have observed that AODV shows the lower load compared with DSR. The peak AODV network load value is 31,526 bits/sec while DSR network load is 48,702 bits/sec. With increased the number of mobile nodes from 20 to 30 nodes in second scenario, clearly illustrating the AODV and DSR network load increased compared with the first scenario. Considering the results in Fig. 10, the network load for AODV is minimum compared with the DSR protocol. The peak value of the AODV network load is 174,203 bits/sec and the DSR network load value is 507,271 bits/sec whereas the peak value of the DSR network load is 48,702 bits/sec for 20 mobile nodes. On the other hand, in the third scenario, the network load of the AODV and DSR protocols is shown in the Fig. 11, where the number of mobile nodes is 60. The difference in the AODV and DSR network load can be seen as compared to 20 and 30 mobile nodes. In the networks considered with the growth of the network, the network load of the DSR is larger than AODV. The DSR network load value is 1,127,567 bits/sec whereas the AODV network load is 427,862 bits/sec.

AODV offer good results in offering low load on the network than DSR respectively. High network load affects the MANET routing control packets. By comparing AODV and

DSR the results in the entire figures and values, it can be seen that AODV perform well than DSR in network load and DSR has the maximum load form three the scenarios.

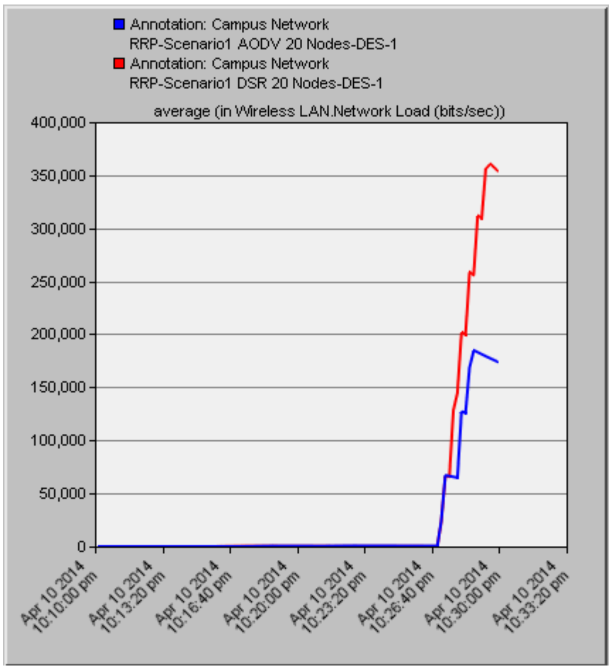

Fig.9 Network Load of AODV vs DSR for 20 Nodes

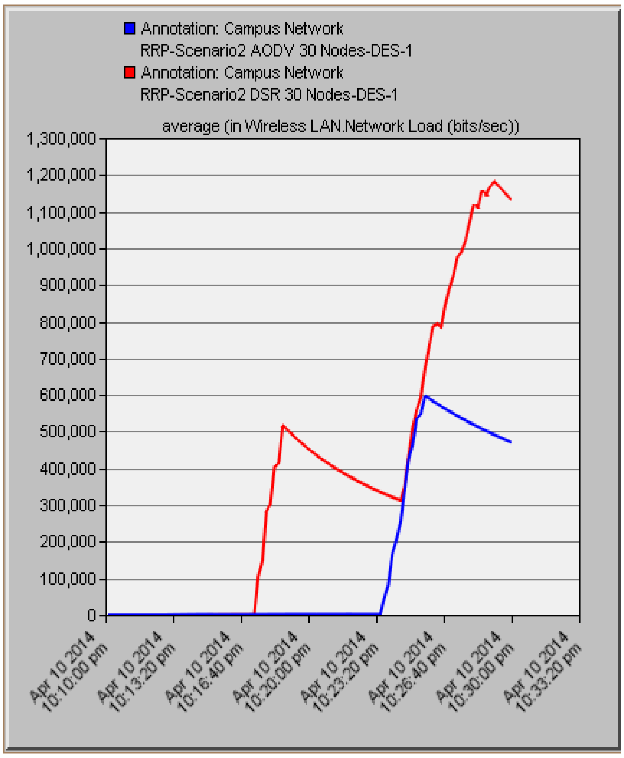

Fig.10 Network Load of AODV vs DSR for 30 Nodes

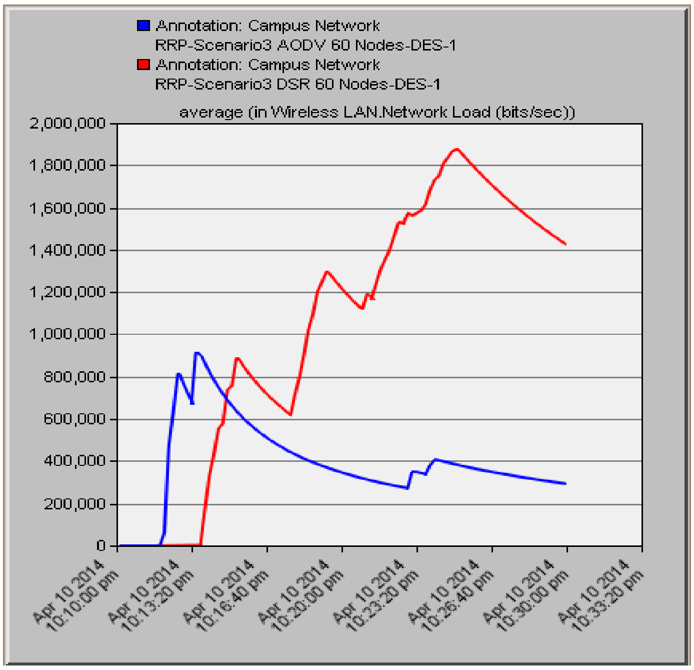

Fig.11 Network Load of AODV vs DSR for 60 Nodes

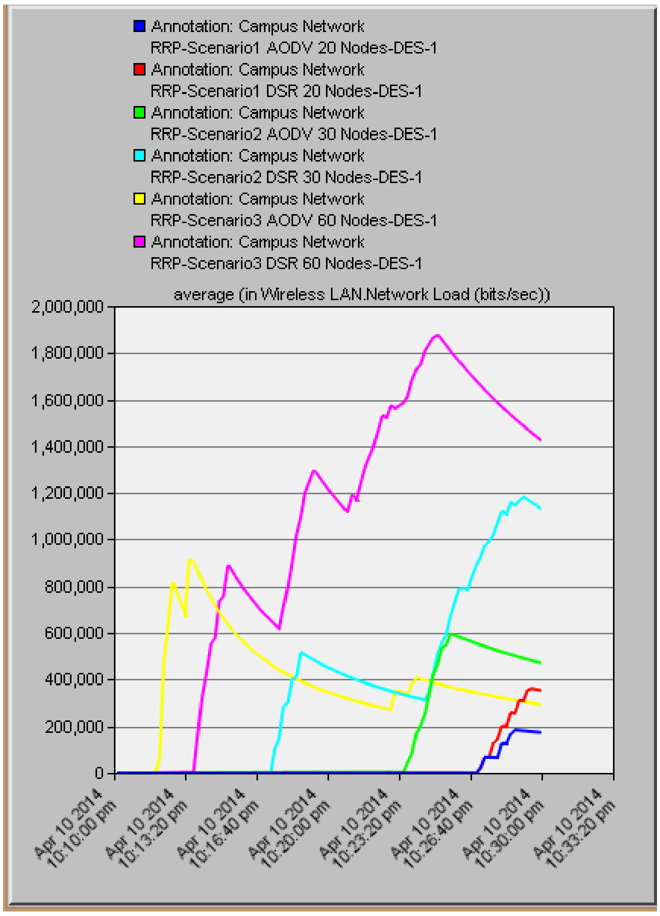

Fig.12 Network Load of AODV vs DSR for 20, 30 and 60 Nodes

C. Throughput

The performance of the AODV and DSR protocols of the parameter throughput is shown in Fig. 13 to 16 we have used three scenarios to evaluate the performance of AODV and DSR throughput. When the number of mobile nodes is 20, AODV marginally performs better than DSR. Also, when the number of traffic source is increased, problems of congestion, network degradation and hidden terminal come more into effect. The protocol starts to react differently due to these problems to the varying conditions, and delay is one of the most important factors in determining the network throughput. The first scenario that consists of 20 mobile nodes, AODV has the maximum throughput in this scenario where the rate reaches up to the peak value of 49,831 bits/sec with passage of time, while DSR gives the throughput rate of 40,302 bits/sec as shown in Fig. 13. The second scenario illustrated in Fig. 14 shows how we observed, that when the number of mobile nodes is increased to 30, the throughput value of DSR slowly increases while DSR gives the throughput rate of 220,592 bits/sec.

The throughput in AODV improves with the number of mobile nodes are increased in the network, and clear difference in the throughput rate of DSR. From the Fig. 14 we can see that when the network is scaled up to mobile nodes of 30 the throughput in AODV is 514,749 bits/sec. In third scenario the number of mobile nodes is increased from 30 to 60 nodes and the AODV and DSR were checked by throughput parameter. The purpose of increasing mobile nodes was to check the behavior of AODV and DSR protocols in the large Ad hoc network to transfer video conferencing application. The AODV throughput is also clear from Fig. 15. The peak throughput value is 1,145,846 bits/sec whereas the DSR throughput value is 920,043 bits/sec. It is clear from the figure and value that throughput is the lowest for DSR than the AODV. The throughput is more for the AODV protocol when compared with the DSR protocol as shown in Fig. 16.

Table 4: Average values of three scenarios for aodv & dsr protocols

Protocols	**Parameters**	**20 Nodes**	**30 Nodes**	**60 Nodes**
AODV	Delay (sec)	0.0023	0.0032	0.0046
	Network Load (bit/sec)	31,526	174,203	427,862
	Throughput (bit/sec)	49,831	514,749	1,145,846
DSR	Delay (sec)	0.0091	0.023	0.032
	Network Load (bit/sec)	48,702	507,271	1,127,567
	Throughput (bit/sec)	40,302	220,592	920,043

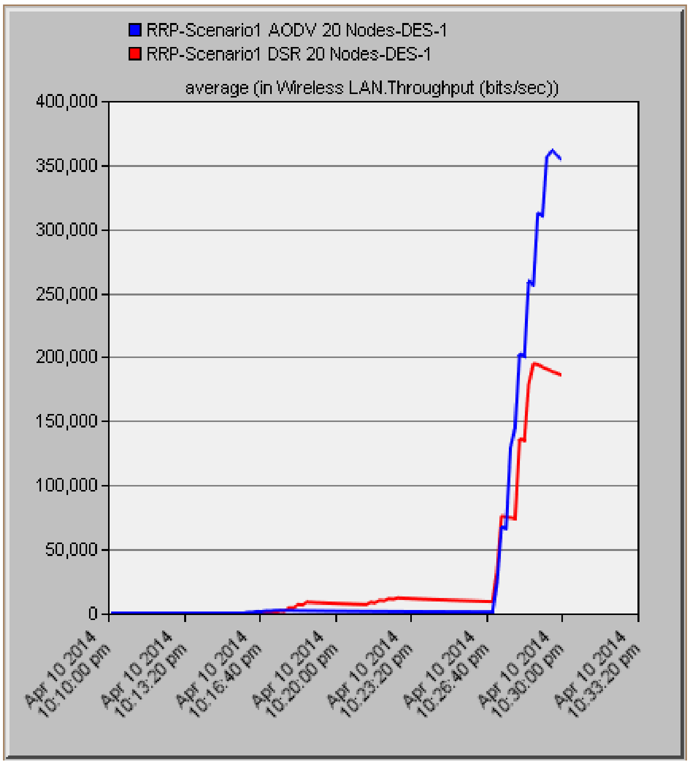

Fig.13 Throughput of AODV vs DSR for 20 Nodes

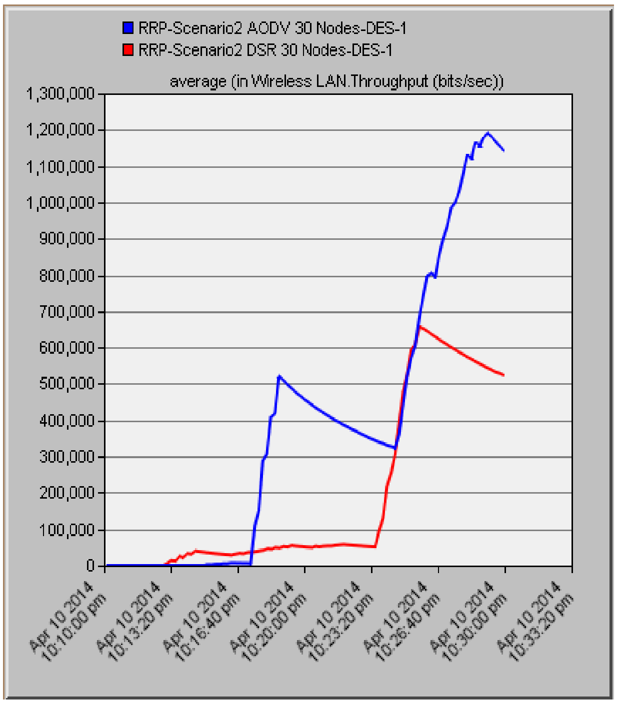

Fig.14 Throughput of AODV vs DSR for 30 Nodes

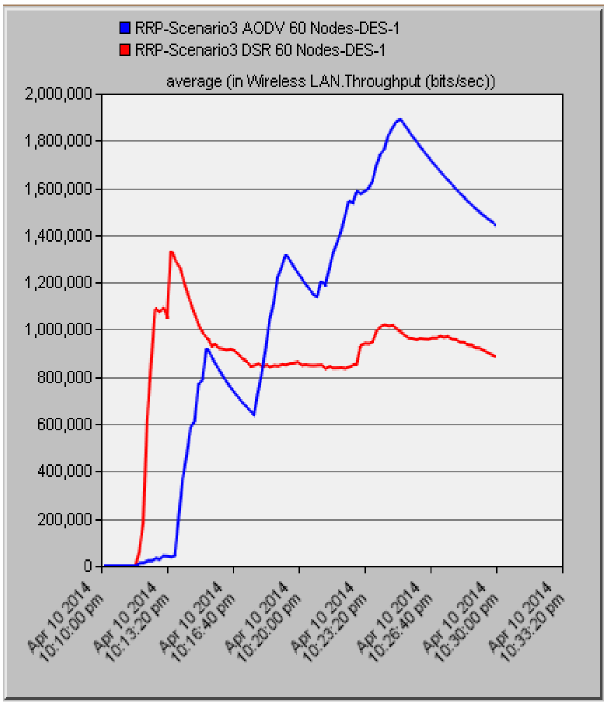

Fig.15 Throughput of AODV vs DSR for 60 Nodes

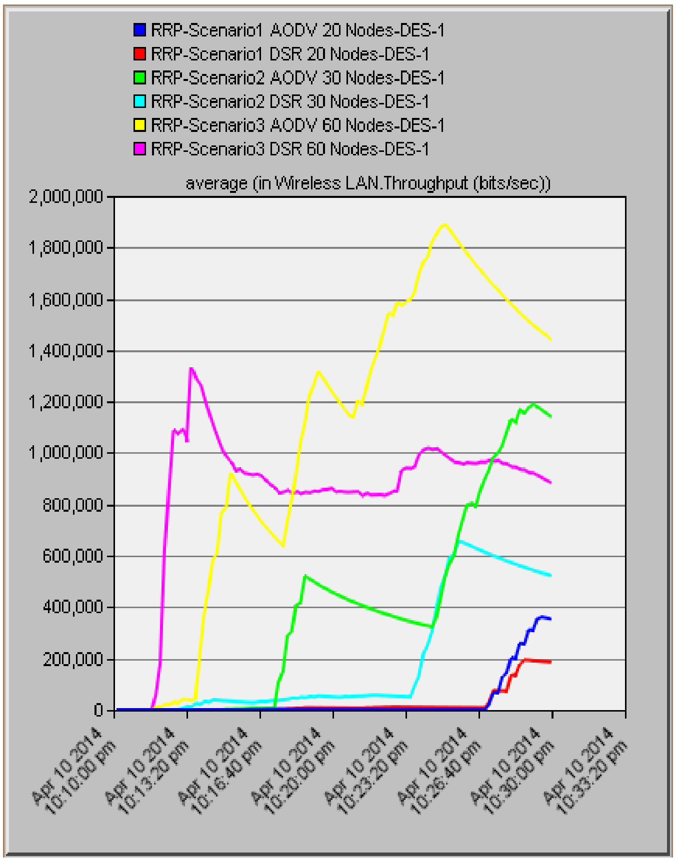

Fig.16 Throughput of AODV vs DSR for 20, 30 and 60 Nodes

VIII. CONCLUSIONS

This paper evaluated the performance of two reactive routing protocols, AODV and DSR, which are used in MANET in a high mobility case under low, medium, and high density scenarios to transfer video conferencing application. For evaluation of these protocols, we used the OPNET simulator. The number of nodes was varied from 10 (low density), 20 (medium density) to 60 (high density). The nodes were spread over an area of 1000 x 1000 meters. In this study, to generate node mobility, a Random Waypoint Mobility model was used. Comparison was based on end-to-end delay, network load and throughput. Simulation results are shown by figures and tables. Both AODV and DSR use a reactive approach to route discovery and maintenance, but with different mechanisms. AODV uses routing tables, one route per destination and a sequence number to maintain a route. On the other hand, DSR uses source routing and a route cache, and does not depend on their time base activity. The study of simulations with a video conferencing application was analyzed and proved that AODV performs better in all three scenarios in terms of throughput and network load than does DSR with varying network size. Also, the average end-to-end delay is the least for AODV and changes slightly if the number of nodes is increased. Thus, we found that AODV has the ability to provide the best performance and a more reliable to transfer video conferencing application in MANET compared to DSR with an increase in the number of nodes in the network.

In future work, the performance of different routing protocols will be investigated for VoIP application in MANET. We will choose different areas of operation instead of one area and the performances of the routing protocols will be analyzed based on different performance matrices, namely: voice quality, throughput, Jitter, packet delay variation, Wireless LAN delay, and packet end-to-end delay. Furthermore, in this future study will be proposed a new routing protocol to improve the performance of VoIP and compare with other protocols.

ACKNOWLEDGMENT

The authors would like to thank Sulaimani University for their help and support in the implementation of our research.

REFERENCES

[1] D. Kumar, A. Srivastava and S. Gupta, "Performance Comparison of DSDV and AODV Routing Protocols in MANETS", International Journal of Electronics Communication and Computer Technology (IJECCT), Vol. 2, Issue 3, PP. (120-124), (2012).

[2] V.Ramesh, P.Subbaiah, N. K. Rao and M.J. Raju, "Performance Comparison and Analysis of DSDV and AODV for MANET", International Journal on Computer Science and Engineering (IJCSE), Vol. 02, No. 02, PP. (183-188), (2010).

[3] M.A. Mahdi and T. Wan, "Performance Comparison of MANETs Routing Protocols for Dense and Sparse Topology", International Conference on Information and Computer Networks (ICICN), Vol. 2, PP. (37-42), (2012).

[4] S. K. Gupta and R. K. Saket, "Performance Metric Comparison of AODV and DSDV Routing Protocols in MANETs Using NS-2", International Journal of Research and Review (IJRRAS), Vol. 8, Issue 1, PP. (339-350), (2011).

[5] H. Paul and P. Sarkar, "A Study and Comparison of OLSR, AODV and ZRP Routing Protocols in Ad hoc Networks", International Journal of Research in Engineering and Technology(IJRET), Vol. 2, Issue 8, PP. (370-374), (2013).

[6] A. Al-Maashri and M. Ould-Khaoua," Performance analysis of MANET routing protocols in the presence of self-similar traffic", In, Proceedings of the 31st IEEE Conference on Local Computer Networks, PP. (801-807), (2006).

[7] P. Khatri, M. Rajput, A. Shastri and K. Solanki, "Performance Study of Ad-Hoc Reactive Routing Protocols" International Journal of Computer Science (IJCS), Vol. 6, ISSN 10, PP. (1159-1163), 2010.

[8] J. Hosek, "Performance Analysis of MANET Routing Protocols OLSR and AODV", Elektrorevue, Vol. 2, No. 3, PP. (22-26), (2011).

[9] S. Mahajan and V. Chopra," Performance Evaluation of MANET Routing Protocols with Scalability using QoS Metrics of VOIP Applications", International Journal of Advanced

Research in Computer Science and Software Engineering (IJARCSSE), Vol. 3, Issue 2, PP. (150-156), (2013).
[10] Y. Kim, I. Moon and S. Cho, “A Comparison of Improved AODV Routing Protocol Based IEEE802.11 and IEEE802.15.4”, Journal of Engineering Science and Technology (JESTEC), Vol. 4, No. 2, PP. (132 – 141), (2009).
[11] N. Karthikeyan, V. Palanisamy And K. Duraiswamy, “A Performance Evaluation Of Proactive and Reactive Protocols Using ns-2 Simulation”, International J. of Engg. Research & Indu. Appls. (IJERIA), Vol.2, ISSN 0974-1518, PP. (309-326), (2009).
[12] S. I. Jassim, “Performance Study of AODV, GRP and OSPFv3 MANET Routing Protocols Using OPNET Modeler”, Journal of Engineering, Vol. 19, No. 8, PP. (1040-1042), (2013).
[13] Shivashankar, Varaprasad.G, **“**Identification of Critical Node for the Efficient Performance in MANET”, International Journal of Advanced Computer Science and Application (IJACSA), Vol. 3, No. 3, PP. (166-171), (2012).
[14] Shivashankar1, G. Varaprasad, H.N. Suresh, G. Devaraju and G. Jayanthi, “Performance Metrics Evaluation of Routing Protocols in MANET”, International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE), Vol. 2, Issue 3, PP. (1513-1520), (2013).
[15] J. Singh and R. Mahajan, “Performance Analysis of AODV And OLSR Using OPNET”, International Journal of Computer Trends and Technology (IJCTT), Vol. 5, ISSN 2231-2803, No. 3, PP. (114-117), (2013).
[16] M. V. Khiavi and S. Jamali, “Performance Comparison of AODV and AOMDV Routing Protocols in Mobile Ad Hoc Networks”, International Research Journal of Applied and Basic Sciences (IRJABS), Vol. 4, No.11, ISSN 2251-838X , PP.(3277-3285), (2013).
[17] P. Nand and S. C. Sharma, “Performance study of Broadcast based Mobile Adhoc Routing Protocols AODV, DSR and DYMO,” International Journal of Security and its Applications (IJSIA), Vol. 5, No. 1, PP. (81-92), (2011).
[18] S. Gowrishankar, T.G. Basavaraju, M. Singh and S. K. Sarkar, “Scenario based Performance Analysis of AODV and OLSR in Mobile Ad hoc Networks”, Proceedings of the 24th South East Asia Regional Computer Conference, Vol. 15, No. SP4, PP. (81-86), (2007).
[19] S. Gupta, S. Arora and G. Banga, “Simulation Based Performance Comparison of AODV and DSR Routing Protocols in MANETS”, International Journal of Applied Engineering Research, Vol. 7 No.11, PP. (1-5), (2012).
[20] D. Rajendra and V. Boppana, “On routing Web and multimedia traffic in mobile ad hoc networks”, System Sciences, Proceedings of the 36th IEEE International Conference, (2003).
[21] D. O. Jorg, “Performance Comparison of MANET Routing Protocols in Different Network Sizes”, Computer Networks & Distributed Systems, University of Berne, Switzerland, PP. (1-31), (2003).
[22] S. Ali and A. Ali, “Performance Analysis of AODV, DSR and OLSR in MANET”, Master Thesis, Blekinge Institute of Technology, Sweden, PP. (1-59), (2009).