A Comparative Performance Analysis of AODV and DSR Routing Protocols for Vehicular Ad-hoc Networks (VANETs)

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Vehicular ad hoc networks (VANETs) are the specific class of Mobile ad hoc networks (MANETs). Since vehicles tend to move in a high speed, the network topology is rapidly changed.
The performance of communication between vehicles depends on how better the routing takes place in the network. Routing of data depends on the routing protocols which are being used in network. In this paper we analyse and compare the performance of two reactive routing protocols Dynamic Source Routing (DSR) and Ad hoc On Demand Distance Vector (AODV) in terms of three performance metrics like throughput, network load and end-to-end delay with different number of mobile nodes (100, 150, 200 and 250) with constant speed 10m/s. We employed OPNET Modeller v14.5 for the performance analysis of two reactive routing protocols (AODV, DSR). OPNET modeller 16.0 is a network simulator environment which is used for simulations of both wireless and wired networks. A conclusion is drawn on the comparison between these two routing protocols with performance metrics like network load, end-to-end delay and throughput on the basis of results derived from simulation.

Keywords—Ad-hoc network, AODV, DSR, MANET, OPNET , VANET

I. Introduction

As the number of vehicles is increasing on the road, vehicle driving is becoming more and more challenging. VANET (Vehicular Ad-hoc Network) is a latest technology that allows the wireless communication among vehicles and between vehicles and roadside equipments. VANET provides long-range communication .In VANET, to provide ad-hoc network Connectivity, each vehicle is equipped with a wireless communication facility. VANET operates without an infrastructure, each and every vehicle in the network can act as receiver, sender and router to broadcast messages to the transportation agency or vehicular network, then they uses the messages to ensure free flow of traffic and safety. VANET stresses on the improvement of intelligent transportation system (ITS) to facilitate the safety applications i.e. to avoid road accidents, speed control, traffic jam and so on and comfort applications to the road users i.e. weather information, internet access, multimedia applications, and mobile e-commerce and so on. VANET communication is classified into three categories: pure vehicle to vehicle (V2V), vehicle to roadside (V2R) and hybrid communication including V2V and V2R. Vehicular network are affected by some environmental factors such as tunnels, obstacles, traffic jams etc.

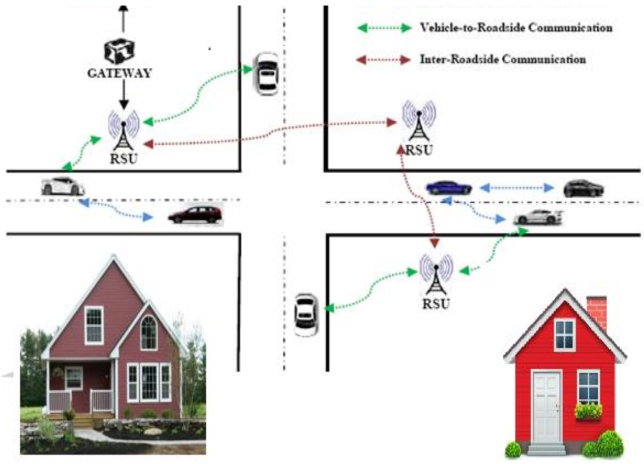

Figure1. Vehicular Ad hoc Network

This paper is organized as follows: VANET routing protocols and simulation setup are described in section II and III, then performance metrics used in this study are described in section IV. In section V we present the simulation result and analysis of our observation. Finally conclusion and future works are given in section VI.

II. VANET Routing Protocols

Routing is a mechanism to build and to choose a particular path to send data from source to destination. Various routing algorithm are designed for ad-hoc networks. VANET routing protocols can be classified as:

A. Proactive Routing Protocols: These routing protocols are also called table driven routing protocols because for sending data from one node to another node these protocols maintain table of connected nodes and each node share its table with another node. There are many types of proactive routing protocols are Destination Sequence Distance Vector Routing (DSDV), Optimized link state routing (OLSR), Fisheye State Routing (FSR).

B. Reactive Routing Protocols: These routing protocols are also called On Demand routing protocols because they make a route from source to destination whenever a node wants to send thus decreasing burden on network. On Demand routing have route discovery phase. There are many types of Reactive routing protocols like DSR, AODV and TORA. Here we are describing two reactive routing protocols for VANET.

Ad Hoc on Demand Distance Vector (AODV): Ad hoc On Demand Distance Vector (AODV) is a reactive routing

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protocol which works on demand basis when the nodes requires within the network. When source node has some data to send to destination node then initially it sends Route Request (RREQ) message which is propagated by intermediate nodes until destination is reached. A route reply(RREP) message is unicasted back to the source node if the receiver either has *a* valid route to the requested address or it is a node using the requested address. This protocol is capable of both unicasting and multicasting.

Dynamic Source Routing (DSR): The Dynamic Source routing (DSR) protocol is a simple and very efficient routing protocol particularly used for the multi-hop mobile wireless ad-hoc networks. It permits the network to be completely self configuring and organizing, without any need for pre established network infrastructure .It uses source routing to deliver packets from source to destination nodes. Source routing means that the source node must have knowledge about complete hop sequence to the destination node. Each node maintains a route cache for storing all route and route information in DSR.

III. Simulation Setup

In this work we employed OPNET Modeler 16.0 for simulation. A campus network was modeled within an area of 100 km x 90 km. The all mobile nodes were spread within the area. In Table I describe the simulation parameters that are used in this simulation in order to evaluate and compare the performance of two selected routing protocols (AODV, DSR) over a VANET network. Each and every scenario there is different numbers of mobile nodes. In first scenario we have 100 mobile nodes at constant speed 10m/s for simulating AODV routing protocol. In second scenario we have 100 mobile nodes at constant speed 10m/s for simulating DSR routing protocol and so on according to the Table II.

Each scenario was run for 1800 seconds (simulation time). Under each simulation we check the behaviour of AODV and DSR routing protocol with constant mobility (20 m/s) and constant pause time. For examining average statistics of the network load, delay and throughput for the AODV and DSR routing protocol of VANET we collected DES (global discrete event statistics) on each protocol and Wireless LAN. We take the FTP traffic in the application configuration object this sets the application to model the high load FTP traffic for analyse the effects on routing protocols. In profile configuration object we configured the profile with high load FTP application. The nodes were wireless LAN mobile nodes with data rate of 11Mbps. After defining profile configuration we configure Mobility Configuration object for defining the mobility pattern and model that the nodes will follow during the simulation. The default random waypoint mobility model was used in this simulation. Mobile nodes in all scenarios moving with the constant speed of 10 m/s and pause time are 200 seconds

Table I Simulation Parameters

Simulation Parameters	
Examined Protocols	AODV and DSR
Number of Nodes	100,150,200,250,300,350
Types of Nodes	Mobile
Simulation Area	100 x 90 KM
Simulation Time	1800 seconds
Mobility	20 m/s
Pause Time	200 s
Performance Parameters	Throughput, Delay, Network load
Traffic type	FTP
Mobility model used	Random waypoint
Data Type	Constant Bit Rate (CBR)
Packet Size	512 bytes
Trajectory	VECTOR
Long Retry Limit	4
Max Receive Lifetime	0.5 seconds
Buffer Size(bits)	25600
Mobility model used	Random waypoint
Data Type	Constant Bit Rate (CBR)
Packet Size	512 bytes
Traffic type	FTP, Http
Active Route Timeout	4 sec.
Hello interval(sec)	1,2
Hello Loss	3
Timeout Buffer	2
Physical Characteristics	IEEE 802.11g (OFDM)
Data Rates(bps)	54 Mbps
Transmit Power	0.005
RTS Threshold	1024
Packet-Reception Threshold	-95

Table II Scenario used

Scenarios	Nodes	Protocol
Scenario 1	100	AODV
Scenario 2	100	DSR
Scenario 3	150	AODV
Scenario 4	150	DSR
Scenario 5	200	AODV
Scenario 6	200	DSR
Scenario 7	250	AODV
Scenario 8	250	DSR

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IV. Performance Metrics:

We have primarily selected the following three performance metrics in order to study the performance comparison of AODV and DSR.

A. End to End Delay

The packet end to end delay is the average time that packets take to traverse in the network. Delay is the total time taken by the packets to reach from the source to destination. It is expressed in seconds. Hence all the delays in the network are called packet end-to-end delay. It includes all the delays in the network such as propagation delay (PD), processing delay (PD), transmission delay (TD), queuing delay (QD).

B. Network Load

Network load can be define as the total amount of data traffic being carried by the network .When there is more traffic coming on the network, and it is difficult for the network to handle all this traffic so it is called the network load. High network load affects the VANET routing packets that reduce the delivery of packets for reaching to the channel.

C. Throughput

Throughput can be defined as the ratio of the total amount of data reaches a destination from the source. The time it takes by the destination to receive the last message is called as throughput. It is expressed as bytes or bits per seconds (byte/sec or bit/sec).

AUTHOR NAME	YEAR	PAPER TITLE	WORK
SUNXi et.al	2008	Study of the feasibility of VANET and its routing protocols	Here, the author studied the application of VANET to city road traffic control by using NS2 simulator. After the simulation, author concluded that reactive routing protocols more suitable for VANET.
Josiane Nzouonta et.al	2009	VANET routing on city roads using real-time vehicular traffic information	In this paper, the author implemented a reactive protocol RBVT-R and a proactive routing protocol RBVT-P and compared them using NS-2.30.The result showed that distributed applications can use RBVT-R when throughput is required and RBVT-P if they are delay-sensitive.
Shaikhul Islam Chowdhury et.al	2011	Performance evaluation of reactive routing protocols in VANET	Here, the author compared performances of reactive routing protocols i.e. AOMDV, DSR, AODV in VANET by using NS-2.34.After simulation, the author showed that DSR has better PDF and lesser routing overload and AOMDV has better performance in end to end delay.
Hua-Wen Tsai	2011	Aggregating data dissemination and discovery in vehicular adhoc network	This paper proposed an aggregating data dissemination and discovery algorithm in vehicular ad-hoc network by using NS2. After simulation, author concluded that ADD algorithm can decrease aggregation and dissemination cost in communication and the user can get data quickly when they need.
Vijaylaxmi S.Bhat et.al	2012	Performance comparison of adhoc VANET routing algorithms	Here, the author proposed a rate adaptation algorithm that behaves as Auto Rate Fallback and evaluated the performance of this algorithm and compared this with other algorithms. the result showed that AODV provides quick adaptation .
Jagdeep Kaur et.al	2013	Performance comparison between unicast and multicast protocols in VANETs	In this paper, author showed the performance comparison b/w unicast and multicast routing in VANETs and calculated the efficiency of unicast routing protocols (AODV,DSR) and multicast routing protocols (ADMR, ODMRP) by using NS-2.34. The author compared the protocols efficiency for result.
Sheeba Memon et.al	2014	Performance evaluation of MANET's Reactive and proactive routing protocols in high speed VANETs	In this paper, the author evaluated the performance of two MANET routing protocols –AODV and DSDV in high mobility VANET by using NS2 simulator. After evaluation author observed AODV has better performance as compared to DSDV which has low performance in even un-stressed conditions.

V. Result and Analysis

The simulation result shows the performance behavior of the considered protocols in terms of network load, end to end delay and throughput. Figure 6.1–6.4 depicts the performance on the basis of network load with varying number of nodes. From graph results it is observed that DSR has less average network load as compared to the AODV. DSR has less average network load because of its on demand routing characteristics so there is no need to update the routing table. Figure 6.5–6.8 depicts the performance on the basis of end to end delay with varying number of nodes. From graph results it is observed that DSR shows higher end to end delay as compared to AODV due to the reason that when a RREQ is sent, the destination replies to all RREQ it received, which make it slower to determine the least congested route. In AODV, every destination replies to only first RREQ. In figure 6.8 observed that as the number of node increases AODV performs better than DSR, due to the route discovery process is very fast. Figure 6.9–6.12 depicts the performance on the basis of throughput with varying number of nodes. Here we see that AODV shows very high average throughput as compared to DSR that shown in figure 6.12. Because AODV is highly reliable in terms of large-scale environment and high-speed.

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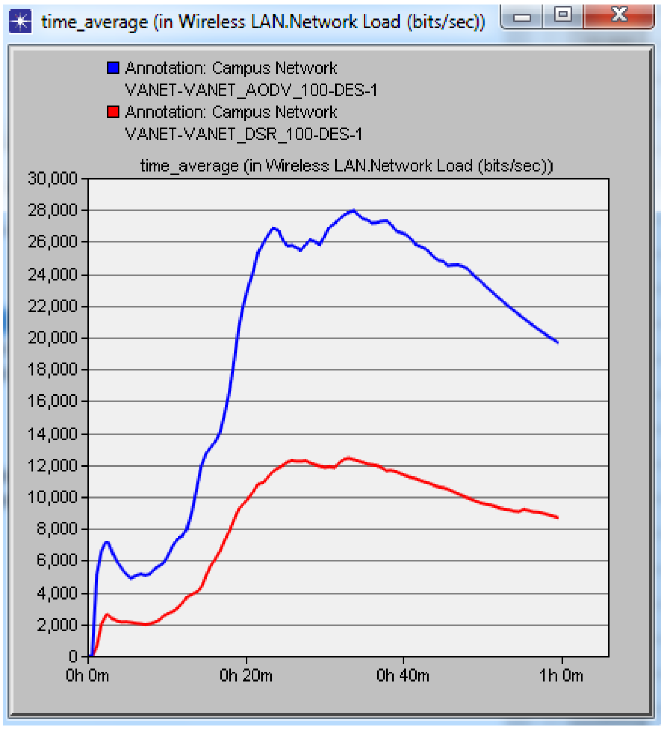

Figure 6.1: Network load of AODV and DSR for 100 nodes.

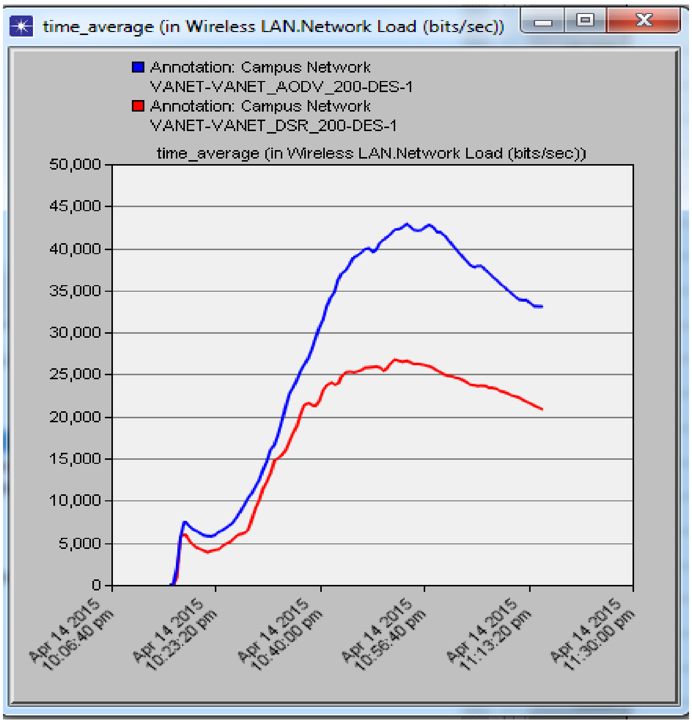

Figure 6.3: Network load of AODV and DSR for 200 nodes.

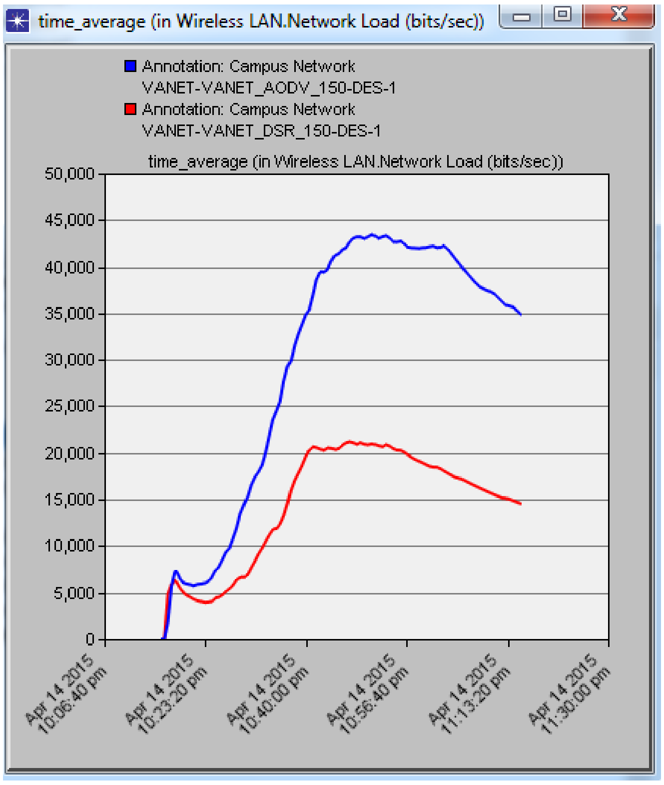

Figure 6.2: Network load of AODV and DSR for 150 nodes.

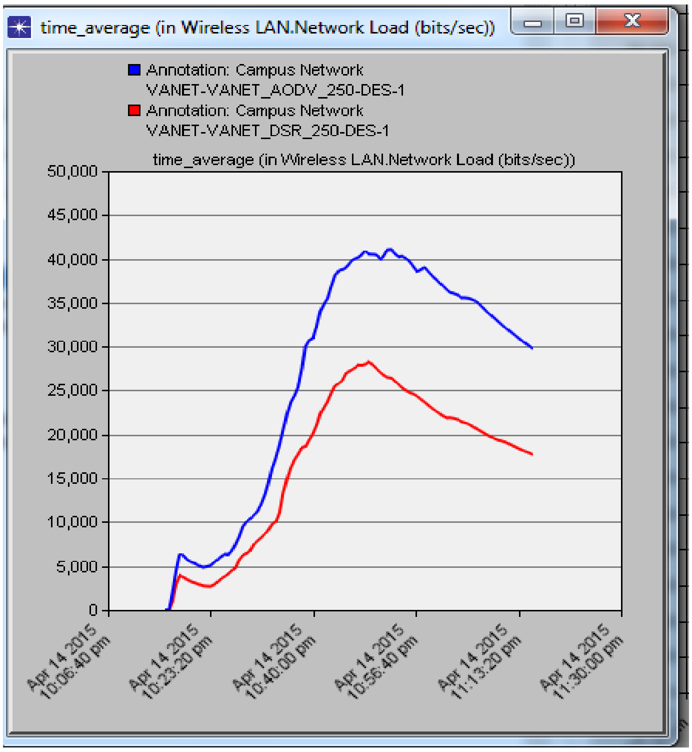

Figure 6.4: Network load of AODV and DSR for 250 nodes.

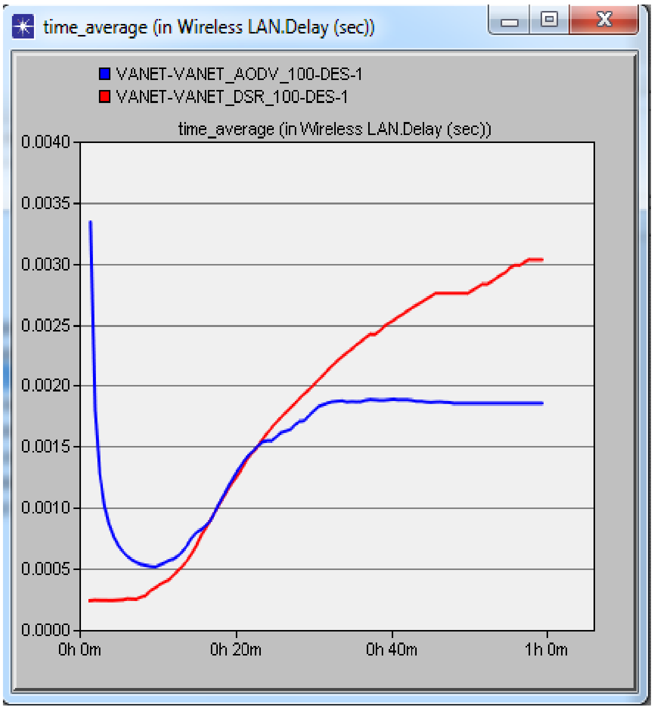

Figure 6.5: End to End Delay of AODV and DSR for 100 nodes

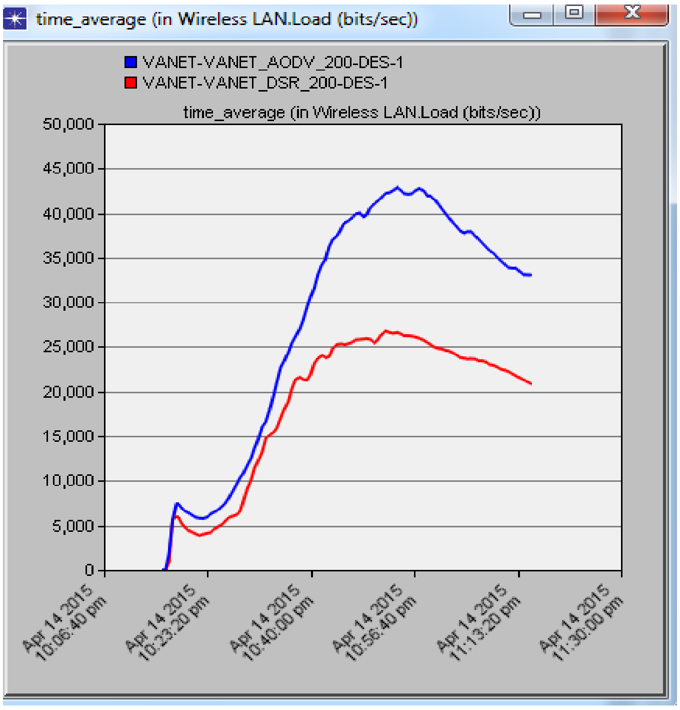

Figure 6.7: End to End Delay of AODV and DSR for 200 nodes

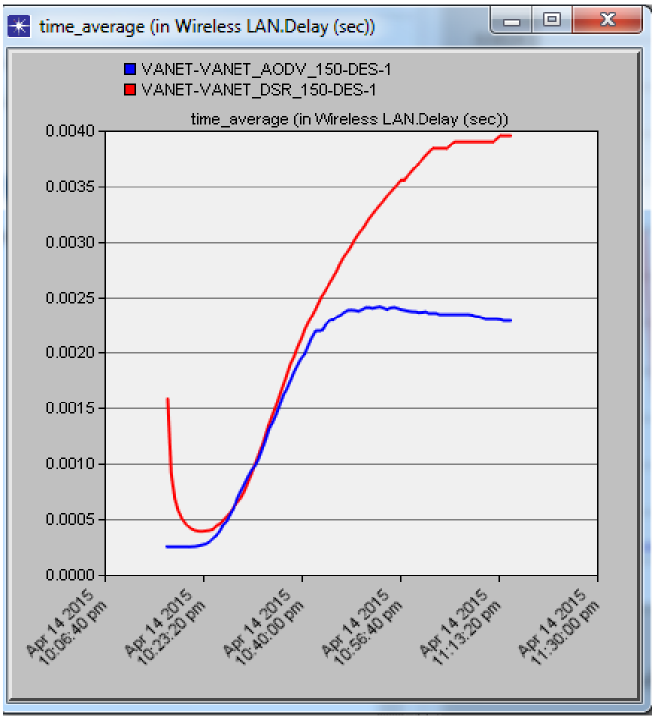

Figure 6.6: End to End Delay of AODV and DSR for 150 nodes

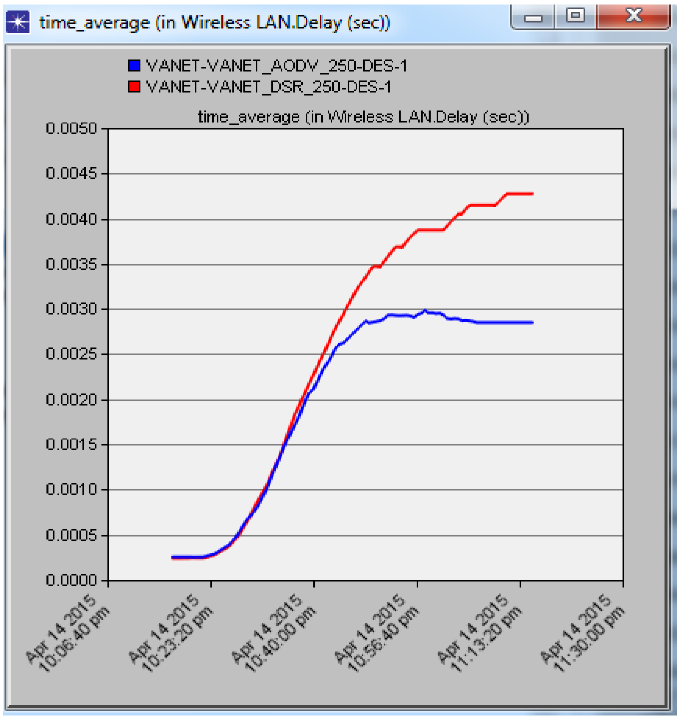

Figure 6.8: End to End Delay of AODV and DSR for 250 nodes

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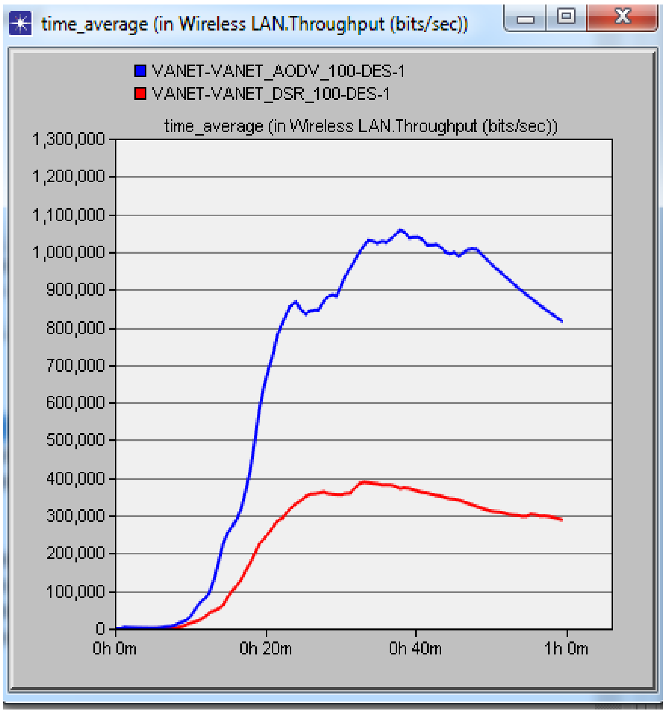

Figure 6.9: Throughput of AODV and DSR for 100 nodes.

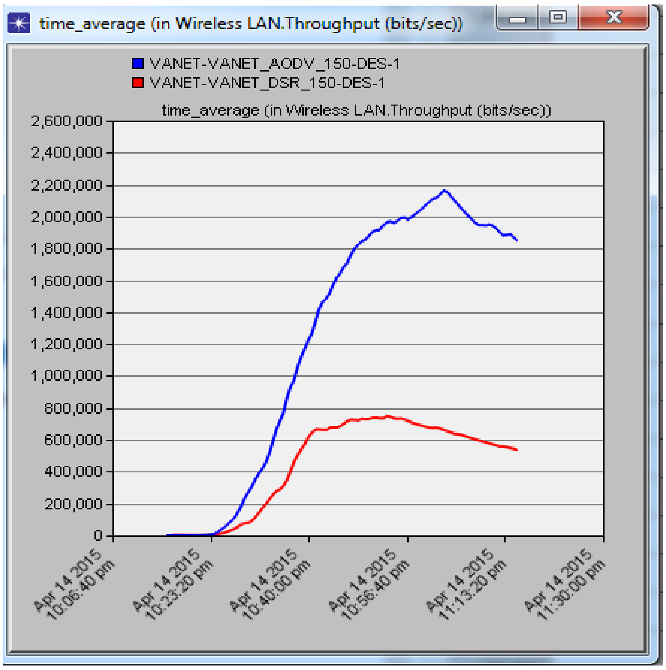

Figure 6.10: Throughput of AODV and DSR for 150 nodes.

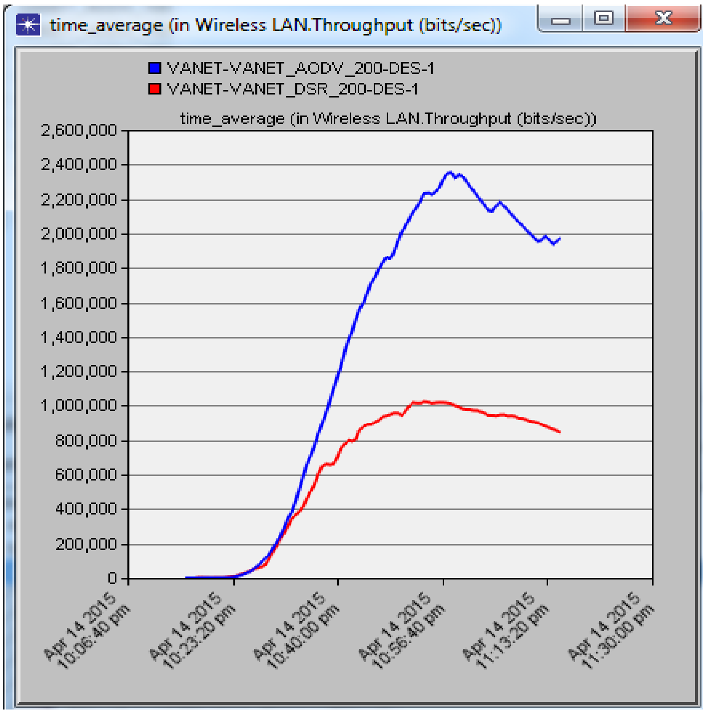

Figure 6.11: Throughput of AODV and DSR for 200 nodes.

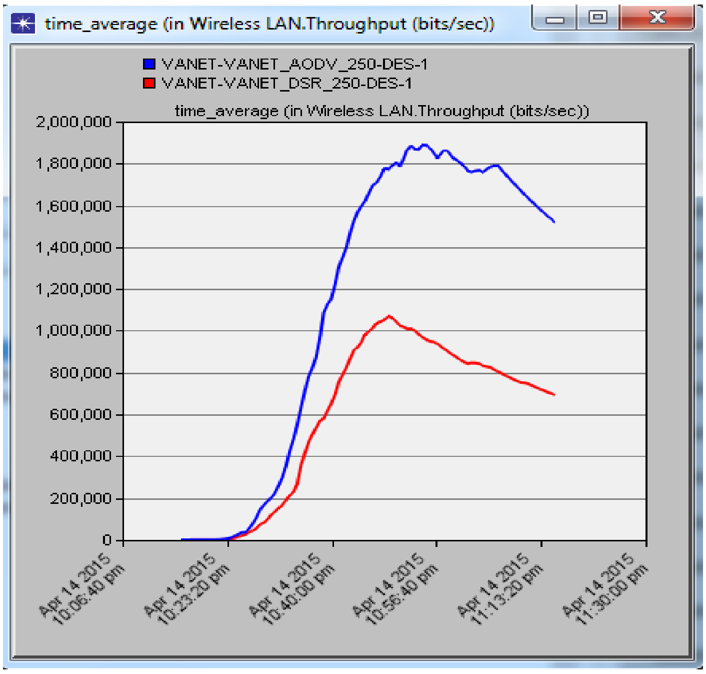

Figure 6.12: Throughput of AODV and DSR for 250 nodes.

VI. CONCLUSION

This paper described a performance analysis and compared two reactive routing protocols (AODV, DSR) for VANET. The simulation for both protocols was done by using OPNET 14.5 and were analyzed in terms of network load, end to end delay and throughput with varying number of nodes (100, 150, 200 and 250). By the simulation result, we can conclude that average end to end delay of DSR is much higher than AODV and average throughput of AODV is much better than DSR in all scenarios and DSR shows less average network load as compared to AODV routing protocol in terms of network load.

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