An Improvement of AODV Routing Protocol for Vehicular Ad-hoc Networks (VANETs)

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Abstract: Vehicular Ad Hoc Network (VANET) is a sub class of Mobile Ad Hoc Networks (MANET). Vehicular Ad Hoc Network (VANET) provides wireless communication among vehicles and road side equipment. The communication between vehicles is used for safety, comfort and for entertainment as well. The performance of communication depends on how better the routing takes place in the network. Routing of data depends on the routing protocols being used in network. In this paper our main aim is to evaluate and improve the performance of one routing protocol i.e. Ad hoc On Demand Distance Vector (AODV) by taking two performance metrics like throughput and end-to-end delay with varying number of mobile nodes or vehicle node density (100, 150, 200, 250, 300 and 350) i.e. low vehicle-node density (100 and 150 mobile nodes) medium vehicle-node density (200 and 250) mobile nodes) and high vehicle-node density (300 and 350 mobile nodes) with constant mobility 10m/s. For the performance evaluation of routing protocols a simulation tool 'OPNET Modeller v14.5' has been used. OPNET (Optimized Network Engineering Tool) is a commercial network simulator environment used for simulations of both wired and wireless networks.

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

I. INTRODUCTION

As the number of vehicles is increasing on the road, vehicle driving is becoming more and more challenging. Ad-hoc Network is an emerging technology which is an autonomous collection of wireless mobile nodes that are self configured to form a network environment without any infrastructure establishment. Vehicular Ad hoc Networks (VANET) is a type of Ad-hoc Network which is spontaneously formed between moving vehicles. In VANET, vehicles act as nodes which can exchange information between each other without any network infrastructure establishment. It is the most advanced technology that provides Intelligent Transportation System (ITS) in wireless communication among vehicles to vehicles and road side equipment (RSUs) to vehicles according to IEEE 802.11p standard . Each node in the network may be either a vehicle or Road Side Unit (RSU) which is equipped with the necessary communication facility. An electronic device placed inside each vehicle will provide Ad-hoc network connectivity for the vehicles.

It is widely finding application in areas such as traffic and road safety, payment collection, tourist guiding information and natural hazards . In VANET environment, routing should be focused, as it is essential for life safety applications. The information should be broadcasted to all the entities in the network with the help of routing protocols. This paper is organized as follows: VANET routing protocols and simulation setup are described in section II and III, Proposed work are described in IV section then performance metrics used in this study are described in section V. In section VI we present the simulation result and analysis of our observation. Finally conclusion and future works are given in section VII.

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. A. Proactive Routing Protocols: When a packet needs to be forwarded, the route is already known. Each node maintains table.

B. B. Reactive Routing Protocols: Determine a route only when there is data to send. It maintains only currently active routes to reduce network load.

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

III. SIMULATION SETUP

In this work we used OPNET Modeler v14.5 Modeller simulator for simulation purpose. A campus is network was modelled for simulation within an area of 50 m x 50 m. The all mobile nodes were spread within this area. Mobility model used is random waypoint model with mobility of 100 meters, the performance of the reactive ad-hoc routing ADOV and EAODV protocol is evaluated by implementing different scenarios. The buffer size of data is set to 1024 Kbps

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for each mobile workstation at data rate of 54Mbps with OFDM 802.11g PHY layer & DCF MAC Protocol implementation. The traffic flows randomly between different Voice applications workstations placed at different distances. We take the different network size according to the number of node as on increasing the number of nodes in a VANET; there will obvious increase power consumption. So by changing the value of Active Route Time, Hello Loss, and Hello Interval we make a scenario (EAODV) and compare with the standard scenario (AODV). The simulation parameter of both scenarios is given in Table I and Table II.

Table I Simulation Parameters

Examined Protocols	AODV	E-AODV
Number of Nodes	100,150,200,250,300 and 350	100,150,200,250,300 and 350
Types of Nodes	Mobile	Mobile
Simulation Area	50*50 km	50*50 km
Simulation Time	3600 seconds	3600 seconds
Mobility	Uniform(10-100) m/s	Uniform(10-100) m/s
Pause Time	200 seconds	200 seconds
Performance Parameters	Throughput, Delay	Throughput, Delay
Traffic type	FTP, Http	FTP, Http
Active Route Timeout(sec)	4	24
Hello interval(sec)	1,2	3,4
Hello Loss	3	5
Timeout Buffer	2	6
Physical Characteristics	IEEE 802.11g (OFDM)	IEEE 802.11g (OFDM)
Data Rates(bps)	54 Mbps	54 Mbps
Transmit Power	0.005	0.005
RTS Threshold	1024	1024
Packet-Reception Threshold	-95	-95
Long Retry Limit	4	4
Max Receive Lifetime(seconds)	0.5	0.5
Buffer Size(bits)	25600	25600
Mobility model used	Random waypoint	Random waypoint
Data Type	Constant Bit Rate (CBR)	Constant Bit Rate (CBR)
Packet Size	512 bytes	512 bytes

Table II Scenario used

Scenarios Name	**No. of Mobile Nodes**	**Protocol Used**
Scenario 1	100	AODV
Scenario 2	100	E-AODV
Scenario 3	200	AODV
Scenario 4	200	E-AODV
Scenario 5	250	AODV
Scenario 6	250	E-AODV
Scenario 7	300	AODV
Scenario 8	300	E-AODV
Scenario 9	350	AODV
Scenario 10	350	E-AODV

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IV. PROPOSED WORK

Various simulation parameters have been used for performance improvement of AODV routing protocol in VANETs. The techniques have been proposed to increase the Throughput and decreases the end to end delay of AODV routing protocol by increasing the number of nodes. Here we present different adaptable parameters to optimize AODV and describe ttheir effects on Throughput and end to end delay. The parameters we target to optimize AODV AODV routing algorithm are Active Route Timeout, Hello Interval and Time to live. The **Active Route time out** is the lifetime of the routing table. After this period of time the MANET will not consider this route. **Hello interval** is the time taken by the source node to send the hello message to the other node to make a contact with the intermediate node.
Time-to-live is the number of hops that a packet is permitted to travel before being discarded by router

PROPOSED ALGORITHM:

Step 1: Take initial parameters, Active Route Timeout(X) and Hello Interval(Y) and calculate QoS, Q.

Step 2: Modify the parameters (X'=X±x, Y'=Y±y) and calculate new QoS, Q'.

Step 3: Compare both QoS (Q and Q').

3.1. If Q' is better than Q, set optimized value of Active Route Timeout X' and Hello Interval Y'. Replace Q by Q'. Go to Step 2.

Apply Time-To-Live(TTL),T parameter on Q' to calculate new QoS, Q_1.

a) Modify TTL (T'=T+t), and calculate QoS, Q_2.

b) Compare Q_1 and Q_2.

c.1) If Q_2 is better than Q_1, set optimized value of Active Route Timeout X', Hello Interval Y' and TTL T'. Replace Q_1 by Q_2. Go to step 3.1.(b).

c) End.

3.2. If Q is better than Q', save optimized value of Active Route Timeout X and Hello Interval Y. Go to Step 2.

a) Apply Time-To-Live(TTL),T parameter on Q to calculate new QoS, Q_1.

b) Modify TTL (T'=T+t), and calculate QoS, Q_2.

c)Compare Q_1 and Q_2.

c.1) If Q_2 is better than Q_1, set optimized value of Active Route Timeout X, Hello Interval Y and TTL T. Go to step 3.2.(b).

d) End

V. 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. 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.

VI. RESULT AND ANALYSIS

The simulation result shows the performance behavior of the considered protocols in terms of end to end delay and throughput. Figure 6.1–6.6 depicts the performance Improvement on the basis of end to end Delay with varying number of nodes. From graph results it is observed that E-AODV has less average end to end delay as compared to the AODV Figure 6.7–6.12 depicts the performance on the basis of Throughput with varying number of nodes. From graph results it is observed that E-AODV shows higher Throughput as compared to AODV.E-AODV is highly reliable in terms of large-scale environment and high-speed.

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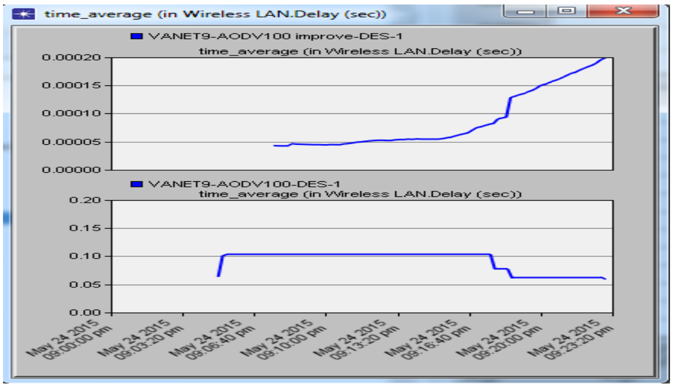

Figure 6.1: Delay of AODV and EAODV at 100 Nodes

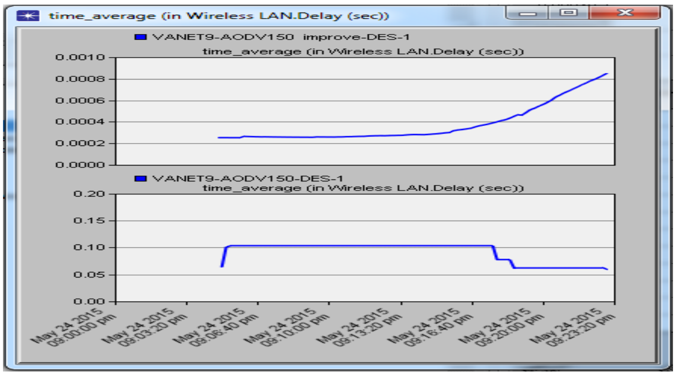

Figure 6.2: Delay of AODV and EAODV at 150 Nodes

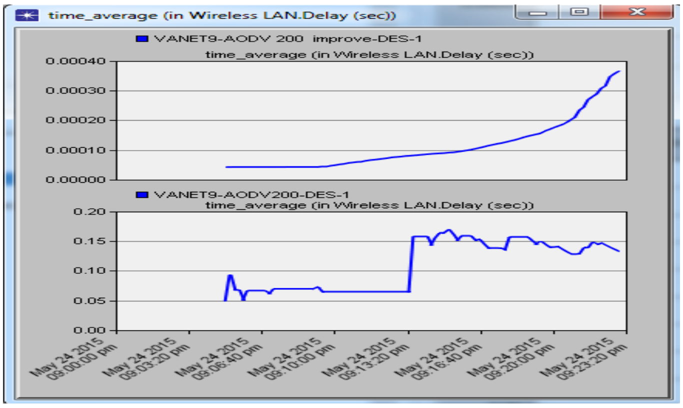

Figure 6.3: Delay of AODV and EAODV at 200 Nodes

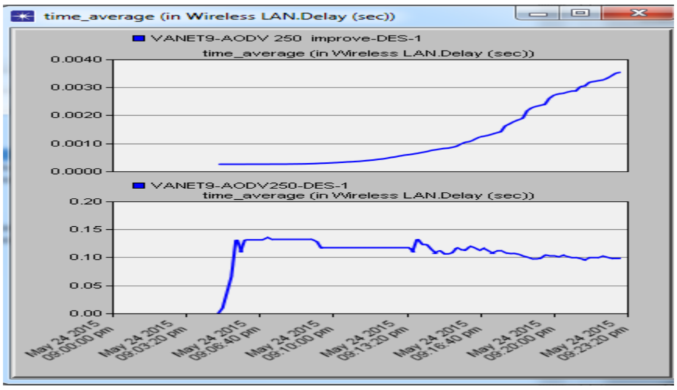

Figure 6.4: Delay of AODV and EAODV at 250 Nodes

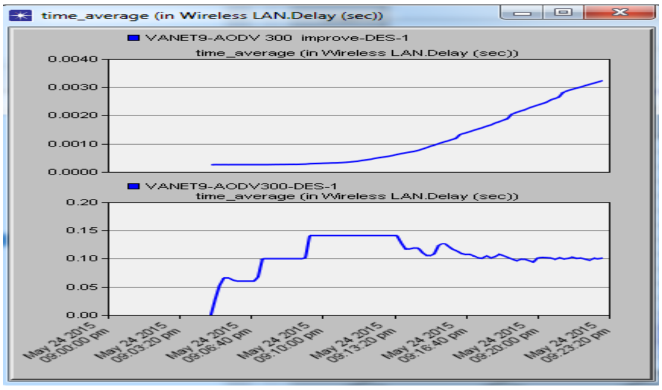

Figure 6.5: Delay of AODV and EAODV at 300 Nodes

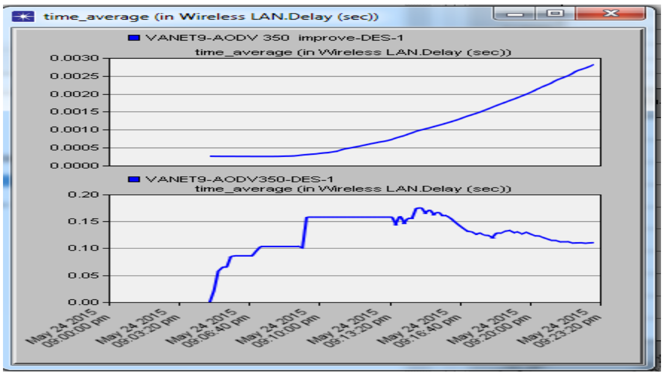

Figure 6.6: Delay of AODV and E-AODV at 350 Nodes

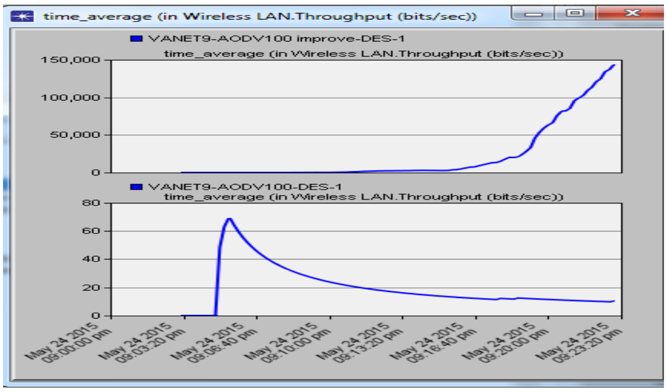

Figure: 6.7 Throughput of AODV and E-AODV at 100 Nodes

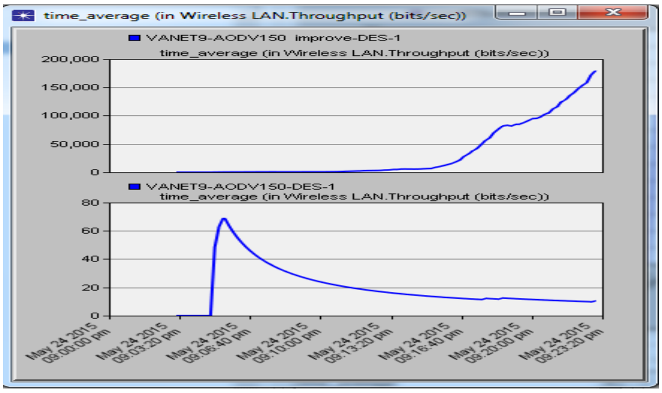

Figure 6.8: Throughput of AODV and DSR for 150 nodes.

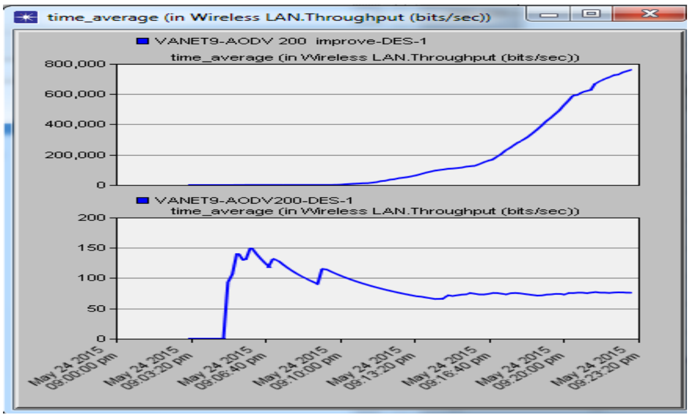

Figure 6.9: Throughput of AODV and DSR for 200 nodes.

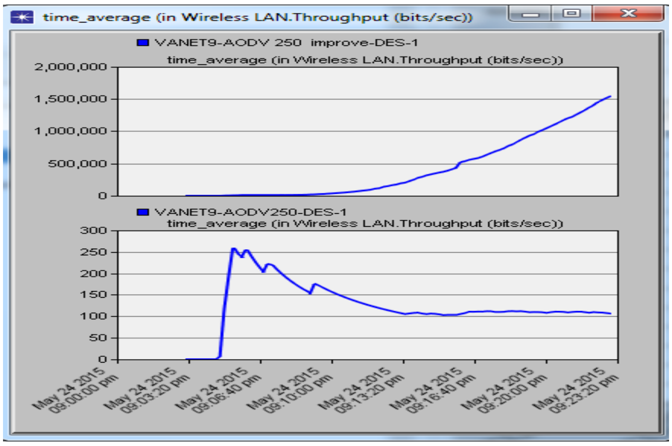

Figure 6.10: Throughput of AODV and DSR for 250 nodes.

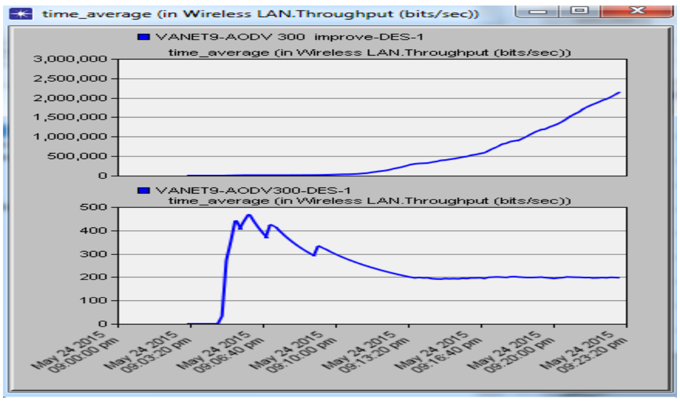

Figure 6.11: Throughput of AODV and DSR for 300 nodes.

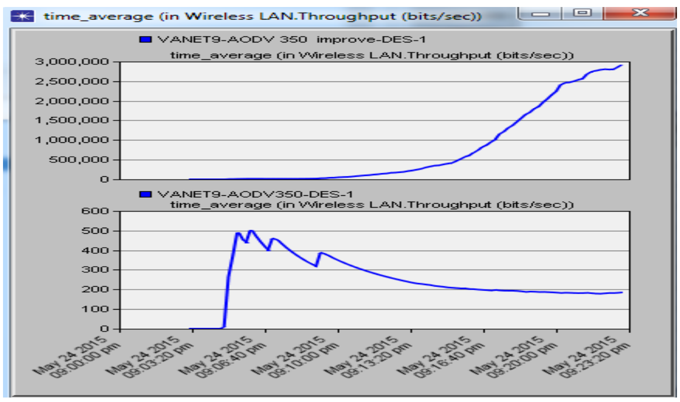

Figure 6.12: Throughput of AODV and DSR for 350 nodes

VII. Conclusion

This paper described the performance Improvement of AODV Routing protocol in VANETs.The simulation for AODV protocol was done by using OPNET 14.5 and were analyzed in terms of end to end delay and throughput with varying number of nodes (100, 150, 200,250,300 and 350). By the simulation result, we can conclude that average end to end delay of E-AODV is much higher than AODV and average throughput of E-AODV is much better than AODV in all scenarios .

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