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Performance Improvement of AODV Routing Protocol for Intelligent Transportation System

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ABSTRACT: The dream of whole cities covered with dynamic networks of "talking cars" is gradually becoming a reality. The network thus produced is Vehicular Ad hoc Networks (VANETs). Routing is considered to be the most critical issue. So, in this paper, the aim is to evaluate and improve the performance of Ad hoc On Demand Distance Vector (AODV) by taking throughput with varying number of mobile nodes (100, 150, 200, 250) or vehicle node density i.e. low vehicle-node density, medium vehicle-node density and high vehicle-node density with constant mobility 50 m/s. For the performance assessment 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: MANET, VANET, AODV, Reactive, Pro-active, OPNET

I. Introduction

Every day, lot of people die, and lot of people are injured in traffic accidents across the world. The need to enhance road safety information among vehicles to prevent accidents and also enhance road safety was the significant motivation behind the growth of vehicular ad hoc networks (VANETs). VANETs are a predicting technology which makes enable interactions between vehicles on roads. They are a particular kind of mobile ad hoc networks (MANETs) that offer vehicle-to-vehicle communications. It is considered that every vehicle is fitted with a wireless communication services to offer ad hoc network connectivity. VANETs have tendency to operate without any infrastructure, each and every network vehicle can forward, obtain messages to other network vehicles. Intelligent Transportation System (ITS) that will change our manner to drive and support emergency facilities. VANETs permit vehicles to easily interact with one another and also with static infrastructure. This will not only enhance the complete road safety, but also raise novel commercial opportunities.

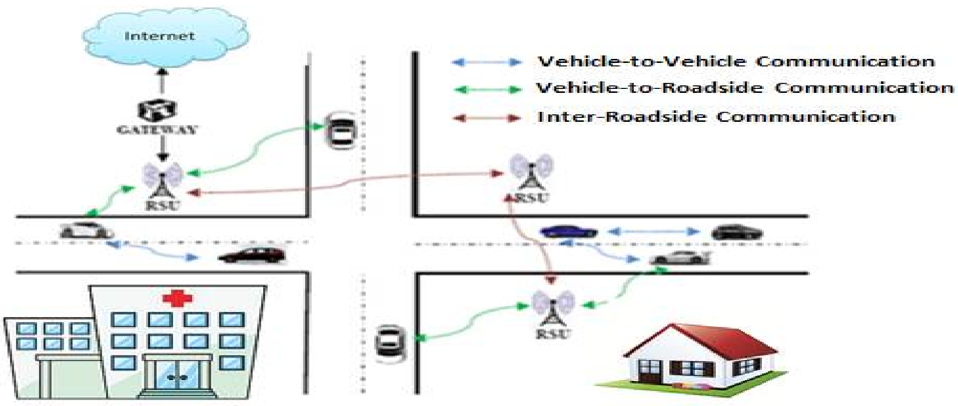

Fig.1 Structure of Vehicular Ad-hoc Networks

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Every vehicle is fitted with a short range communication device and controller nodes are positioned in the intersection with traffic lights. Our suggestion maintains traffic information viewing to avoid accidents, although the information here is collected from the vehicles themselves so no further infrastructure is required. This manner, vehicles can interchange real-time information, and drivers can be reported about road traffic situations and other travel-related information. The major challenging issue is high mobility and the frequent changes of the network configuration. In VANETs, the network configuration could change when the vehicles alter their velocities and/or lanes. These changes are based on the drivers and road conditions and are generally not scheduled in advance. Embedded wireless devices are the significant components of emerging cooperative active safety systems for vehicles. These systems, which depend on communication among vehicles, provide alerting messages to drivers and may even directly take vehicle control of such applications, involving communication and detection of vehicle information are tightly integrated with vehicle physical dynamics and drivers nature. Current research on such cooperative vehicle safety (CVSS) systems has indicated that important performance enhancement is possible by integrating the components design of the systems that are concerned to dynamics of vehicle with the cyber components that has responsibility for tracking other cars and determining attacks. The kinds of possible warnings and actions in vehicle safety systems range from low-latency collision warning or avoidance systems to moderate-latency system that offer heads up information about possible dangers in the non immediate vehicle route. The primary differences of these systems are the sources and means of information acquisition and distribution. In active safety systems, vehicles are needed to be seamlessly aware of their neighbourhood of few hundred meters and scan possible emergency information. This aim can be obtained by frequent real time interaction among vehicles over dedicated short range communication (DSRC) channel. In addition to inter-vehicle communication; roadside devices may also guide vehicles in learning about their atmosphere by providing traffic signal or pedestrian related information at intersections. The main need of these active safety systems is the probability of delivering real-time achieved information to and among vehicles at lower latencies than few hundred milliseconds. Prototypes of these systems are being grown by several automotive manufacturers.

II. AODV ROUTING PROTOCOL.

This protocol is consisted of two phase (1) Route Discovery and (2) Route Maintenance. AODV utilizes Route Re Request (RREQ), Route Reply (RREP) control messages in Route Discovery stage and Route Error (RERR) control message in Route Maintenance stage .The header information of this control messages can be viewed in detail. Generally , the nodes playing role in the interaction can be categorized as source node, an intermediary node or a target node. With every role, the node behaviour actually changes [3]. When a source node wishes to link to a target node, first it examines in the available route table, as to whether a new route to that destination is existed or not. If a fresh enough route is existed, it utilizes the same.

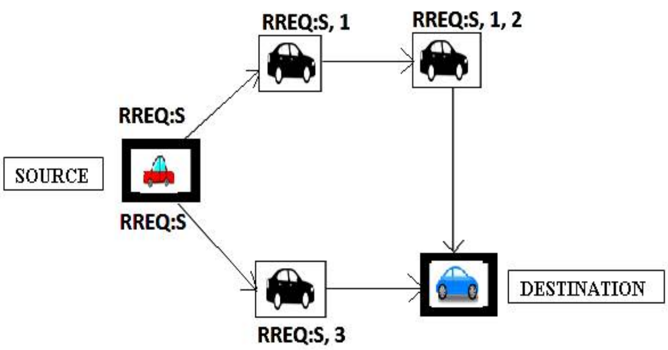

Figure 2: Route Request Propagation in DSR

Else the node starts a Route Discovery by flooding a RREQ control message to all of its neighbouring nodes. This RREQ message will further be sent (again flooded) by the intermediary nodes to their neighbouring nodes [4]. This procedure will proceed until the target node or an intermediary node having a fresh route to the destination node. At

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this phase, at last , a RREP control message is created. Hence, a source node after forwarding a RREQ waits for RREPs to be achieved.

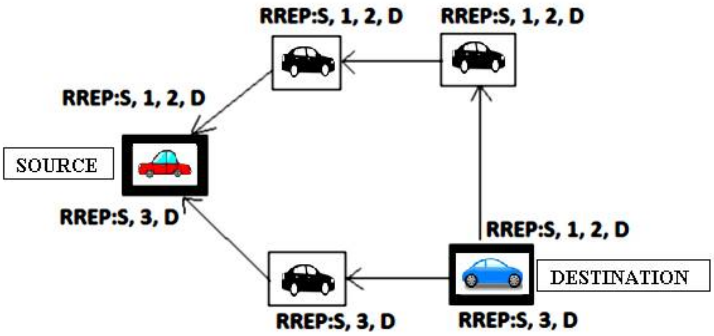

Figure 3: Route Reply Propagation in DSR

III. RELATED WORK

Author Description	Work
T. Sujitha , S. Punitha Devi et.al[1]	In this paper authors evaluates Intelligent Transportation System For Vehicular Ad-Hoc Networks. In their work for the performance evaluation authors used the NS2 simulator. This paper aims at enabling accurate and efficient evaluation of issuing vehicular network applications such equally Intelligent Transportation Systems (ITS).The results show that Dynamic Route Planning can be effectively held by a VANET system with up to 118% increase on the number of vehicles reaching the destination, 36.2% reduction in travel time and 56.1% reduction in delay time
Reza Fotohi, Shahram Jamali et.al [2]	In this paper authors An Improvement over AODV Routing Protocol by Limiting Visited Hop Count. In their work for the performance evaluation authors used the NS2 simulator. The work was accomplished by limited TTL (Time to Live) of RREP packet that the route reply (RREP) packet of AODV is modified to limited TTL information of nodes, and evaluated the four performance measures (i.e. PDR, throughput, good put and jitter with different number of nodes). Then we compared performance of our work with regular AODV in one scenario with 20 to 80 nodes. Simulation results show that the improved AODV protocol has a distinct advantage in terms of packet delivery ratio (PDR), throughput, good put and jitter over the regular AODV protocol (approximately 20%). As part of future work, we plan to add the factor of interfere between nodes into the route metric then work for MANETs.
Asha Ambhaikar,H.R. Sharma, V. K. Mohabey et.al [3]	In this paper authors Improved AODV Protocol For Solving Link Failure In MANET.In their work for the performance evaluation authors used the NS2 simulator. This work proposes an improvement of existing AODV and compares its performance in several parameters. The improved AODV functions differently by updating new path and resolving link break due to various causes. Our simulation results held to accept a decision that proposed AODV is better than conventional AODV by increased PDR, throughput and reduced Average end to end delay. And finally, concluded that the improved AODV protocol is a better choice for reliable communication.
Jing Zuo, Yuhao Wang , Yuan Liu and Yan Zhang et.al [4]	In this paper authors evaluate Performance Evaluation of Routing Protocol in VANET with Vehicle-node Density. In their work for the performance evaluation authors used the OMNET++ platform simulator. The paper simulates the performances of routing protocol, based on the two topical and realistic mobility models for VANET, with the increasing vehicle-node density around the receiver. Simulation results indicate the improvement of performance of routing protocols according to increase the node density about the receiver properly and show that the adaptability of reactive routing protocol and

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	proactive routing protocol with the vehicle-node density near the receiver is vary from different mobility models.
Venetis Kanakaris, David Ndzi, Kyriakos Ovaliadis et.al [5]	In this paper authors evaluate improving AODV performance using dynamic density driven route request forwarding. Their performances on different size networks and on mobile settings have been studied using simulations developed in Network Simulator 2 (NS2). Simulation results show that AODV_EXT achieves 3% energy efficiency, 19.5% improvement in data throughput and 69.5% reduction in the number of missed packets for a network of 50 nodes. Greater efficiency is achieved in high density network and marginal improvement in networks with a small number of nodes.
Nzouonta J. et al. [6]:	In this paper authors proposed a Road based vehicular traffic (RBVT) routing which is a class of VANET routing protocols for the city based environments. In this work ,authors described a road based vehicular traffic (RBVT) routing protocol that uses real time vehicular traffic information to create road based paths between endpoints. And also authors outline how to improve the end to end performance for the high contention areas by using the distributed mechanism.

IV. PROPOSED ALGORITHM

In our proposed algorithm we show the effect of different parameters on energy consumption through routing QoS. First we take an example of Active route time out, Hello Interval and Time-To-Live. The constant value is used to modify the values of the parameters.

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

Step 2: Modify the parameters (X'=X±x, Y'=Y±y, T) 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'.

a) Set Q_1 = Q'.
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'. Replace Q_1 by Q_2. Go to step 3.1.(b).
d) End.

3.2. Else, set optimized value of Active Route Timeout X and Hello Interval Y.

a) Set Q_1 = Q.
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.

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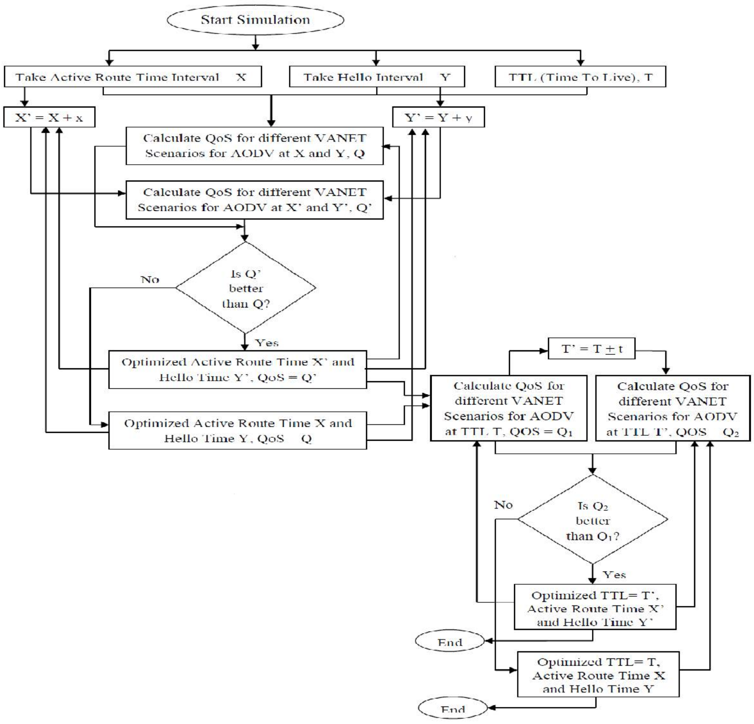

Figure 4: Flow Chart of Proposed Algorithm

V. SIMULATION RESULTS

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 can express as bytes or bits per seconds (byte/sec or bit/sec). There are some factors that affect the throughput such as; changes in topology, availability of limited bandwidth, unreliable communication between nodes and limited energy. A high throughput is absolute choice in every network.In figure 5 to 12, the graph represents the throughput in bits per seconds. The x-axis denotes the simulation time in minutes and the y-axis denotes throughput in bits per seconds. In first scenario of 100 nodes of our experimentation, packets travels are shown as throughput with peak value of approx. 28 lac. bits per seconds. In second scenario which EAODV packets transfer rate increases too high due to our approach In third scenario of 150 nodes of our experimentation, packets travels are shown as throughput with peak value of approx. 2250890 bits per seconds at pause time100 and active route time 5 to30 sec, and hello interval (1,1.1).

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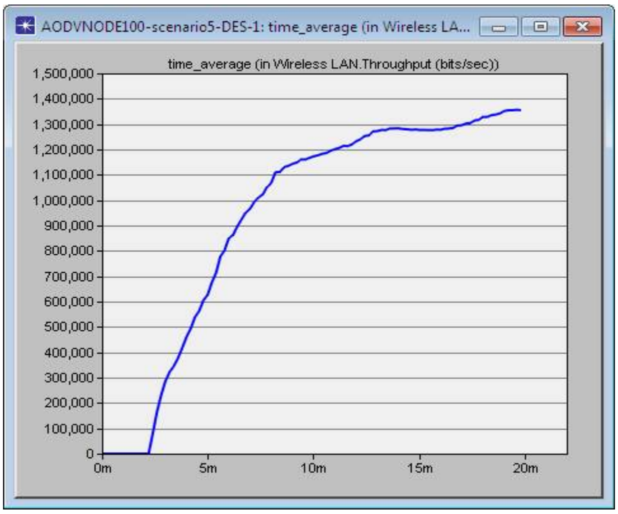

Figure 5 : Improved throughput for 100 Nodes

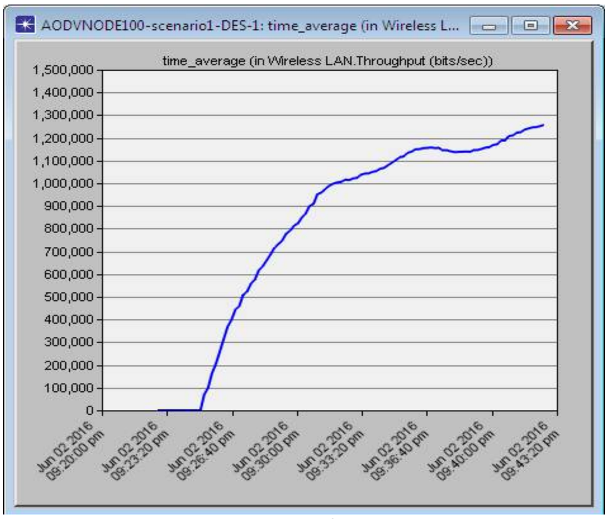

Figure 6 : Normal throughput for 100 Nodes

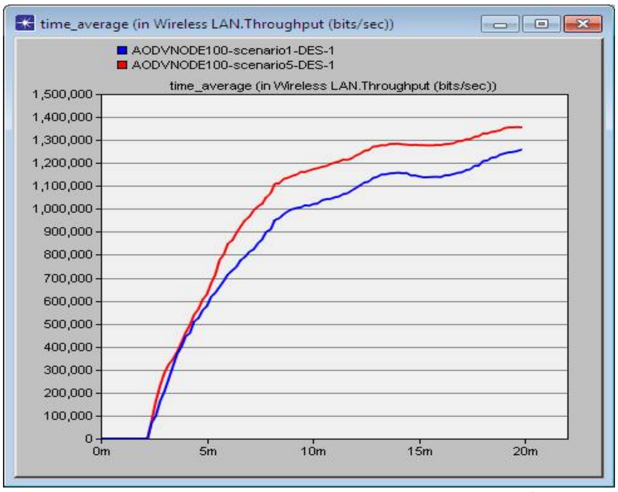

Figure 7 : Improved and Normal throughput for 100 Nodes

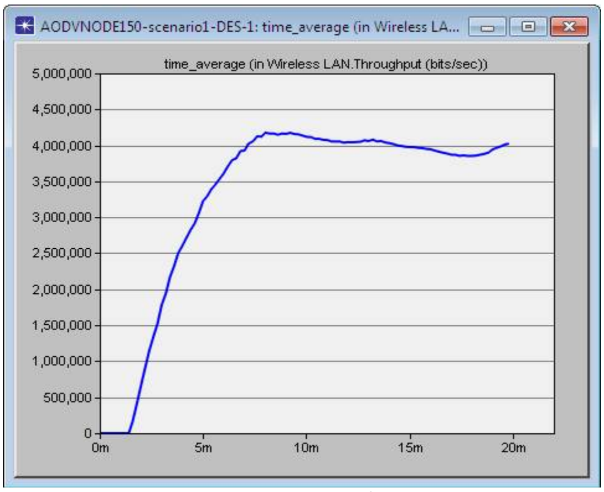

Figure 8 : Improved throughput for 150 Nodes

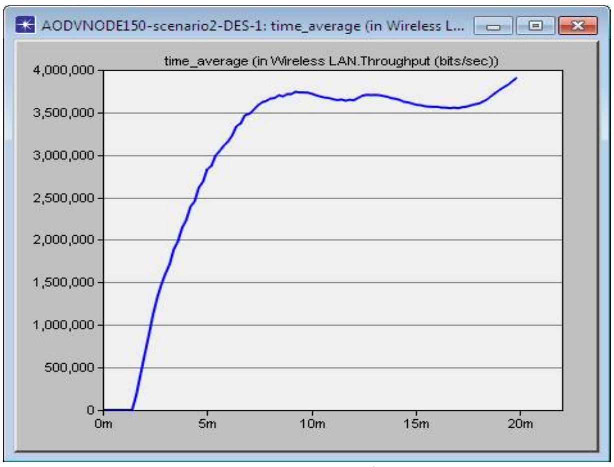

Figure 9: Normal throughput for 150 Nodes

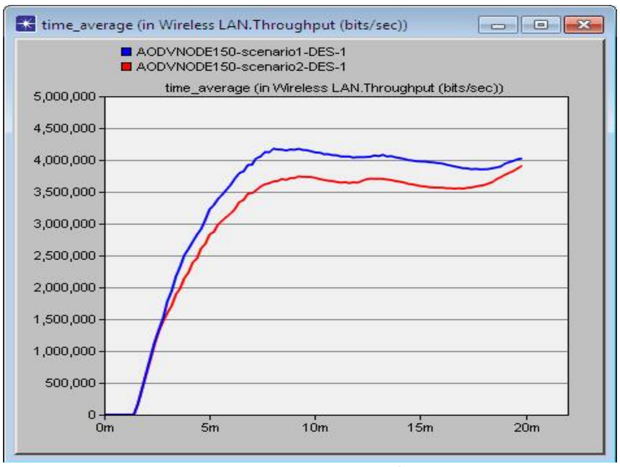

Figure 10 : Improved and Normal throughput for 150 Nodes

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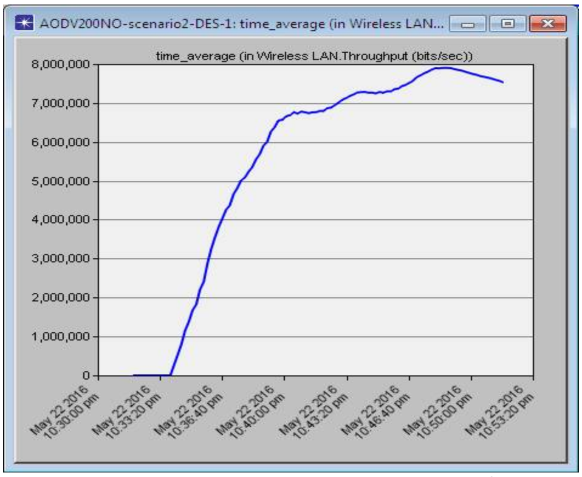


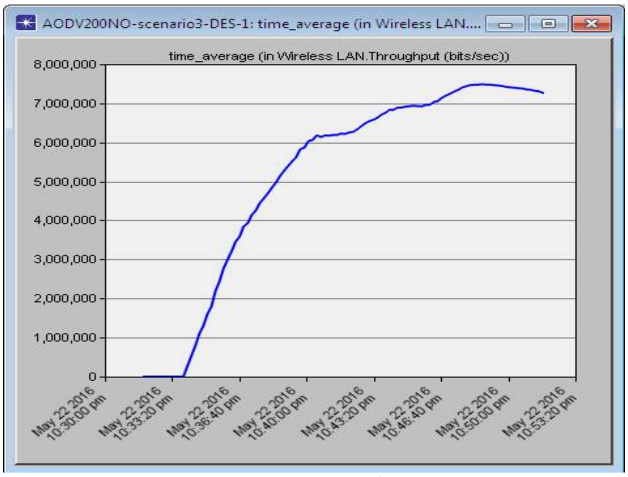
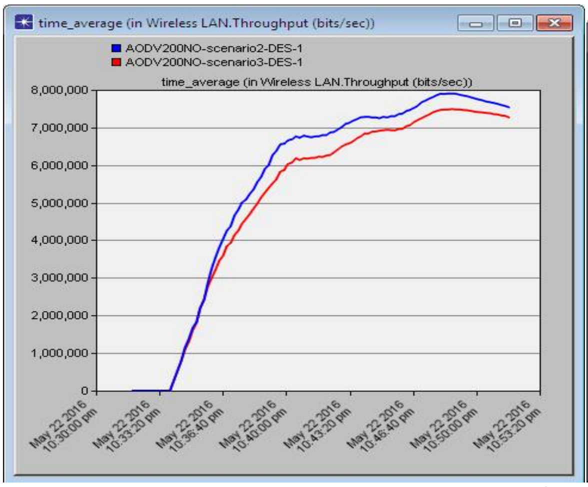


Figure 7 : Improved throughput for 200 Nodes   Figure 8: Normal throughput for 200 Nodes



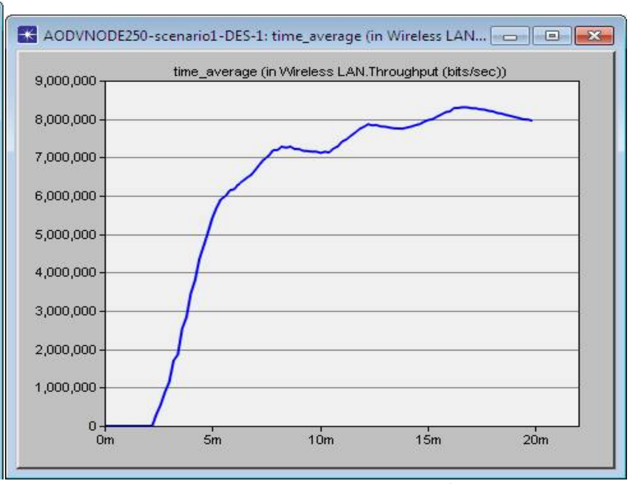
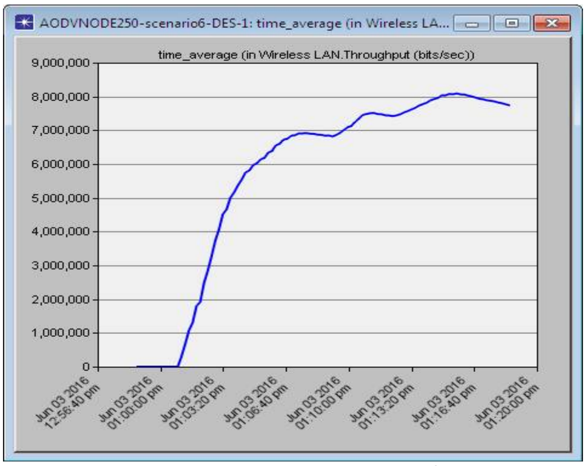


Figure 9: Improved and Normal throughput for 200 Node   Figure 10: Improved throughput for 250 Nodes



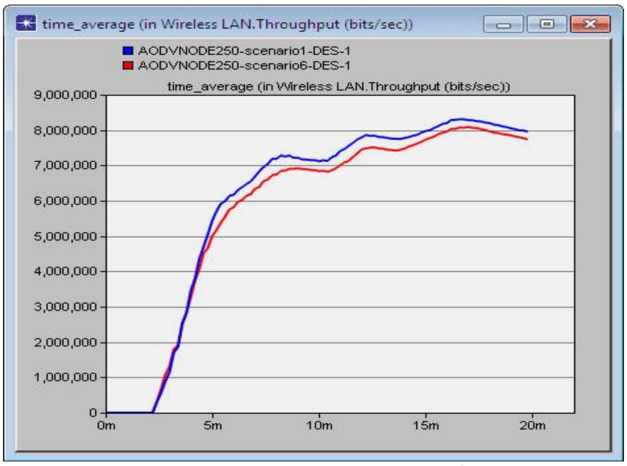


Figure 11: Normal throughput for 250 Nodes   Figure 12: Improved and Normal throughput for 250 Nodes

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VI. CONCLUSION AND FUTURE WORK

In this dissertation, AODV routing protocol with varying number of moving nodes or vehicles (100, 150, 200 and 250) and a constant speed of 10m/s with 200s pause time has been evaluated and improved. AODV protocol is evaluated and improves in terms of throughput. These performance metrics used in our evaluation represents performance aspects of performance in a network. Throughput addresses the reliability of the protocols.The simulation model of VANET network is simulated using Riverbed simulator and analysed and improves for AODV routing protocol. We applied some methodology to improve the performance of AODV protocol by modifying the values of parameters like Active Route Timeout, Time to live (TTL) and Hello Interval and make E-AODV routing protocol. We applied this modified AODV (E-AODV) to different numbers of nodes like 100, 150, 200 and 250 and concluded that this is effective in all the cases. It is concluded that E-AODV has better Quality of services such as throughput as compared to AODV protocol.

Future Work: Future work will improve the performance of existing ad hoc routing protocols with varying number of mobility, under other network scenario by varying the network size and mobility models using Qualnet and OPNET 17.5 using genetic based swarm optimization appraoch.

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