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An Implementation and Modification of VANET Routing Protocols using Multipath and Multicast Algorithm for Varying Node Density

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Abstract: Wireless networks between vehicles formed by VANET (Vehicular Ad hoc Networks). VANET incorporates the wireless communication and data sharing capabilities to turn into vehicles as a network topology. VANET is showing great potential in research area. Inter-vehicle communication system in VANET improves traffic safety. VANET consists of high dynamic topology alternating connectivity Patterned mobility and on board sensors etc. A challenging task in vehicular ad hoc network is routing of data due to its high dynamic behavior. An efficient routing protocol by understanding the dynamic behavior of VANET topology will plays an essential role in communication of vehicles. Mobility of nodes, road topologies are some of the internal factors are presented on the performance of routing protocols. Routing protocols are of mainly categorized into: Proactive, Reactive and Hybrid routing protocols. This paper occurs with performance evaluation of AODV (Ad-Hoc on-Demand Distance Vector), DSDV (Destination-Sequenced Distance Vector) routing protocols based on metrics such as packet delivery ratio, throughput and average end to end delay. AODV is reactive routing protocol and DSDV is proactive routing protocol. VANET represent a rapidly emerging and challenging class of MANET. In this type of network, each node operates not only as a host but also as a router; promote packets for other mobile nodes. Communication between nodes i.e. vehicles by means of wireless technology has a large potential to improve traffic safety and travel comfort for drivers and passengers. VANET, being an infrastructure-less networks, vehicle will be expected to cooperate to perform essential networking tasks such as routing.In this work, nodes have been used as vehicles and based on evaluation between four mostly used routing protocols Ad hoc on demand distance Vector routing protocol (AODV), DSDV and modified-AODV in VANET scenario. 30 sec time is taken for simulation with varying nodes i.e. 25 nodes, 50 nodes and 75 nodes and 100 nodes. Various mobility have been analyzed here which are 50 m/sec and 100 m/sec and performance has been evaluated on the basis of residual energy, packet delivery ratio, routing overhead, throughput and end to end delay with different environments. The simulation study has been completed using network simulator (NS2)tool. In this work we have carried out the detailed analysis of the routing protocols AODV, DSDV and modified AODV and concluded that varying mobility as well as varying node density drastically affects the behavior of the routing protocols.

Keywords: VANET, AODV, DSDV, Modified-AODV, IEEE802.11p, Network Simulator-2.35

1. INTRODUCTION

Vehicular ad-hoc networks (VANETs) are an extended class of Mobile ad-hoc networks (MANETs). As a class of wireless ad-hoc networks, their nodes are self-organized and distributed. A VANET is a technology that uses moving cars as nodes to create a mobile network.

VANET turns every participating car into a wireless router or node, allowing cars approximately 100 to 300 meters of each other to connect and, in turn, create a network with a wide range. VANETs can be regarded as a special type of MANETs. In addition to the characteristics of MANETs, VANETs present three unique features as follows:

1. High mobility of nodes results in rapid changes in Network topology and short life expectancy of routing.
2. With the changes of road condition, vehicle type, vehicle relative speed, wireless links are unstable.
3. The static shape of the road makes movement of vehicles limited, so vehicle trajectory is generally predictable.

VANET is the technology of building a robust Ad-Hoc network between mobile vehicles and vice versa, besides, between mobile vehicles and roadside entities. As shown in Fig. 1.3, there are two types of nodes in VANETs; mobile nodes as On Board Units (OBUs) and static nodes as Road Side Units (RSUs).

An OBU resembles the mobile network module and a central processing unit for on-board sensors and warning devices. The Road Side Unit can also be mounted in various centralized locations such as intersections areas, parking or oil/gas stations. It can play a significant and effective role in many applications such as a gateway to the Internet.

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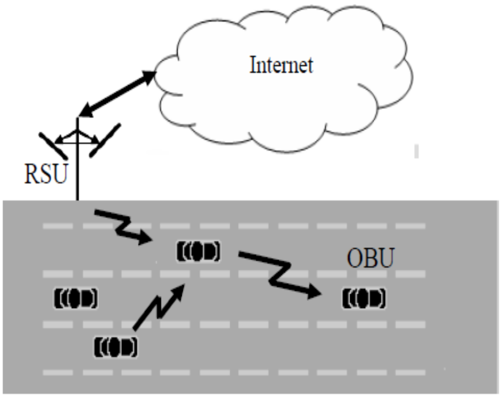

Figure.1Node Types in VANET

VANET presents a new and promising field of research & Development as well as standardization. All over the world, there are so many national and international projects in academia, industry, and governments devoted to the development of VANET routing protocols. These projects include technologies like (DSRC)' (USA), the 'Car-to-Car Communication' (Europe) and the 'Intelligent Transportation Systems ' (Japan), and standardization efforts like the IEEE 802.11p 'Wireless Access in Vehicular Environment' (WAVE).

Vehicular communication is seen as a key technology for improving road safety and comfort through Intelligent Transportation Systems (ITS). There are many possible applications of wireless technologies for vehicular environment. Vehicular Ad Hoc Networks (VANETs) are an instance of ad-hoc networks, which are general-purpose distributed wireless networks interconnected without the need of any centralized infrastructure. VANET are expected to be massively deployed in upcoming vehicles, because their use can improve the safety of driving and makes new forms of inter-vehicle communications possible as well.

2. LITERATURE SURVEY

Literature review presented here is for the vehicular ad hoc network taking various routing protocols under consideration. A routing protocol specifies how routers communicate with each other, disseminating information that enables them to select routes between any two nodes on a computer network. Routing algorithms determine the specific choice of route. Each router has a priori knowledge only of networks attached to it directly. Jing Zuo et.al [2] has proposed the vehicle node density concept parameter to improve the performance of AODV routing protocol and OLSR routing protocol under two typical mobile models in VANET scenario and analyzed the properties of the two mobility models in high density urban areas and concluded that good performance often does not mean strong adaptability under different mobility models. The method proposed here could indeed inform drivers and other passengers of potentially dangerous traffic situations while there is still time to avoid them.

That is useful and considered as necessary to overcome the communication problem in the application of VANET. Vehicular Ad hoc Network (VANET) is a challenging network environment in which communication between vehicles in highly fading environments, like an urban scenario, is unanticipated and arduous. In order to scrutinize the performance of protocols and applications, network simulator NS2 is used. Imran khan et.al [3] analysed that all protocols were guesstimate by measuring PDR, End-to-End delay and NRL. And they concluded that OLSR with more frequent Hello and TC messages was able to give better PDR and less End-to-End delay than AODV and its default variant. NRL was much higher than its competitors as the frequency of Hello and TC messages was higher.
Evjola Spaho et.al [4] investigated the performance of OLSR and AODV protocols in a VANET crossroad scenario in which mobility patterns of vehicles are generated by means of CAVANET (Cellular Automation based Vehicular Adhoc Network) and as communication protocol simulator NS3 (Network Simulator 3) has been used in the proposed research work Packet Delivery Ratio (PDR), throughput and delay is being scrutinized and concluded that for small transmission rates, all packets sent from the source are received at the destination and the PDR is maximal for both protocols i.e. AODV & OLSR but at the same time For high transmission rate the PDR is decreased for twain protocols. For big transmission rates, the OLSR has better throughput compared with AODV. The delay for small transmission rates is small for both protocols and they can be used for real time applications such as safety applications. Overall the work done is the analysis of two routing protocols under the various performance matrices considering small and big transmission scenarios.

Bijan Paul et.al [5] analyzed the performance of three routing protocols i.e. AODV, DSR and DSDV which shows some differences in low and high node density. From their experimental analysis they have concluded that in low density with low pause time the packet delivery ratio (PDR) of CBR connection for above mentioned routing protocols are low but for TCP connection it is higher for DSR and average for DSDV. In above scenario average end to end delay (E-To-E) is low in DSDV for TCP & CBR connection. But in AODV it is average and high for TCP & CBR connection. On the other hand in DSR it is high and low for TCP & CBR connection. The loss packet ratio for CBR connection is high for AODV, DSR and DSDV. But in TCP connection it shows different characteristics for each protocol.
If the pause time is high the PDR for these routing protocols using CBR is low but in TCP connection for DSR it is high and average for AODV & DSR. S. S. Manvi et.al [6] scrutinized and peg the performance of routing protocols: AODV, DSR, and Swarm Intelligence based routing protocol and clinched that that AODV and DSR may not be suitable for vehicular environments, whereas SWARM showed promising results.

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3. OVERVIEW OF ROUTING PROTOCOLS

Vehicular ad-hoc network is a self-governing system in which nodes are connected through wireless links with each other Classification of VANETs routing protocols is based on their functionality, into three diverse categories are as follows.

1. Proactive (Table driven) protocol.
2. Reactive (On demand) protocol.
3. Hybrid protocol

The hierarchy of these protocols is shown below in the Figure 3.13.

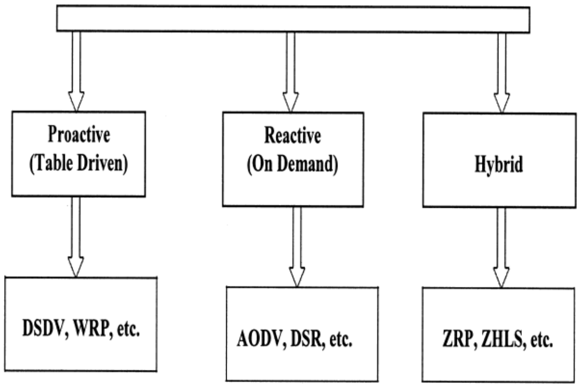

Figure2HierarchiesofVANETRoutingProtocols

a) Proactive routing protocols

Pro-active routing protocols are table-driven protocols that maintain up-to-date routing table using the routing information gained from the neighbors on a permanent basis. Routing in such protocols involves selecting a path form the source to the destination.

A drawback of such protocols is the proactive overhead due to route maintenance and frequent route updates to cope with node mobility. Examples of this class are DSDV (Destination Sequenced Distance Vector routing Protocol), OLSR (optimized link state routing) [3].

b) Reactive routing protocols

Reactive routing protocols are demand-driven protocols that find path when necessary. This type of protocols, creating a new route encompasses a route discovery phase comprising of route request and a reply route (by the destination node).

Nodes sustain only the active routes until a desired period or until destination becomes inaccessible along every path from the source node [27]. Examples of this class are AODV (ad hoc on demand distance vector), DSR (Dynamic source routing) etc.

c) Hybrid routing protocols

Hybrid protocols make use of both reactive and proactive approaches. Example of this type includes TORA (Temporally Ordered Routing Protocol), ZRP (Zone Routing Protocol).

4. PROBLEM DEFINITION

The Intelligent Transport System (ITS) that uses Vehicular Ad-hoc Network has been established to protect passengers and drivers. It allows vehicles emergency and entertainment information through mobile applications which greatly benefit the travelers. This inter-vehicular communication field has two types of communications: vehicle-to-vehicle communication and vehicle to Road Side Unit communication. Each VANET node contains a Global Positioning System (GPS) device, which identifies the position of each vehicle in the vehicular network. VANET uses this information to alert other vehicles and exchange information, hence by decreasing the count of accidents in the highways. This innovative Vehicular Ad-hoc Network communication requires a new type of routing protocol that would provide efficient data transmission.

The IEEE standard 802.11 is not well suited for vehicular environment because the topology of VANET changes more frequently than other networks. Therefore, new standard for VANET model was established. It is known as the Wireless Access in Vehicular Environment (WAVE) with improved version of 802.11 known as 802.11p. The high-speed vehicles are equipped with a communication device known as On-Board Unit (OBU), which allows vehicle to communicate with each other as well as with Road Side Unit (RSU). In addition, a network simulator is needed to be combined with mobility models to evaluate scalability and efficiency of a protocol for VANET. Many mobility model tools may be used while simulating VANET. But in most of the cases, VANET mobility model which is followed is a simple random way point mobility model.

5. METHODOLOGY

In the research work the network simulator 2.35 used as a simulation tool for vanet scenario 802.11p. Mobility model used is two way ground random way point mobility model. In the vanet model designed for the study purpose number of nodes taken into consideration are 25, 50, 75, 100 nodes whereas node movement speed are 50 m/sec and 100 m/sec. Traffic type generated is using TCP i.e. transmission control protocol. We have used the Omni directional antenna as movement of the vehicle is random and direction of the signal could be random so we would be needed signal in every direction. In this particular study we are using IEEE 802.11p MAC layer.

In this work we are analyzing the performance of various routing protocols. We have considered four routing protocols for this analysis which are AODV (Ad hoc on demand distance vector), DSDV (Destination Sequenced Distance Vector routing Protocol), and extended EAODV. In the traffic scenario we have considered maximum number of packets is 50 and simulation area is 1000 m * 1000m. We are working on the wireless channel and queue types are droptail and CMU priqueue. In the fig 4.1 we have defined the steps of the simulation process.

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EAODV is that the multicast modification of AODV. each AODV and EAODV are routing protocols for ad-hoc networks, with AODV for unicast traffic and EAODV for multicast traffic. NS2 a wide used simulation tool, includes a customary implementation of the AODV protocol to analyse its performance, upon that we tend to developed our initial EAODV implementations however those EAODV implementations have 2 key limitations:

1) Independent cluster members will send multicast traffic to the multicast group
2) The multicast knowledge packets are unicast, leading to wasted information measure. This redo of EAODV permits every node within the network to transport multicast knowledge packets, and also the multicast knowledge packets are broadcast once propagating on the multicast cluster tree. additionally, many functions are improved similarly during this redo.

Each node in the network may maintain three tables. The first one is the Unicast Route Table, recording the next hop for routes to other destinations for unicast traffic. Usually, the destination is one of the other nodes in the network. A special case is when the destination is a multicast address, which happens when the node is not a multicast tree member but has multicast data packets to send to that multicast group. The second one is the Multicast Route Table, listing the next hops for the tree structure of each multicast group.

Each entry represents one group tree structure. Every node that belongs to that group tree should maintain such entries, with its own identity as group leader, group member, or router (non-multicast member that is in the tree to provide connectivity). Every next hop is associated with direction either downstream or upstream. If the next hop is one-hop nearer to the group leader, the direction is upstream; otherwise, the direction is downstream. The group leader has no upstream, while other nodes in the tree should have one andonly one upstream. The third table is the Group Leader Table. It records the currently-known multicast group address with its group leader address and the next hop towards that group leader when a node receives a periodic route message. This is the most task of AODV protocol and there's a customary implementation in NS2 Two things we should always mention once more are:

1) solely waterproof layer detection is employed for detection broken links on the active routes, either the route to a selected node or the route to a multicast tree. Although the AODV implementation within the latest version of NS2 (2.26) will implement the native
2)repair for link breakage, in our implementation and simulation, we have a tendency to ignore native repair and still let the data supply node initiate discovery for a replacement route instead.

During multicast data packet forwarding, each node first checks if itself is in the multicast tree. If it is not a tree member, it will check its Unicast Route Table to find the next hop for the multicast address. If it has the information, the data packets are forwarded towards the next hop; otherwise, it will send an unsolicited RREP back to the source node, in order to let the source node initiate a new route discovery if it still needs a route to that multicast address. If the node itself is a tree member, it will follow its Multicast Route Table to forward the packets.

A multi-metric route selection algorithm, which considers the availability of frequency band in addition to traditional metric like switching delay and queuing delay.A Combined opportunistic routing (OR) with transmit power control (TPC) schemes, which simplifies the selection of CFNs, improving the delivery ratios of CFNs and achieving service differentiation to traffic flows with different priorities.

PROPOSED ALGORITHM

Initiate route discovery:

Begin
if (no valid route found on cache) then
1. Create RREQ packet;
2. Initialize route record in RREQ packet to empty, initialize delay to 0, initialize MEATT to 0;
3. Broadcast RREQ packet on common control channel.
else
Perform Route Decision.
endif
End

Propagate RREQ and route reply:
Begin
if (receive RREQ packet) then
1. Determine if its address is on the list of route record;
2.if (it is on the list of route record) then
Discard RREQ packet.
else

1. Append own address and frequency channel to route record in RREQ packet;
2. Set switching delay dswitch = td ms if the receiving frequency is fixed to the same channel as the previous hop node's transmitting frequency. Otherwise, theswitching delay is set to dswitch = 0 ms;
3. Add switch to the delay field;
4. Add average queuing delay to the delay field where dqueue 1⁄4 n t nsend À t nreceiv e =n, where tnsend and tnreceive are the send and receive time of the previous n packets;
5. Update MEATT field.
6. if (receiving node is destination) then
1. Creates RREP packet;
2. Send RREP packet.
7. else

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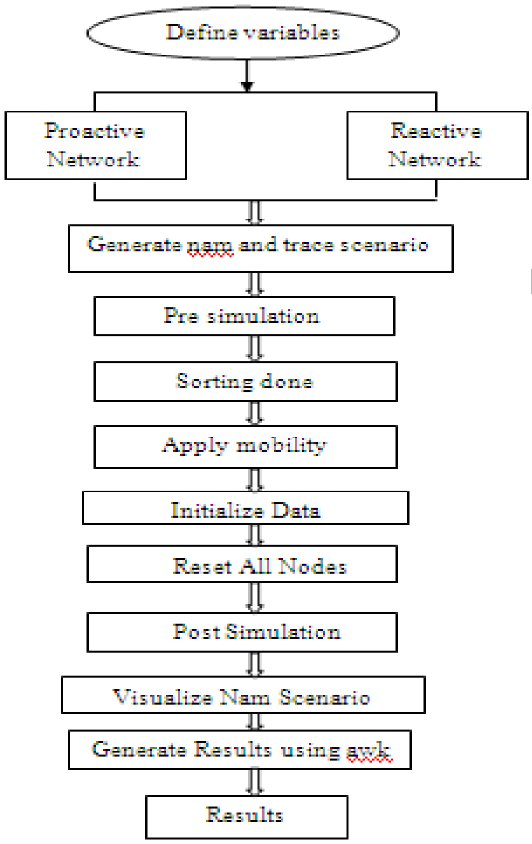
Rebroadcasts the RREQ packet on the common control channel.
endif
endif
endif
End
Route discovery

Before the start of the data transmission, the route cache will be examined to see if there is a valid route to the desired destination. If a valid route cannot be found In the cache, route discovery will be triggered. EAODV performs path discovery by implementing the complete set of route discovery mechanisms.
When the destination node receives the RREQ packet, a Route Reply or RREP packet would be generated with a copy of the accumulated route record from the RREQ packet. The RREP packet will be sent to the source node through the reverse path the RREQ packet had traversed. The route information, delay and MEATT information within the RREP packet will be used to update the route cache at the sender.
Route decision
Begin
1. Identify routes with MEATT > sflow;
2. Sort route in ascending order of delay;
3. Choose minimum delay route.
End

Once the routes with less delay have been discovered, OSDRP selects the minimum delay–maximum stability route to fulfil the required flow duration sflow of the traffic flow. Only the route with MEATT P s flow will be considered.
This ensures that the SOP along the selected route is available during the transmission of the data in order to avoid costly route re-discovery. That is, for the entire duration sflow of the flow, the nodes along the selected path will not need to stop transmission due to the sudden appearance of a primary user.
Transmit power control and multicast routing
Begin
switch (priority)
case ‘c1’:
1. minimum required data rate rt = 24 Mbps;(Changable
2. OR Candidate Selection Range = 3. (Changable)
case ‘c2’:
1. minimum required data rate rt = 12 Mbps; (Changable)
2. OR Candidate Selection Range = 2. (Changable)
case ‘c3’:
1. minimum required data rate rt = 6 Mbps; (Changable)
OR Candidate Selection Range = 1. (Changable)
end switch
1. Determine corresponding SINR threshold ct for
BER 6 10À5;
2. Calculate required transmitter power Pi using
SINRij 1⁄4 ðP i Gij =ðN 0 þ NoiseÞÞ P ct
i;j1⁄41;2;::;N;i–j
where Gij denotes the link gain from node ni to node nj, N0 denotes thermal noise of node nj;
Noise is the measured noise due to other sources at the nj
3. Based on OR Candidate Selection Range,
examine remaining number of hops; insert
CFNs into packet header;
4. Transmit packet.
End
Route maintenance
Begin
for every 1 second
if (route is valid) then
1. Reduce MEATT by 1;
2. If MEATT = 0, delete route entry from the
cache.
End if
end for
End



Flow Chart

6. IMPLEMENTATION AND RESULTS

In this work, the random way point mobility model is used for the simulation of VANET routing protocols. The source-destination pairs are spread randomly over the network where the point to point link is established between them. In this work TCP agent with FTP traffic is used. The random packet size and rate as well as variable node speed and variable node density is used for the transmission to evaluate the changes in performances in the routing protocols. The simulation configuration for mobile nodes

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consists of many network components and simulation parameters which are used in this research are shown in the table 5.1 in detail.

7. SIMULATION PARAMETERS

Table is showing the simulation parameters that are used in the research work.

Simulation TOOL	Network Simulator-2.35
IEEE Scenario	VANET(802.11p)
Mobility Model	Two Ray Ground
Number Of Nodes	25, 50, 75,100
Node Movement speed	50m/sec ,100m/sec.
Traffic Type	TCP
Antenna	Omni Directional Antenna
MAC Layer	IEEE 802.11p
Routing Protocols	AODV,DSDV,EAODV
Queue Limit	50 packets
Simulation Area 1(in meter)	1000*1000
Queue type	Droptail
Channel	Wireless Channel

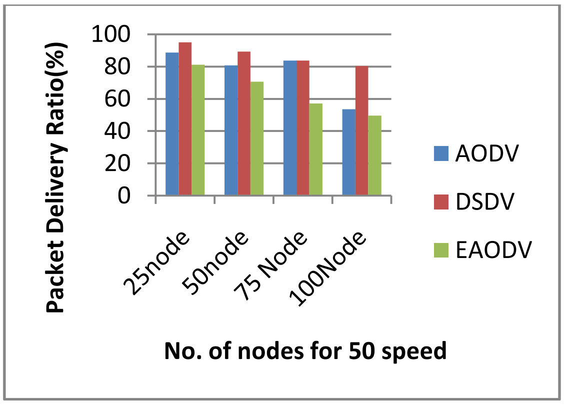
8. PERFORMANCE METRICS & SIMULATION RESULTS

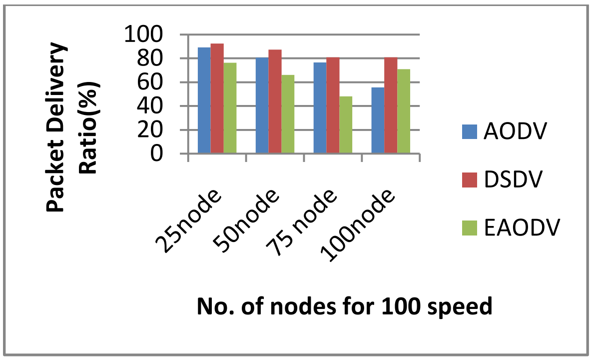
The following metrics are used in this work for the performance evaluation of AODV, DSDV & EAMDV routing protocols.

a)Packet Delivery Ratio :
Throughput for the node mobility of 50m/sec and 100 m/sec:

Following table and graph is plotted between number of nodes which are represented on Y axis and routing protocols on X axis to calculate packet delivery ratio on mobility of nodes taken as 50 m/sec and 100 m/sec.

Number of nodes taken are 15, 25 and 35 nodes while protocols are AODV, DSDV, and EAODV.

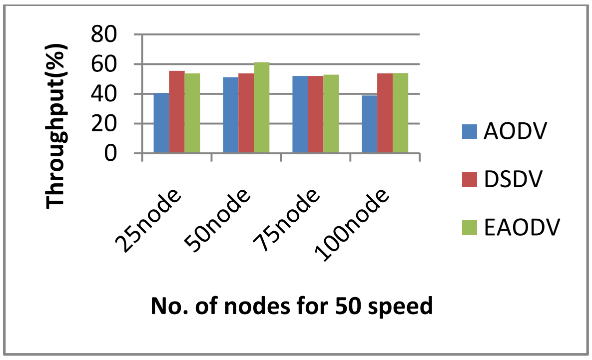


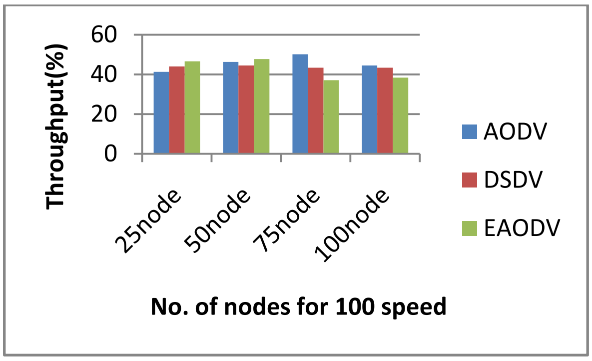


b) Throughput
Throughput for the node mobility of 50m/sec and 100 m/sec:

Following table and graph is plotted between number of nodes which are represented on Y axis and routing protocols on X axis to calculate throughput on mobility of nodes taken as 50m/sec and 100 m/sec.

Number of nodes taken are 15, 25 and 35 nodes while protocols are AODV, DSDV, and EAODV.





c) End to End Delay
End to End Delay for the node mobility of 50m/sec and 100m/sec:

Following table and graph is plotted between number of nodes which are represented on Y axis and routing protocols on X axis to calculate end to end delay on mobility of nodes taken as 50 m/sec and 100 m/sec. Number of nodes taken are 15, 25 and 35 nodes while protocols are EAODV,

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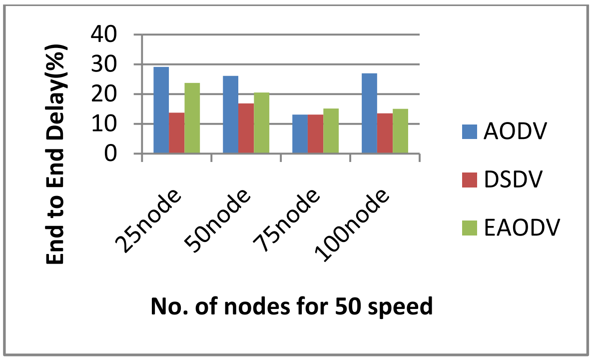
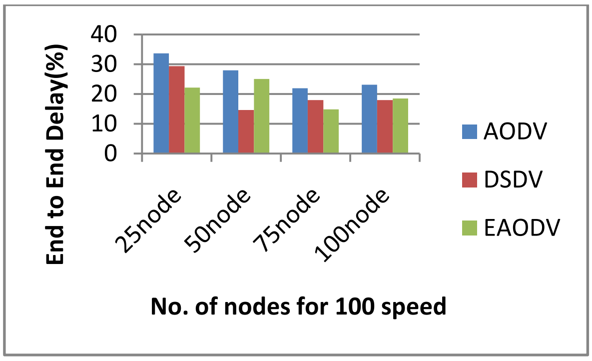
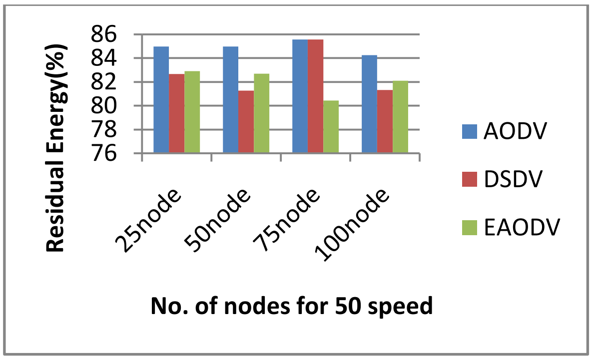
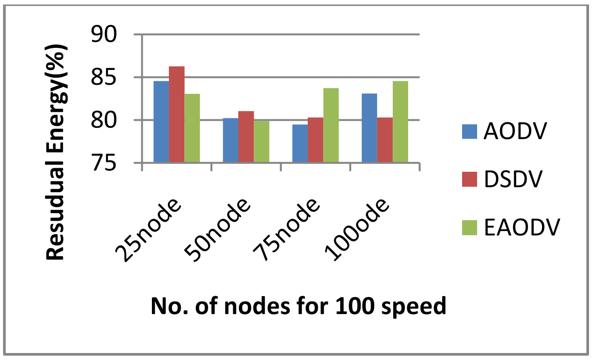




d)Residual Energy
Residual Energy for the node mobility of 50m/sec and 100m/sec:

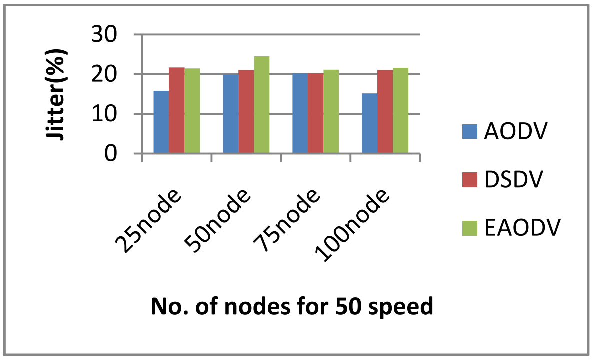
Following table and graph is plotted between number of nodes which are represented on Y axis and routing protocols on X axis to calculate residual energy on mobility of nodes taken as 50m/sec and 100 m/sec. Number of nodes taken are 15, 25 and 35 nodes while protocols are AODV, DSDV and EAODV.

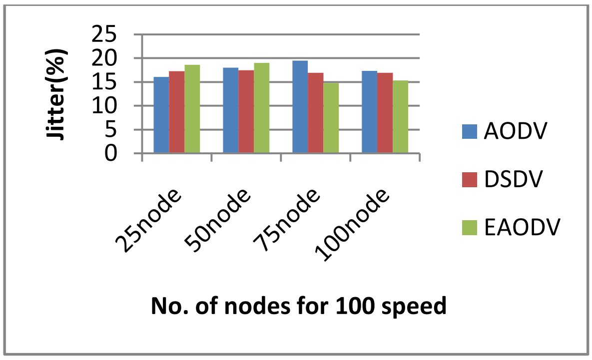




e) Jitter:
Jitter for the node mobility of 50m/sec and 100m/sec:

Following table and graph is plotted between number of nodes which are represented on Y axis and routing protocols on X axis to calculate jitter on mobility of nodes taken as 50m/sec and 100 m/sec. Number of nodes taken are 15, 25 and 35 nodes while protocols are AODV, DSDV and EAODV.





9. CONCLUSION

This work has been meted out with the careful analysis of AODV, DSDV, EAODV routing protocols in theory and thru simulation by NS-2 for VANET on the premise of various performance metrics viz. packet delivery magnitude relation, residual energy, finish to finish delay, routing overhead and output. These performance metrics ar investigated for the four routing protocols by variable the node quality for variable range of nodes. Simulation results show that, because the quality of nodes will increase within the network from fifty m/sec to a hundred m/sec, the performance of the routing protocols decreases. Nodes quality affects the performance of routing protocols most as frequent path break will increase with the quality. per the results because the quality of nodes will increase from 50m/sec to a hundred m/sec, the top to finish delay and routing overhead of routing protocol will increase whereas output and packet delivery magnitude relation decreases.
The summarization conclusion as follows:
•The behavior of routing protocols was analyzed and therefore the calculation show that EAODV has least packet delivery magnitude relation and it's increased by 4 wheel drive in DSDV, 6 June 1944 in therefore

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performance of EAODV is found to be best for packet delivery magnitude relation.

- In case of residual energy, it had been analyzed and calculated that it's least for EAODV whereas it's increased by 4 wheel drive in AODV, 6% in DSV . therefore EAODV has best performance for residual energy.
- In case of finish {to finish|to finish} delay it's analyzed and calculated that EAODV has least end to finish delay whereas it's been accrued by eighteen in DSDV, fifty fifth in AODV therefore EAODV has best performance as finish to finish delay should be low.
- In case of routing overhead it's analyzed and calculated that DSDV has least price for routing overhead whereas its price is accrued by fifty fifth in AODV, EAODV that's one hundred and twentieth. therefore DSR is activity best out of all routing protocols as routing overhead conjointly should be low.
- In case of output it's analyzed and calculated that DSDV has worst results out of all the protocols whereas it's been increased third in AODV, five-hitter in EAODV leads to output as output come back to be high.

10. FUTURE WORK

We see many areas for future work that can expand this research. We pinpoint different ranges for more research and where existing research can be integrated into ours:
As mobiles are familiar and used by us in our day to day life, similarly the future of VANETs is undoubtedly secure. It has become the part of the government projects. In India, National Highways Authority of India (NHAI) is planning to replace manual toll collections at plazas with electronic toll collection (ETC) systems across the country.

The ETC system will be based on radio frequency identification (RFID), which will be complemented by a wireless on-board unit (OBU) on a vehicle, as well as a stationery roadside unit (RSU) at the toll plaza.

Complex traffic modeling and driving behaviors (mobility models) that incorporate lane changing and multiple entry and exit points can be integrated to our simulation framework to validate and evaluate our algorithm in more complex scenarios, taking them closer to real world applications.

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