

# Comparative Study of AODV, DSDV and DSR Routing Protocols in Vehicular Network Using EstiNet Simulator

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**Abstract**— Vehicular Ad hoc Network can ease our life by making driving safe in near future. To make it successful efficient routing protocols need to be used for communication among vehicles. This communication can be direct within vehicles and can be through road side units (RSUs). In this paper we are exploiting the AODV, DSR and DSDV routing protocols by comparing their performances with respect to throughput and number of packets dropped during communication. We are using IEEE 802.11p as a standard protocol for Vehicular Ad hoc Network with 5.9 GHz band.

**Index Terms**— VANET, Routing, AODV, DSR, DSDV, RSU, Estinet

## 1 INTRODUCTION

Vehicular Ad hoc Network (VANET) is one of the latest technologies evolved in IT industry. This technology is very beneficial in providing safety to the road users and comfort to the passengers. With the increase in motorization, urbanization and population growth, road accidents are also increasing at a very fast rate. The reasons behind these accidents are lack of earlier knowledge about traffic congestion, road condition, lane changing, etc. All these problems can be solved with VANET [1] using vehicle to vehicle communication. The communication between vehicles that are one hop away is easy but the vehicles which are far away can communicate using multi hop communication. To make multi hop communication possible, the routing should be done very attentively. Routing protocol should be chosen in such a way so that the message reaches the destination within time.

Since speed of vehicles is very high and delay in message may lose the importance of message, a routing protocol for VANET is very important. VANET is a subclass of Mobile Ad hoc Network i.e. MANET [2]. The mobility of VANET is higher than MANET. Because vehicles need to run on roads, the mobility pattern of VANET is restricted. Due to high speed of vehicles the topology of the network is very dynamic. Also there is no power constraint in vehicles. The traffic density on the roads plays a major role.

If the traffic density is very low, the network can be partitioned.

Because of all these characteristics, routing protocols which

VANET. Here we want to compare the performance some routing protocols of MANET in VANET environment.

## 2 LITERATURE SURVEY

Routing is one of a big issue in Vehicular ad hoc network. Mobility of vehicular ad hoc network is very high as compared to other traditional networks. So we need to provide more attention towards routing protocol in such networks. Here we are considering AODV [3], DSR [8] and DSDV [9] routing protocols in two different scenarios. One scenario includes only vehicles communicating with each other and the other includes vehicles communicating through road side units (RSUs). First we will discuss them in brief. After that their results are compared based on throughput and number of packets dropped during communication.

## 3 AD HOC ON DEMAND DISTANCE VECTOR (AODV) ROUTING PROTOCOL

AODV is a routing protocol especially useful for mobile networks. AODV [3] allows mobile nodes to find routes quickly for new destinations and does not require nodes to maintain routes to destinations that are not in active communication. It helps in both unicast and multicast routing [5]. It is a reactive protocol i.e. it establishes a route to a destination only when there is a demand for that route. It makes sure that the route is shortest and does not contain loop. AODV makes use of <RREQ, RREP> pair to find the route. The source node broadcast the RREQ i.e. Route Request message to its neighbors to find the route to destination. The RREQ message [4] contains the source and destination address, lifespan of message, sequence numbers of source and destination and request ID as unique identification. Destination Sequence Number is the latest sequence number received in the past by the source for any route towards the destination and Source Sequence Number is the current sequence number to be used in the route entry pointing towards the source of the route request [6]. If any

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are better enough for MANET behave very strangely in

node from a list of neighbors is destination or knows the route to destination, it can send RREP message to source.

For example, we have considered 24 vehicles in fig. 1 for vehicular ad hoc network. Node 5 wants to send data to node 15 and 16. Node 16 is a one hop neighbor of node 5, so it sends data directly. But node 15 is not in its range so it broadcast RREQ to all its neighbors.

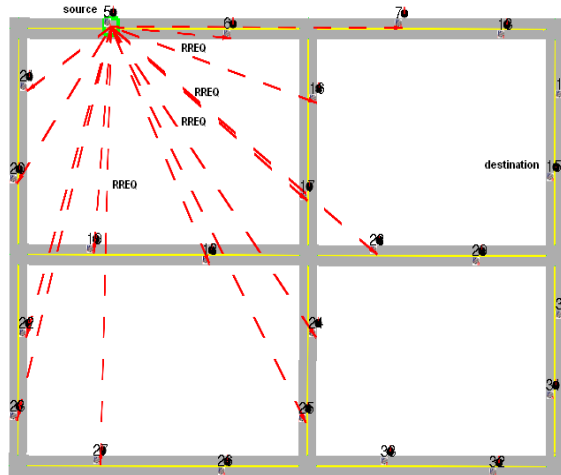


Fig. 1 Route Request from node 5 for node 15

In this case node 7 will send RREP to node 5 as node 15 is in the transmission range of node 7. But node 7 is not fixed as an intermediate node since it changes its position with time. After some time, node 16 passes the message to node 15. In this way, intermediate node remains changing according to position of nodes. If none of its neighbor knows about destination they rebroadcast the RREQ message until the destination or route to destination is found. Rebroadcast of RREQ message can be done until its hop count becomes zero. If before reaching to destination, hop count of RREQ becomes zero then the source node need to broadcast a new RREQ message with greater hop count and new sequence number.

A source node may receive multiple RREP messages with different routes but updates its routing entries if and only if the RREP has a greater sequence number, i.e. fresh information. Sequence number of a node helps in determining the latest message from that node [7]. A message with higher sequence number signifies the more accurate information.

As the nodes are mobile, the established route breaks after sometime. A node came to know about link failure when it stops receiving beacons from its neighbor. Then the node sends RERR message [7] to all the nodes that are using this link to send message by incrementing the sequence number of destination. When a node receives RERR message it marks its route to destination as invalid. When source node receives this RERR message, it initiates route discovery again by using destination sequence number as large as incremented sequence number in RERR message with new request ID.

## 4 DYNAMIC SOURCE ROUTING PROTOCOL (DSR)

DSR is a reactive routing protocol. It initiates route discovery only on demand like AODV. DSR [8] stores the whole path to destination in its routing table instead of next hop node unlike AODV. The packet header includes the address of all the nodes through which the packet must pass to reach the destination node. This kind of routing is called source routing and that's why the name of protocol is. A pair of <RREQ, RREP> message is used to discover the route similar to AODV. Source node broadcast the RREQ message and the node having route to destination replies with RREP message. If node receiving RREQ message doesn't have information regarding destination node it rebroadcast the RREQ message after adding its address to source address.

Suppose a node E receives RREQ message with source address <A, B, C> for destination D, it stores the path to A as <E, C, B, A> in its cache. Similarly if any node overhears the RREQ message or data packet, it can copy the route in its cache for future use. In DSR, cache of route is used in case of link failure. Suppose a source node S has a route to D as <S, A, B, C, D> and the link of node <C, D> breaks after sometime due to the movement of nodes. In this situation, S will look in its cache for another route to node D. This cache of routes can speed up data transmission.

New route discovery always initiates when the source node receives a RERR message after some link breakage. This RERR message is originated by the node that came to know about the link failure closer to the source. The source node piggybacked the RERR message with the new RREQ message so that all the nodes get information about the link failure and don't reply with the route containing that link. Because packet header includes the address of all the intermediate nodes, the size of packet increases with the length of route. DSR doesn't include any periodic packet to update neighbor list or the link status. When using cached routes in DSR, care must be taken to make sure that the route is valid or not expired.

## 5 DESTINATION SEQUENCED DISTANCE VECTOR (DSDV)

Both AODV and DSR protocols discussed above are reactive protocols which find the route to a destination on demand. But DSDV [9] is a proactive protocol that maintains route to all the destinations before requirement of the route. Each node maintains a routing table which contains next hop, cost metric towards each destination and a sequence number that is created by the destination itself. This table is exchanged by each node to update route information. A node transmits routing table periodically or when significant new information is available about some route. Whenever a node wants to send packet, it uses the routing table stored locally. For each destination, a node knows which of its neighbor leads to the shortest path to the destination.

DSDV generates a large volume of control traffic in a highly dynamic network like VANET. This excessive control traffic may take up a large part of available bandwidth. To avoid it two types of updates are used: full dump and incremental dump. A full dump carries a complete routing table which is broadcasted infrequently. An incremental dump carries minor changes in the routing table. This information contains changes since the last full dump. When the size of an incremental dump becomes too large, a full dump is preferred.

DSDV is an efficient protocol for route discovery. Whenever a route to a new destination is required, it already exists at the source. Hence, latency for route discovery is very low. DSDV also guarantees loop-free paths.

## 6 ESTINET SIMULATOR

We have used EstiNet 7.0.0.3 [10] as a platform to implement routing protocols on Vehicular Ad hoc Networks (VANETs). It is a GUI based network and traffic simulator. This simulator provides us a convenient way to construct our road structure. We can easily plan and prepare a model for our vehicles with some minor mouse operations. We are considering the simulation model with infrastructure i.e. road side unit (RSU) and without infrastructure.

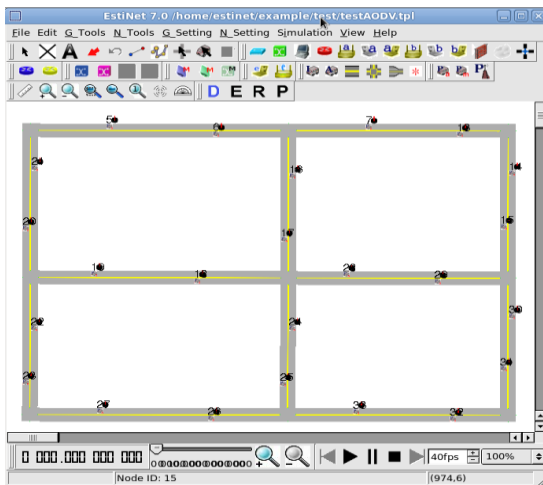


Fig. 2 The mobility model without RSU

Fig. 2 above shows the mobility model for simulation of routing protocols without any infrastructure. After selecting the mobility model, we got protocol stack of a node from its node editor. In this protocol stack, we can add the routing protocol for simulation. Fig. 3 shows the stack with AODV added in it.

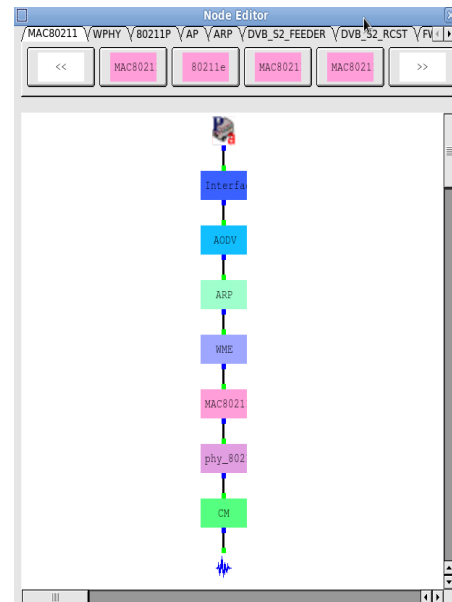


Fig. 3 Protocol stack of vehicle

We can change the parameters by clicking on individual modules in this stack. For example in MAC 802.11p, we can select the log files we require for generating graphs after simulation.

Similarly we can set the environment for vehicles communicating through RSU i.e. by making use of infrastructure. In this scenario 4 RSUs are added in addition to the vehicles of earlier scenario. In each block, one RSU is placed to make the communication easier. The source and destination nodes are same but now they use the RSUs for communication. The simulation model for the implementation of routing protocols with RSUs is shown in fig. 4. Red lines shows the transmission range of node 5 i.e. source node. It clearly shows that destination node 16 is reachable directly but for destination 15 we need some intermediate node to transmit the packet successfully. RSU with id 35 will act as an intermediate node for route between node 5 and node 15.

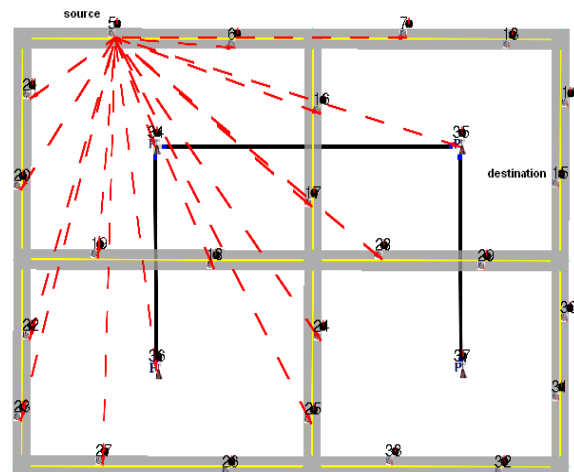
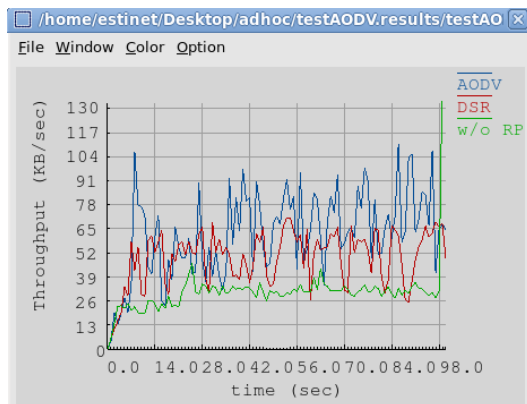


Fig. 4 The mobility model with RSU

## 7 RESULTS

The performance of routing protocols is evaluated on EstiNet simulator. We have considered two parameters for evaluation: throughput and no. of packets dropped.

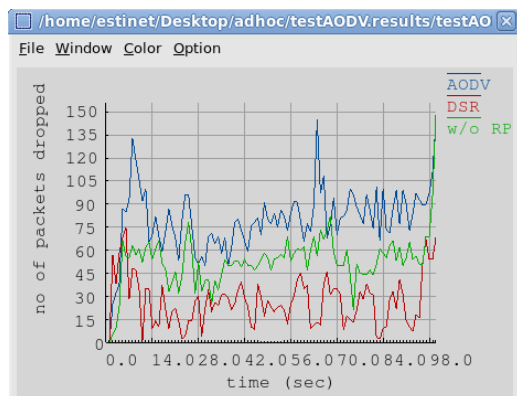
Throughput is described as the total number of received packets at destination out of total transmitted packets [11]. The simulation result for throughput shows total received packets at destination in KB/sec. In graph 1, the throughput of AODV is higher. AODV outperforms DSR. Also we can see that without using any routing protocol, the throughput is very low i.e. we need to add some routing protocol to increase the throughput of network.



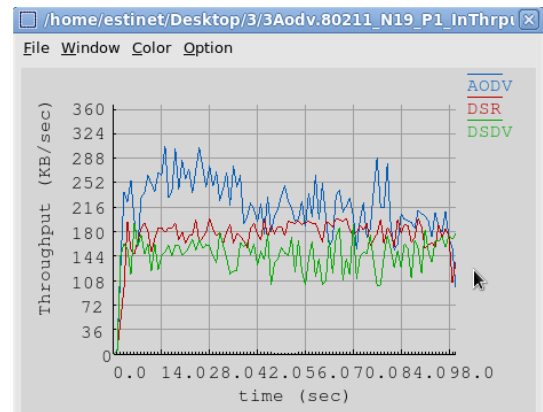
Graph 1 Throughput without any infrastructure

Packet drop shows the total number of data packets that are not sent to destination successfully. Packet drop affects the network performance by consuming time and more bandwidth to resend a packet. The protocol performance considered to be efficient if packet drop rate is lower.

In the graph 2 below, we can see that fewer packets are dropped in case of DSR. Here AODV dropped maximum packets as the control packets in case of AODV are higher. Due to high speed of vehicles most of the beacons or control packets are dropped.

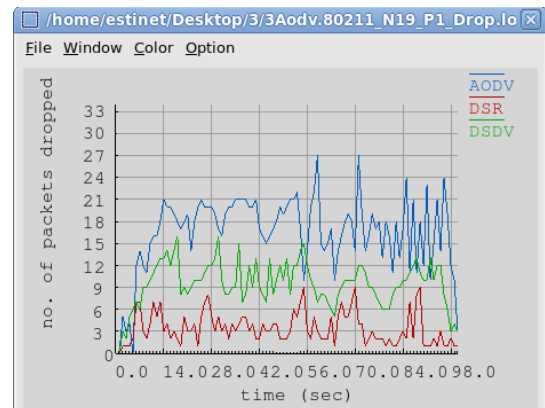


Graph 2 Number of packets dropped without RSU



Graph 3 Throughput with the use of RSU

In graph 3, we can see that AODV is better than DSDV and DSR. Throughput of DSR is still good as compared to DSDV. By using RSU, the throughput of the network increased significantly since the communication range of RSU is better than the range of vehicles.



Graph 4 Number of packets dropped with RSU

Graph 4 shows that the number of packets dropped with the use of RSU are less as compared to the network without RSU. Here DSR outperforms all other routing protocols.

## 8 CONCLUSIONS

In this paper we have shown the performance of AODV, DSR and DSDV routing protocols in the presence and absence of RSU. From the results shown in last section, we can observe that the routing protocol AODV is better. Throughput of AODV is highest. DSR also outperforms DSDV protocol. Number of packets dropped is high in case of AODV but it doesn't mean that most of the data packets are dropped. In case of AODV the control packets to establish route are maximum and most of these packets are dropped but data packets reach the destination successfully. It can be observed from results that the performance of the network is better in the presence of RSU as compared to the network without RSU. But it doesn't mean that we should always use RSU for better performance since it increases the cost factor. Also we can see that the case in which no routing protocol is used behaves worst. From this we can

infer that the routing protocol is necessary for better performance.

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