



Performance comparison of various Ad-Hoc routing protocols of VANET in Indian city scenario

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Abstract: One emerging, new type of ad-hoc network is the Vehicular Ad-Hoc Network (VANET), in which vehicles constitute the mobile nodes in the network. Due to the prohibitive cost of deploying and implementing such a system in real world, most research in VANET relies on simulations for evaluation. This paper presents a comparative study of various Ad-hoc routing protocols on Vehicular Ad-hoc Network in three well-known Indian city. The AODV, ADV, GOD, DSR Ad-hoc routing protocols have been used for the simulation. In order to make the comparisons three well known performance parameters have been considered these are packet-drop, throughput and total time taken by the simulator to simulate the given network. To carry out the simulation process an open source simulator tool is used for this study namely-NCTUns-6.0. With suitable simulation set-up the simulation has been performed. Based on the simulation result of the above mentioned protocol, the outputs have been compared for AODV, ADV, GOD, DSR routing protocols.

Keywords--- VANET; Ad-hoc network; Performance; Throughput; Packet Drop; Packet Collision; NCTUns6.0 network simulator.

I. INTRODUCTION

Vehicular Ad-Hoc Network (VANET) communication has recently become an increasingly popular research topic in the area of wireless networking as well as the automotive industries. The goal of VANET research is to develop a vehicular communication system to enable quick and cost efficient distribution of data for the benefit of passengers' safety and comfort.

We have obtained an interesting result in our previous work [1] based on different scenario, that the simulation shows a better result in dense traffic situation. Therefore we have taken Delhi scenario for more real life implementation. Further we have studied the [2], [3], [4], [5], [10] papers where we have observed that those real life simulation on VANET is done on the basis of routing. Therefore, we attempt to find out the result on the over populated scenario like Indian scenario. In present situation we need to apply the navigation system with automation for all kind of traffic vehicles. But there is a big question of security involves as it the automation is deployed with human. Here we proposed a simulation based on different AODV, ADV, GOD, DSR ad-hoc routing protocols and to find out the successful rate of VANET in dense traffic situation. Therefore, we try to find out the best performance of VANET on different AODV, ADV, GOD, DSR ad-hoc routing protocols. The only precondition is that all vehicles should equipped with mobile communicating device and sensor device and those are much cheaper than agent based or infrastructure based VANET.

A. ROUTING PROTOCOLS

Ad-hoc routing protocol setup the path, exchange information and take decision of runtime path [12].

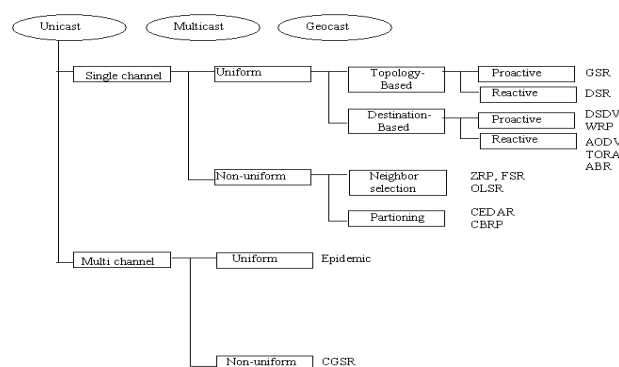


Fig. 1: Ad-hoc Routing Protocols [12]

In this paper we work on reactive routing (AODV).

There are three types of topology based routing

1. Proactive (table-driven) routing protocols
2. Reactive (on-demand) routing protocols
3. Hybrid routing protocols

- *Proactive Routing*

Proactive routing protocols are based on shortest path algorithms [12]. It maintains and update information on routing among all nodes of a given network at all times even if the paths are not currently being used. Thus, even if some paths are never used but updates regarding such paths are constantly broadcasted among nodes [13]. Route updates are periodically performed regardless of network load, bandwidth constraints.

- *Reactive Routing*

On demand or reactive routing protocols were designed to overcome the overhead problem, that was created by proactive routing protocols, by maintaining only those routes that are currently active [13]. These protocols implement route determination on a demand or need basis and maintain only the routes that are currently in use, thereby reducing the burden on the network when only a subset of available routes is in use at any time [14].

AODV maintains and uses an efficient method of routing that reduces network load by broadcasting route discovery mechanism and by dynamically updating routing information at each intermediate node. Route discovery in AODV can be done by sending RREQ (Route Request) from a node when it requires a route to send the data to a particular destination. After sending RREQ, node then waits for the RREP (Route Reply) and if it does not receive any RREP within a given time period,

II. RELATED WORK

There are several research on the VANET regarding Ad-hoc routing protocols.

The paper [1] shows the performance analysis on same scenario for different traffic situations of theoretical scenario.

Paper [2] proposed some greedy approach to minimize the cost with respect to throughput, packet loss and collision.

Paper [3] proposed an extra warning message to enhance the throughput in terms of collision.

But, we try to find the performance based on road structure of city. Further we opted different ad-hoc routing protocol for routing purpose as those the best in terms of worst situation of dynamic routing.

III. PROPOSED ANALYSIS

A. Performance metrics

Different performance metrics are used to check the performance of routing protocols in various network environments. In our study we have selected throughput and packet drop to check the performance of VANET routing protocols against each other. The reason for the selection of these performance metrics is to check the performance of routing protocols in highly mobile environment of VANET. Moreover, these performance metrics are used to check the effectiveness of VANET routing protocols i.e. how well the protocol deliver packets and how well the algorithm for a routing protocol performs in order to discover the route towards destination. The selected metrics for routing protocols evaluation are as follows [6], [9].

1) Throughput

Throughput is the average number of successfully delivered data packets on a communication network or network node. In other words throughput describes as the total number of received packets at the destination out of total transmitted packets [6]. Throughput is calculated in bytes/sec or data packets per second. The simulation result for throughput in NCTUns6.0 shows the total received packets at destination in KB/Sec, mathematically throughput is shown as follows:

$$\text{Throughput (bytes/sec)} = \frac{\text{Total number of received packets at destination} * \text{packet size}}{\text{Total simulation time}}$$

2) Packet Drop

Packet drop shows total number of data packets that could not reach destination successfully. The reason for packet drop may arise due to congestion, faulty hardware and queue overflow etc. Packet drop affects the network performance by consuming time and more bandwidth to resend a packet. Lower packet drop rate shows higher protocol performance.

3) Collision

The Collision of data packet is the number of packets collides to each other due to congestion. It affects the performance directly on the bandwidth. Lower packet collision rate shows higher protocol performance.

B. Testing scenario conditions of VANET:

- 1) Network is taken ad-hoc and the path is absolutely dynamic in nature.
- 2) Lane Width is taken 30m
- 3) Initial average distance is 500m in between different car.

- 4) Simulation time is taken 200sec on average
- 5) RTS threshold is 3000bytes
- 6) The car profile is taken five
(20%---speed is 18km/hour, 20%---speed is 36km/hour, 20%---speed is 50km/hour, 20%---speed is 60km/hour,20%---speed is 80km/hour)
- 7) Number of lane is taken 2

Table1: Simulation environment parameter for VANET

Frequency (MHz)	2400
fadingVar	10.0
RiceanK	10.0
TxAntennaHieght (m)	1.5
System Loss	1.0
Trans Power (dbm)	3.0
AverageBuilding Height (m)	10
Street Width (m)	30
Average Building Distance (m)	80
Path Loss exponent	2.0
Shadowing Standard Deviation	4.0
CloseInDistance (m)	1.0
RxAntenna Height (m)	1.5

C. Simulation Setup

The first step for simulation setup is to create Vehicular Ad Hoc Network. We designed two different networks for evaluation of routing protocols. Network is created by using blank project workspace that is provided by NCTUns6.0 network simulator. For simulation setup for VANET we followed following mentioned steps [7], [8]:

1) Draw Topology

In this step we designed roads networks and select the total number of nodes. First we designed the roads by selecting the appropriate icons for road design that is provided by NCTUns6.0 network simulator. Total length of the roads network also defined in this step. These nodes are highly mobile and we have selected vehicular nodes as it is required by the network. Roads are designed according to real situation for the movement of vehicular nodes [Fig.1].

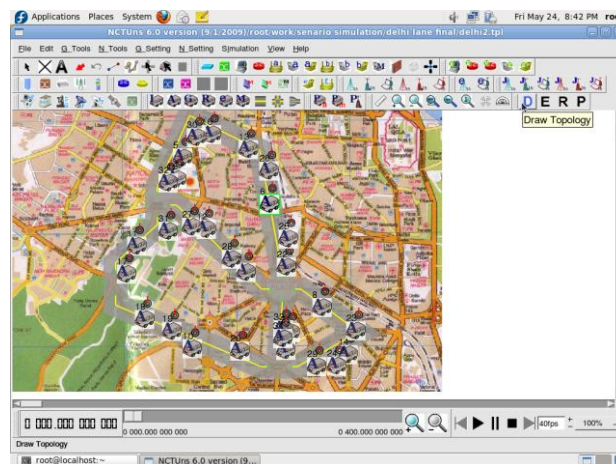


Fig. 2 Draw topology of Delhi Traffic Scenario on NCTUns6.0 network simulator

2) Edit properties

It is the most important step for our simulation setup. In this step we assigned different values in each parameter of vehicular nodes and configured each parameter that is provided by NCTUns6.0 network simulator. Besides these node settings other important settings for simulation and communication among various nodes such that defining the total simulation time, signal selection, implementation of routing protocols for communication, communication type etc. In this simulation study we selected the following network parameters and tools for vehicular nodes and communication among them:

- TCP/IP network transmission mode.
- The protocol is taken AODV,ADV,DSR, GOD of ad-hoc category
- IEEE 802.11b standard used for each vehicular node.
- 1400 bytes of TCP packets used for communication.
- 32 cars are selected for three different scenarios.

- 15dbm Transmission power used for node operation.
- Radio obstacles are set for the interruption of signals in city scenario.

3) Simulation

After making necessary changes in vehicular nodes, network environment and tools we run the simulation [Fig. 2 and 3] to generate the results.

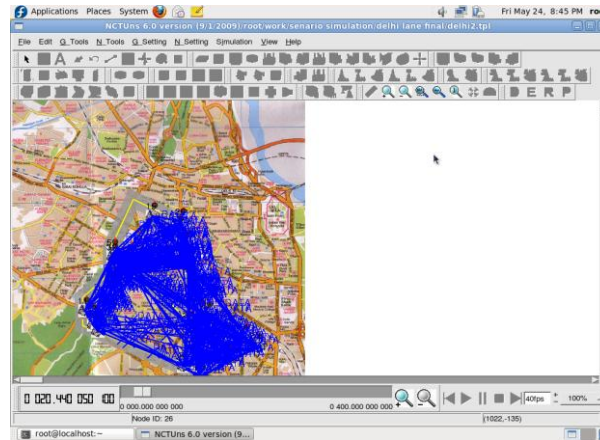


Fig. 3 Run mode with packet transmission from different moving car of Delhi Traffic Scenario on NCTUns6.0 network simulator

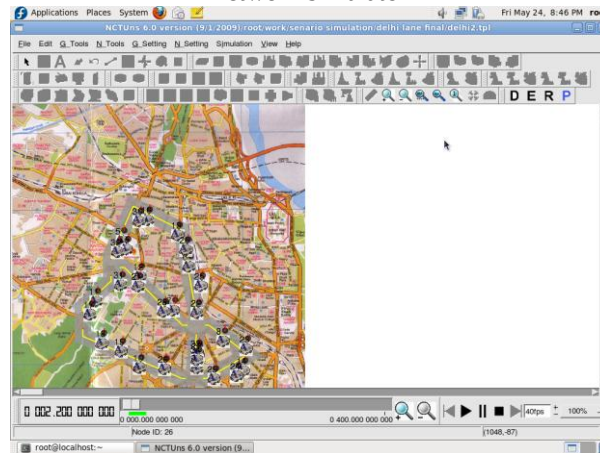


Fig. 4 Moving car with packet transmission from different moving car of Delhi Traffic Scenario on NCTUns6.0 network simulator

IV. TESTING AND RESULTS

A) SCENARIO

We have considered three different congested City map of India from website [11] and we draw the two lane road on the map on the simulator. Next we place the 32car on scenario map.

1) Senario:



Fig. 5 Delhi Scenario

B) RESULTS

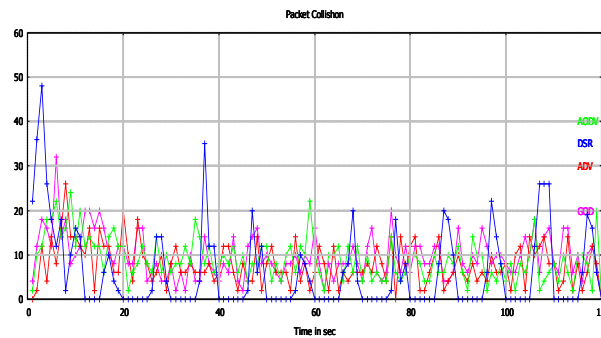


Fig. 6 Number of packet collision vs. time

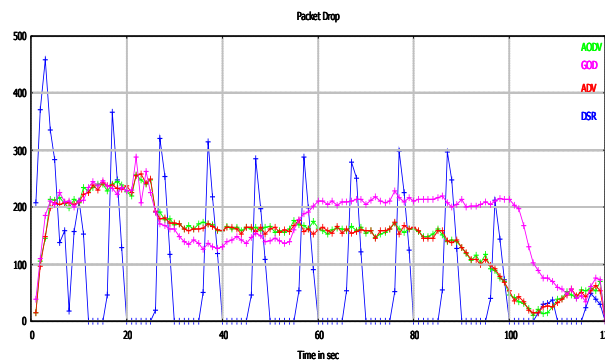


Fig.7 Number of Packet drop vs. time

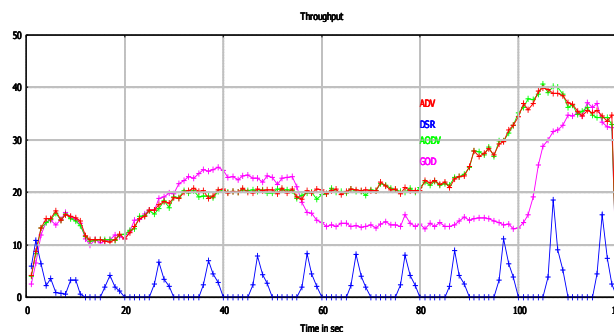


Fig. 8 Throughput vs. time

C) OBSERVATION

The Figures above show the performance of all DSR, GOD, AODV and ADV protocols in respect of chosen performance metrics. The Figure 6 represents the number of packet collision vs.. time it is found that there is some variation in the packet collision during the simulation time and this variation remain almost same for the mobility scenarios of VANET. And we got highest packet collision in DSR. Where in figure 7, number of packet drop vs. time is shown for all four different routing protocol. Here we found that packet drop is much high in DSR and discrete in nature. Finally we have observed that the throughput [Figure 9] is best at ADV and AODV as the number of packet drop is less than DSR and GOD.

Therefore we have got better result in ADV and AODV than DSR and GOD. Even AODV and ADV have highest throughput.

V. CONCLUSION AND FUTURE WORK

As we found DSR is reactive and topology based also table driven, it is not good in highly dynamic nature ad-hoc network. Next GOD is not best for high mobility nature ad-hoc scenario. Therefore we got better result for AODV and ADV as these are good adaptive in nature. Those works better in close distance and mesh type network. Further ADV and AODV is almost same result is expected for ordinary data [15, 16], but ADV is better in real time multimedia data.

We try to simulate on guided path with those routing protocols (ADV, DSR, AODV, GOD) to study the mobility VANET scenarios in various metros to have a comparative picture for them.

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