International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169
Volume: 2 Issue: 6 1380 – 1384

Comparative Analysis of AODV, DSR and DSDV Routing Protocols for VANET City Scenario

Namita Chandel[1], (M.Tech Final Year Student)
Department of Computer Science & Engineering
M. M. Engineering College, Maharishi Markandeshwar University, Mullana, Ambala, Haryana, India
naystewards016@gmail.com

Mr. Vishal Gupta[2] (Asstt. Professor)
Department of Computer Science & Engineering
M. M. Engineering College, Maharishi Markandeshwar University, Mullana, Ambala, Haryana, India
sahara.vishal@gmail.com

Abstract: In this paper we present comparative analysis of VANET (Vehicular Ad-Hoc Network) routing protocols. The analysis is based on different parameters. Vehicular Ad Hoc Network (VANETs) is a network where a short lived network is formed among the vehicles. Vehicles itself are the nodes within the network. VANET is formed by vehicles so node movement is restricted by the factors like road structure, traffic congestion and traffic rules and regulations. Therefore, VANETs consist many antique networking research challenges, and also consist crucial design of an efficient routing protocol for VANETs is very essential. In VANET, there are two kinds of communication can be done i.e. Vehicle to vehicle and vehicle to roadside communication. Therefore the performances of such communication i.e. Vehicle to Vehicle and Vehicle to roadside, between vehicles depend on the various protocols. The performance of routing protocols AODV, DSDV and DSR are examined on the basis of ns2 simulations by using different parameter i.e. throughput, end to end delay, packet delivery ratio and jitter for different number of vehicles. Results are then analyzed on these parameters and to find the suitability of these routing protocols for vehicular area networks.

Keyword: *Vehicular Ad Hoc Networks (VANET), Routing Protocols AODV, DSR and DSDV, SUMO, NS2.*

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I INTRODUCTION

In wireless networks, the recent advancement has introduce a new type of networks i.e. called VANETs (Vehicular Ad Hoc Networks).Vehicular ad hoc network (VANETs) is the type or subclass of MANETs (Mobile Ad Hoc Networks) with some unique properties ,which helps to deploys the concept of continuously varying vehicular motion. There are some VANET applications such as Vehicle collision warning, Security distance warning, Driver help, Cooperative driving, and Cooperative cruise management, Dissemination of road info, Net access, Map location, Automatic parking, and Driverless vehicles[1]. VANET provide communications between vehicles, among nearby vehicles, and nearby fixed units, usually described as a roadside unit (RSU). VANETs have grown out of the need to support the growing number of wireless products that can now be used in vehicles [2]. These products include remote keyless entry devices, personal digital assistants (PDAs), laptops and mobile. The term of VANET is autonomous & self-organizing wireless communication network. The main goal of VANET is to provide safety and comfort for passengers, drivers and other road users. The architecture of VANET is classified in the following three categories i.e. given as [3]

- WLAN/cellular
- Ad hoc
- Hybrid

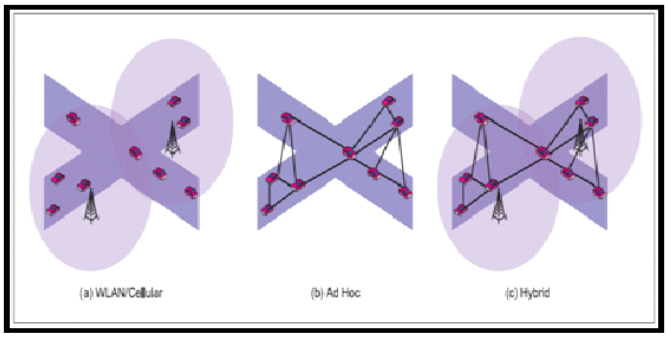

Figure 1: Three possible network architectures for VANETs. [3]

VANET is a new emerging technology so VANET has drawn significant interests from academy, industry and government. Therefore there are many VANETs research projects around the world in which different countries are worked. There are some VANETs projects are COMCAR [4],

DRIVE [5], FleetNet [6] and NoW (Network on Wheels) [7], CarTALK 2000 [8], CarNet [9].

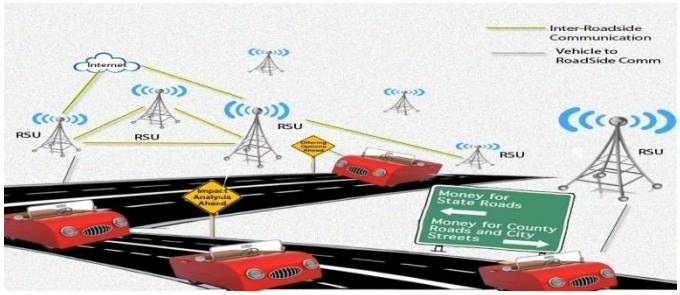

Figure 1.2: A VANET scenario which shows V2V and V2I Communications

In this paper, we are trying to analyze the performance of the routing protocols i.e. AODV, DSR and DSDV with respect to various parameters like Throughput, end to end delay, packet delivery ratio and jitter for different number of vehicles, etc. The performance of the proposed protocol has been studied using sumo and ns2 simulation.

The paper is organized in five sections. The next section describes VANET routing protocols in which AODV, DSR and DSDV are described. In section III we discuss about research methodology and performance metrics i.e. carried out in our experiment. In section IV we discuss about simulation setup. Section V shows the results and analysis made and last section covers the conclusion part.

II ROUTING PROTOCOLS

VANETs area particular class of ad hoc networks, the main difference between MANET and VANET is the special mobility pattern and rapidly changing topology. The unremarkably used ad hoc routing protocols at first enforced for MANETs are tested and then evaluated to be used in a VANET environment. A routing protocol governs the way in which communication takes place between different entities to exchange the desired information in the considerable amount of time. Fig. 2 illustrates the hierarchy of these VANET routing protocols which can be classified as following:

- Position(geographic) Based Routing Protocol
- Topology Based Routing Protocol
- Broadcast Based Routing Protocol
- Cluster Based Routing Protocol
- Geocast Based Routing Protocol

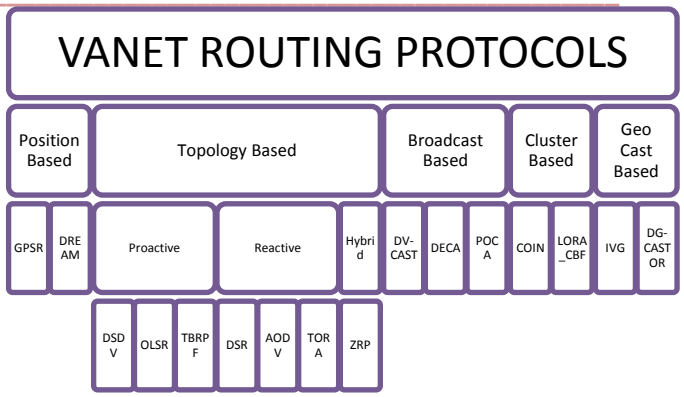

Figure 2: Routing protocol hierarchy

In this paper we focused on only topology based routing protocol i.e. DSDV, AODV and DSR.

A. DSDV Routing Protocol

DSDV refer as Destination Sequence Distance Vector. It is a proactive routing protocol in which every node maintains a table of information in the presence of every other node in the network [10]. It update the table periodically when change occurred in the network).If any change occur in the network then it broadcasted to every node in the network.

B. AODV Routing Protocol

AODV refer as Ad hoc on Demand Distance Vector. It is a reactive routing protocol which establishes a route to a destination when there is a demand occurs for the transmission of the data [11]. It does not contain any loop. AODV routing protocol has consist < RREQ, RREP> pair of message to find the route. AODV is only updates the relevant neighboring node(s) instead of broadcasting every node of the network.

C. DSR Routing Protocol

DSR refer as Dynamic Source Routing. It is also reactive routing protocol as AODV. DSR helps to maintain the source routing, in which, every neighbor in DSR maintains the entire network route from source to the destination [12].

III RESEARCH METHODOLOGY and PERFORMANCE METRICS USED

Research Methodology:

- NS2
- SUMO
- MOVE

These are the various tools that are used for simulation which help to produce the realistic mobility model, simulation parameter and performance metrics.

- NS2: NS2 refer as network simulator (version 2) developed at UC Berkeley. It is a event driven simulator and

we are using this for the simulation of routing protocols and help to simulating their corresponding behavior. It is object oriented simulator in which code is written either in C++ or in OCTL and consist a separate file i.e. executed by OCTL interpreter, thus generating the output file for NAM (Network Animator) [13]. Then it plots the nodes in a position defined by the code script and exhibits the output of the nodes communicating with each other. It consists of two tools i.e. network simulator (NS) contains all commonly used IP protocols and network animator (NAM) is use to visualize the simulations.

- SUMO: SUMO refers as Simulation of Urban Mobility, it is an open source, highly portable, microscopic road traffic simulation package which help to designed and handle large road networks. SUMO is licensed under the GPL. It is mainly developed by the ITS (Institute of Transportation System) at the German Aerospace Center by its employees. It allows the user to build a customized road topology, and also it helps to import different ready-made map formats of many cities and towns of the world [14].

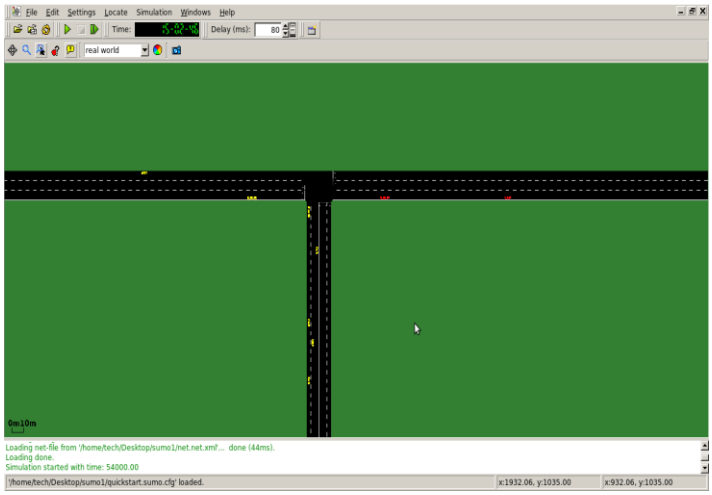

Figure 3.1: SUMO visualization (Movement of Vehicles).

- MOVE: It refers as Mobility model generator for vehicular networks [15]. This tool is used to generate realistic mobility models for VANET simulations. In VANET it is important to represent real world mobility model so that the results obtained from the simulation are correctly reflect the real world. It is currently implemented in Java and is built on top of an open source micro-traffic simulator SUMO. By providing a set of Graphical User Interfaces that automate the simulation script generation, MOVE allows the user to quickly generate realistic simulation scenarios without the hassle of writing simulation scripts as well as learning about the internal details of the simulator. The output of MOVE is a mobility trace file that contains information about realistic vehicle movements which can be immediately used by popular simulation tools such as ns-2.

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, end to end delay, packet delivery ratio and jitter for different number of vehicles 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:

- Packet Delivery Ratio

This metric is defined as the number of data packets that were successfully delivered at destinations by the number data packets that were sent by sources.

- Throughput

Throughput is defined as the average number of the successfully delivered data packets on a communication network. In different words it describes as the total number of received packets at the destination out of total transmitted packets. Throughput is calculated in data packets per second or bytes/sec. The simulation result shows that the overall received packets at destination in KB/Sec.

- Average End-to-End Delay (E2E Delay**)**

It is define as the calculation of the total time from the source end to the destination end taken by the packet. In other words, it covers all of the potential delays such as route discovery, buffering processes, various in-between queuing stays, etc. during the entire trip of transmission of the packet. For this metric, lower the time taken, more privileged is the routing protocol.

- Jitter

Jitter is defined as the difference between the expected time of arrival of a packet and the actual time of arrival**.** It is define the mean deviation of the packets from source to

destination for number of vehicles. Jitter is caused primarily by delays and congestion in the packet network.

IV SIMULATION SETUP

In the following table the configuration parameters assumed for simulation i.e. given as:

Table1: Simulation Setup

Simulator	NS 2.34
Antenna Model	Antenna/Omini Antenna
Radio Propagation Model	propagation/ TwoRayGround
MAc Type	IEEE 802.11
Interface Queue Type	Queue/ DropTail/PriQueue
Routing Protocols	DSDV,DSR and AODV
No. of Vehicles	12,24,51,60
N/W Interface Type	Phy/Wireless Phy
Traffic Type	CBR

A. Simulation Details

Mostly MOVE is used for simulation in which movement of vehicles are occur in a particular road map. Since in our paper we also done the simulation by using MOVE and at the final step we get (.tcl) file i.e. named as (NS2.tcl) which is used for further analysis. Therefore we can run NS2 script by using the NS2 programs script runner. Finally we call NAM (Network Animator) from the main menu and play and visualize the actual movement of vehicles in NAM.

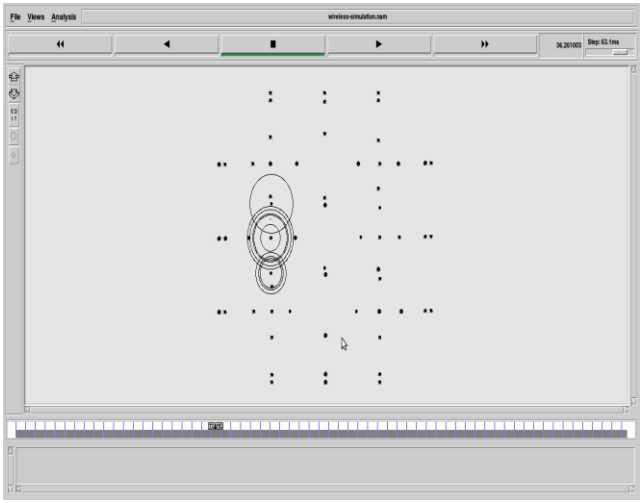

Figure 4.1: NAM Visualization (Show movement of vehicles and also show V-V communication).

V RESULTS and ANALYSIS

In order to evaluate performance metrics for each case different simulations are carried out and then average value is used for plotting graphs. The first metric which is the plotted for packet delivery ratio v/s number of vehicles. In this we see that the data packets that were successfully delivered at destinations by the number data packets that were sent by sources for the different routing protocols.

Packet Delivery Ratio:

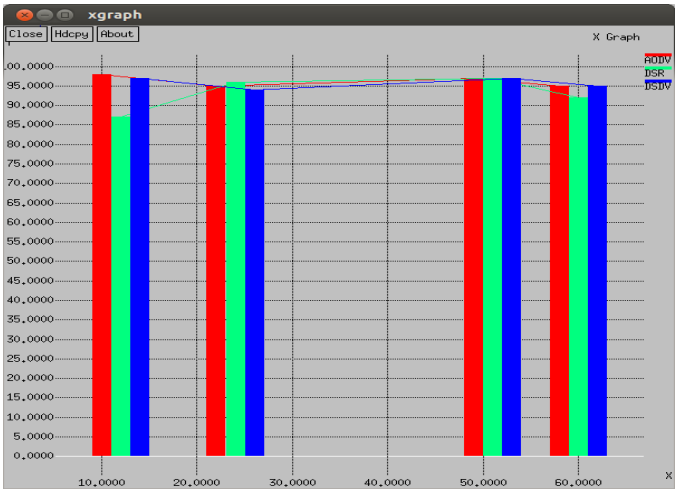

Figure 5.1: Packet delivery ratio v/s number of vehicles.

Throughput:

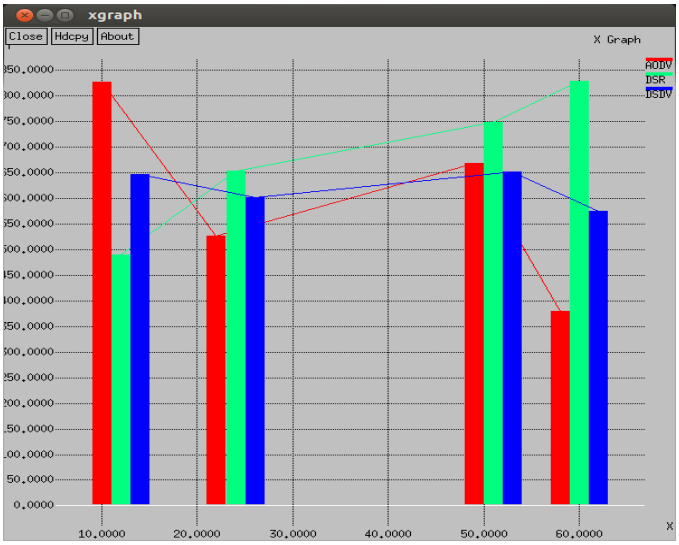

Figure 5.2: Aggregated throughput v/s different number of vehicles.

Average End to End Delay:

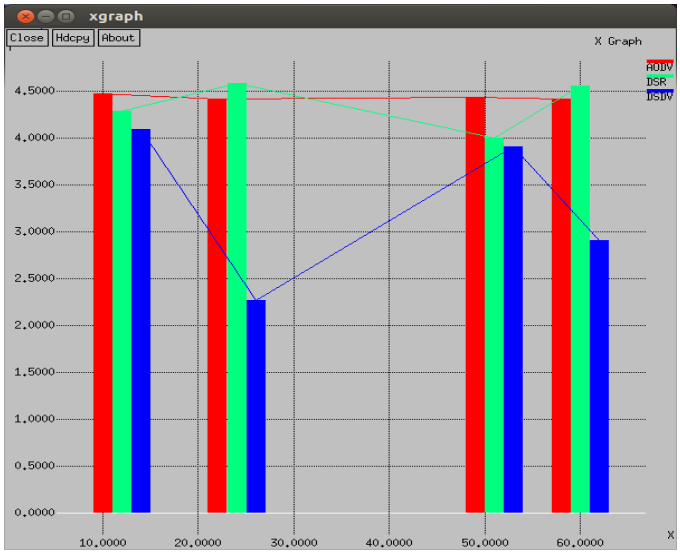

Figure 3: Average end to end delay v/s number of vehicles.

Jitter:

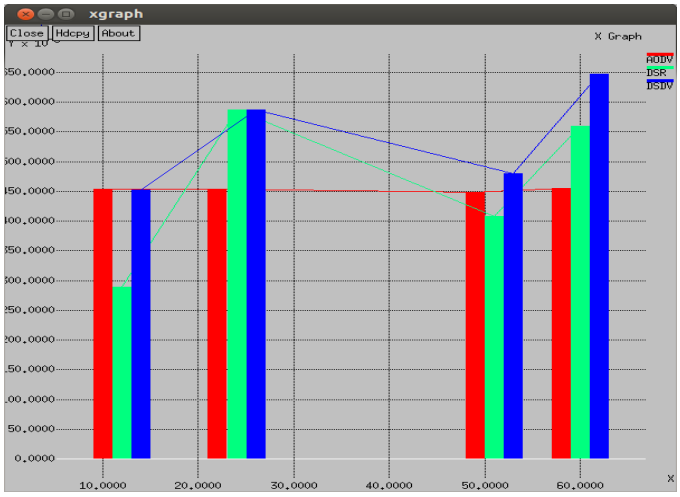

Figure 5.4: Jitter v/s number of vehicles.

VI Conclusion

The main goal of this paper is to analysis of topology based routing protocols and to evaluate these routing protocols with different parameter in VANET. In VANET, due to high mobility of nodes the network route path changes frequently and it depends on urban road infrastructure. So it is necessary to consider realistic and specific road map. In this paper we use MOVE along with SUMO and NS2 to simulate AODV, DSDV and DSR routing protocols with realistic mobility model.

In this study we focused only topology based routing protocols. We have examined how different topology routing protocol suffers from the highly mobile nature of VANET. From the results of our study we realized that the AODV preferable for packet delivery ratio as compare to DSR and DSDV while DSR have lower end to end delay. Whereas the DSR have consist the aggregated throughput for different number of vehicles and DSDV routing protocol have max. Jitter value for different number of vehicles as compare to another routing protocols.

In future, it can be simulated and analyzed for higher number of nodes (vehicles).

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