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Road-Based Routing Protocol for Vanet Using Sumo and Move

Devipriya. D[1] and Muruganandam.A[2*]

[1,2*]*Department of Computer Science,*
Don Bosco College, Dharmapuri-636 809, TamilNadu, India

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Abstract— Vehicular Ad Hoc Network (VANET) is a form of Mobile Ad Hoc Networks (MANET). The field of VANETs started gaining attention in 1980s and it has been an active field of research and development. VANETs provide us with the infrastructure for developing new systems to enhance drivers' and passengers' safety and comfort. There are many routing protocols that have been proposed and assessed to improve the efficiency of VANET. Simulator tool has been preferred over outdoor experiment because it is simple, easy and cheap. In this paper, simulation of one of the routing protocols i.e. AODV is done on simulators which allow users to generate real world mobility models for VANET simulations. The Simulation of Urban Mobility (SUMO) and MObility model generator for VEhicular network tools used. MOVE tool is built on top of SUMO which is an open source micro-traffic simulator. Output of MOVE is a real world mobility model and using the simulation of Network Simulator tool and then graphs were plotted using Trace Graph for evaluation. Based on the simulation results obtained, the performance of AODV is analyzed and compared with different node density i.e. 5, 10, 15 and 20 with respect to various parameters like Throughput, Packet size, Packet drops, End to End delay etc.

Keywords— VANET, AODV, SUMO, MOVE, *On Board Units*

I. INTRODUCTION

A.Vehicular Ad Hoc Network

Absence of road traffic safety takes a toll of precious human lives and poses a dire threat to our environment as well. Other negative consequences are related to energy waste and environmental pollution. According to National Highway Traffic Safety Administration (NHTSA), following figure 1. indicate some of the consequences of recent car accidents [3].

VANETs provide us with the infrastructure for developing new systems to enhance drivers and passenger's safety and comfort. It distributes self-organizing networks formed between moving vehicles equipped with wireless communication devices. This type of networks is developed as part of the Intelligent Transportation Systems (ITS) to bring significant improvement to the transportation systems performance. There are many routing protocols that have been proposed and assessed to improve the efficiency of VANET.

B.Architecture of Vanet

One of the main goals of the ITS is to improve safety on the roads, and reduce traffic congestion, waiting times, and fuel consumptions. The integration of the embedded computers, sensing devices, navigation systems, digital maps, and the wireless communication devices along with intelligent algorithms will help to develop numerous types of applications for the IT'S to improve safety on the roads. The up to date information provided by the integration of all these systems helps drivers to acquire real-time information about road conditions allowing them to react on time. Vehicular networks are composed of mobile nodes, vehicles equipped with On Board Units. (OBU), and stationary nodes called Road Side Units (RSU) attached to infrastructure that will be deployed along the roads. Both OBU and RSU devices have wireless/wired communications capabilities. OBUs communicate with each other and with the RSUs in Ad hoc manner.

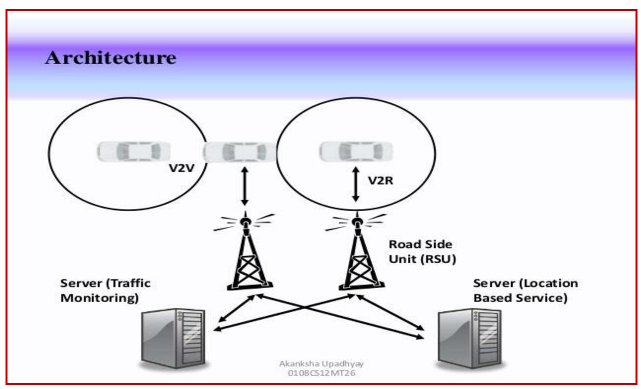

Figure 1: Architecutre of VANET

There are mainly two types of communications scenarios in vehicular networks: Vehicle-to-Vehicle (V2V) and Vehicle-to-Road Side Unit (V2R). The RSUs can communicate with each other and also with other networks like the internet as shown in the above Figure 1. Vehicular

Networks are expected to employ variety of advanced wireless technologies such as Dedicated Short Range Communications (DSRC), which is an enhanced version of the WiFi technology suitable for VANET environments. The DSRC is developed to support the data transfer in rapidly changing communication environments, like VANET, where time- critical responses and high data rates are required.

1. *Advantages of VANET*: Public Safety, Traffic Management, Traffic Coordination and Assistance, Traveller Information Support, Comfort, Air pollution, emission measurement and reduction.

2. *Disadvantages of VANET:* Flooding in route discovery initial phase, wasted band, width delay, increasing network congestion and bad performances for long distance between sources and destination.

A. EXISTING PROBLEM

VANET has become an active area of research, standardization, and development because it has tremendous potential to improve vehicle's and road safety, traffic efficiency, and convenience as well as comfort to both drivers and passengers. We survey some of the recent research results in these areas. We present a review of wireless access standards for VANETs, by describing some of the recent VANET trials and deployments in the US, Japan, and the European Union. Finally, the outline of the VANET research challenges that still need to be addressed to enable the ubiquitous deployment and widespread adoption of scalable, reliable, robust, and secure VANET architectures, protocols, technologies and services.

B. Proposed Scheme

The VANET MAC layer 802.11p standard to add wireless access in vehicular environment is used to measure packet receiving time, packet delivery ratio for various clusters with different nodes and speeds. Time taken to reach the information to all the nodes in this model is low. This model provides an efficient architecture for service request/response procedure. The existing routing protocols for VANET are not efficient to meet every traffic scenarios. Thus design of an efficient routing protocol has taken significant attention. By studying different routing protocol in VANET we have seen that further performance evaluation is required to verify performance of a routing protocol with other routing protocols based on various traffic scenarios. The comparison of different VANET protocols features is essential to design a new proposal for VANET using SUMO and MOVE.

C. ROUTING PROTOCOLS

Routing is a mechanism to establish and select a specific path in order to send data from source to destination. There are various routing algorithm designed for ad-hoc networks.

D. MOBILITY MODELS

In order to achieve good result from VANET simulations, there is a need to generate a mobility model that is realistic as an actual VANET environment. The usage of mobility model signifies the movement of mobile node that will consume the protocol.

E. WORKING with AODV

The Ad hoc On-Demand Distance Vector (AODV)[5] is a reactive routing protocol which enables dynamic, self-starting, multihop routing between participating mobile nodes wishing to establish and maintain an ad hoc network. It allows the communication between two nodes through intermediated nodes, if those two nodes are not within the range of each other. To establish a route, there is route discovery phase in AODV, along which messages can be passed. AODV makes sure these routes do not contain loops and tries to find the shortest route possible. AODV allows mobile nodes to respond quickly to handle changes in route. When links break, AODV causes the affected set of nodes to be notified so that they are able to invalidate the routes using the lost link. Distinguish feature of AODV is that it uses destination sequence number for each route entry, which ensures loop free route. In case there are two routes to a destination, a requesting node selects the one with greatest sequence number. The route discovery and maintenance proposes control messages are defined in AODV.

IV. METHODOLOGIES

Many applications vehicular network has fascinated research institutes and automotive industries. Various types of challenges in vehicular communications have been identified and addressed. Main issue of concern is implementation of an appropriate routing protocol because of several issues. Routing protocol is an algorithm used to determine an appropriate path to destination along which messages can be forwarded. VANET routing protocol is classified into topology based and position based. It will be interesting to evaluate the performance of AODV (reactive routing), with realistic mobility model for VANET.

1. Firstly, simulation environment is to be setup. MOVE tool is used for rapid generation of realistic mobility model along with SUMO and NS2.

2. The performance comparison is made with different number of nodes. Three different sets of node density would be used to compare the performance of the said protocols.
3. Awk scripts are used to get the value from trace file and ms-excel is used to generate graphs.
4. Results are compared under various parameters like throughput, End to End delay, Packet delivery ratio etc.

V. SIMULATION & IMPLEMENTATION

Simulation is "the process of designing a model of a real system and conducting experiments with this model, for the purpose of understanding the behavior of the system and/or evaluating various strategies for the operation of the system." Developing a VANET in practical application is too costly therefore to test and to evaluate the protocols simulators are used. Simulation of protocol is the initial step of implementation of VANET protocols. Several communications network simulator already exist to provide a platform for testing and evaluating network protocols, such as NS-2[12], OPNET[11], and Qualnet[8]. Apart from the available simulators, several simulation tools available such as PARAMICS [9], CORSIM [10], MOVE [13] and SUMO [14], etc that have been developed to analyze transportation scenarios at the micro and macro- scale levels. Node mobility is the most important parameter in simulating ad-hoc network. It's important to use real world mobility model so that the results from the simulation correctly reflect the real-world performance of a VANET.

"Simulation of Urban Mobility", or "SUMO" [14] is a highly portable microscopic road traffic simulation package designed to handle large road networks. The major reason for the development of an open source, microscopic road traffic simulation was to support the traffic research community with a tool into which own algorithms can be implemented and evaluated.

It is script based tool. It allows users to create a road topology with vehicles movement according to users requirement. It also allows user to define the departure and arrival properties, such as the lane to use, the velocity, or the position can be defined. These all properties are defined when the vehicle is created and its flow definitions are set.

MOVE (MObility model generator for VEhicular networks) is a Java-based application built on SUMO (Simulation of Urban Mobility) with an ability of GUI. In this paper, a tool MOVE (MObility model generator for VEhicular networks) has been used to allow the users to generate realistic mobility models for VANET simulations. The output of MOVE is a mobility trace file that contains information of realistic vehicle movements which can be used by popular simulation tools such as NS-2. MOVE consists of two main components: Mobility model and Traffic model generator.

MOVE and SUMO are used to generate a realistic mobility model for VANETs. With the help of MOVE, scripts for SUMO have been generated. These scripts help in generating realistic mobility model. Routing protocols (AODV, DSDV, ZRP) have been implemented over the generated realistic mobility model to analyze their behavior and performance. Following steps are involved in the implementation process:

Firstly select "Mobility Model" on the main top level menu. It has three main modules: map editor, vehicle movement editor, simulation. Map editor is used to generate the map, here one has to specify nodes, which act as junction or dead ends and edges which represent roadways, one can either create new topology manually or can generate any random maps. Vehicle movement editor is used to create vehicles. This module is responsible for defining number of vehicles, flow of vehicles that will specify the groups of vehicle movements flow on the simulation and turning ratio that will define the probability of directions on each junction. Simulation module is used to visualize the configured topology and also specify the beginning and end time of simulation.

VI. RESULT AND DISCUSSIONS

Routing protocols can be analyzed and compared by observing their behavior under some performance metrics. To analyze the behavior of AODV routing protocol performance metrics has been used. Simulation has been performed on each protocol for 25 to 150 nodes. Vehicular Ad hoc Network (VANET) are treated as mobile sensor networks and characterized with special characteristics such as high node mobility and rapid topology changes. VANET nodes can sense a variety of data in its surrounding area to offer several services including traffic monitoring, speed controlling, lost vehicle locating and environmental monitoring as it covers permanently a wide geographical region. Nodes are configured with different communication. Vehicles moves within the specified network boundary. Nodes in VANET can communicate in two ways: Vehicle-to-Vehicle (V2V) communication and Vehicle-to-Infrastructure (V2I) communication. In V2I communication model, vehicles communicate to Road-Side-Unit (RSU) through Road-Side-Routers(RSR). Data Transmission is established between nodes using UDP agent and CBR traffic The reactive on demand routing protocols establish the route to a particular destination only if it is needed. Adhoc on-demand Distance Vector (AODV) is one of the commonly used reactive on demand routing protocols in Mobile Ad hoc Network (MANET). AODV is a reactive enhancement of the DSDV protocol. The route discovery process involves ROUTE REQUEST (RREQ) and ROUTE REPLY (RREP) packets.

The source node initiates the route requested through the route discovery process using RREQ packets. The generated route request is forwarded to the neighbors of the source node and this process is repeated till it reaches the destination. On receiving a RREQ packet, an intermediate node with route to destination, it generates a RREP containing the number of hops required to reach the destination. All intermediate nodes that participates in relaying this reply to the source node creates a forward route to destination. AODV minimizes the number of packets involved in route discovery by establishing routes on-demand. The van.tcl shows a node configuration for a wireless mobile node that runs AODV as its adhoc routing protocol. Prior to the establishment of communication between the source and receiver node, the routing protocol should be mentioned to find the route between them. Data Transmission is established between nodes using UDP agent and CBR traffic. Most of the simulation is done using MOVE for movement of vehicles in a particular road map. At the final stage of MOVE we get a (.tcl) file named (ex_NS2.tcl) that can be used for further analysis. We can either run the NS-2 script in own shell or using the program's NS-2 script runner.

a. Experimental Analysis

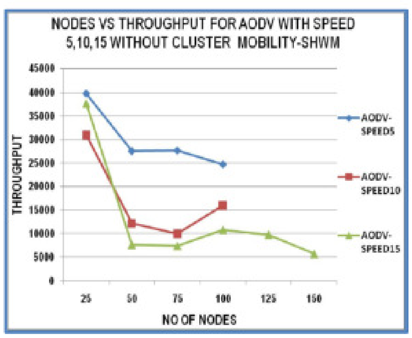

Figure 2. Through put for AODV

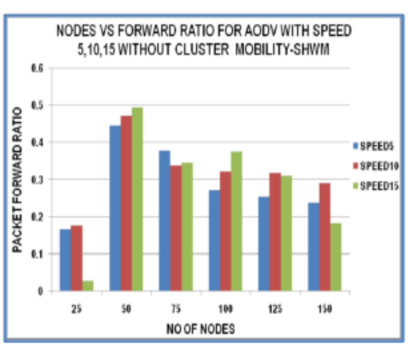

Figure 3. Packet Forward Ratio for AODV

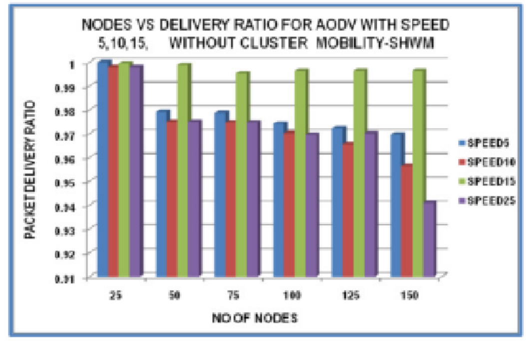

Figure 4. Packet Delivery Ratio for AODV

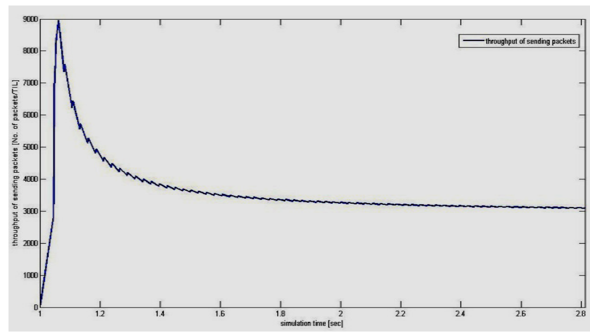

Figure 5. Throughput of sending packets

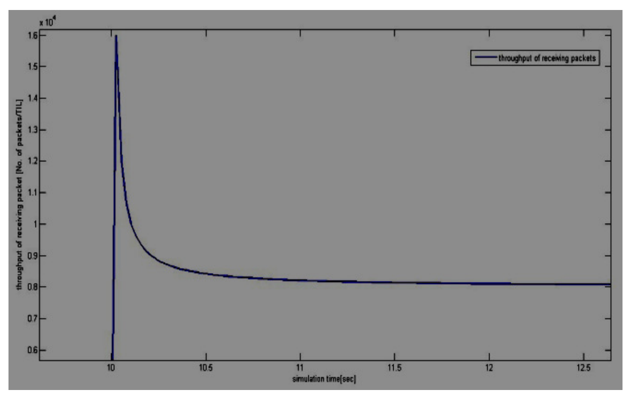

Figure 6. Throughput of receiving packets

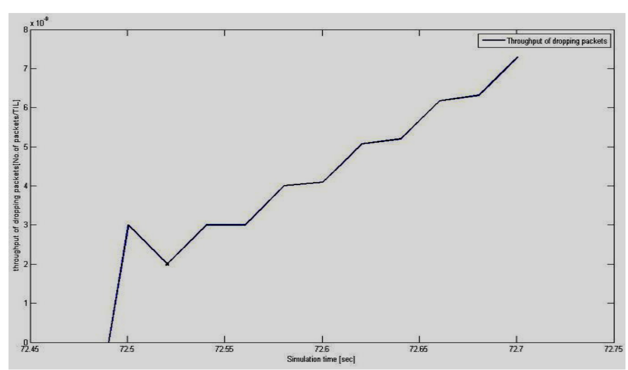

Figure 7.Throughput of dropping packet

VII CONCLUSION

In this paper, AODV is simulated with realistic mobility model. The behaviors of reactive routing protocol (AODV) have been analyzed under the microscopic mobility model. The evaluations made on these protocols bring out some important characteristics of these protocols when they are used in VANET. From the obtained results, it is observed that reactive protocol (AODV) performed well because mechanisms of route discovery, route maintenance and elimination of periodic broadcasting are used by AODV and by almost all reactive protocols. A tool MOVE has been used to allow the users along with SUMO to implement over realistic mobility model. The implementation modules mad editor, vehicle movement editor and simulation help us to visualize and configure the topology and time of simulation. Further, graphs are plotted using Tracegraph for evaluation. AODV's performance is analysed for different nodes density 5, 10, 15 and 20 with respect to various parameters like throughput, packet size, packet drops etc.

VIII FUTURE WORK

In future, it can be simulated and analyzed for higher number of nodes. It would be interesting to see how AODV performs in high node density network. Here it has been implemented for single mobility model and manually generated maps. In future performance can be compared for different mobility models. It would be interesting to simulate and analyze their behavior in realistic scenario by specifying acceleration, decelerations, maximum speed and other movement characteristic of vehicle under real map with large number of nodes and by generating a scenario where vehicles can exchange messages that will change their speed, lane etc.

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AUTHORS PROFILE

Mrs. D. DEVIPRIYA, Research Scholar, Department of Computer Science, Don Bosco College, Dharmapuri, Tamilnadu, India. She is a Research Scholar in the field of Wireless Sensor Networks at Periyar University, Salem, Tamilnadu, (India). Her research is focusing on providing reliable Road-based Routing Protocol for Vehicular Ad hoc Networks using SUMO and MOVE.

Mr. A. MURUGANANDAM, Assistant Professor, Department of Computer Science, Don Bosco College, Dharmapuri, Tamilnadu, India. He is a Research Scholar in the field of Wireless Sensor Networks at Bharathiyar University, Coimbatore, Tamilnadu, (India). His research is focusing on Data hiding method for preventive and selective jamming attacks in Wireless Sensor Network.