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REALISTIC SIMULATION FOR COMPARISON OF NETWORK ROUTING PROTOCOL IN VANET

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Abstract

Vehicular Ad-hoc Networks (VANETs) is attracting considerable attention from the research community and the automotive industry to improve the services of Intelligent Transportation System (ITS). As today's transportation system faces serious challenges in terms of road safety, efficiency, and environmental friendliness, the idea of so called "ITS" has emerged. Due to the expensive cost of deployment and complexity of implementing such a system in real world, research in VANET relies on simulation. Vehicular Ad-Hoc Network (VANET) is surging in popularity, in which vehicles constitute the mobile nodes in the network. Many routing protocols have been proposed and assessed to improve the efficiency of VANET. It has various challenges to adopt the protocols that can serve in different topology and scenario. This paper presents a comparative study of the ad-hoc routing protocol in realistic scenario of VANET environments. In order to make comparison three performance criterions are selected which include number of packet drop, throughput and total time taken by the simulator to simulate the given network. For this MOVE is used along with SUMO and the simulator used is NS-2. In this paper we analyzed and compared the performance of AODV, DSR and DSDV under different node densities of 10 to 30 nodes.

I. INTRODUCTION

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In the recent years, vehicular networking has gained a lot of popularity among the industry and academic research community and is seen to be the most valuable concept for improving efficiency and safety for future transportations. A Vehicular Ad-Hoc network is a form of Mobile ad-hoc Networks, to provide communication among nearby vehicles and between vehicles and nearby fixed equipment i.e. roadside equipment. The main goal of VANET is providing safety and comfort for passengers. The important factors that would influence the adoption of VANET architecture for future vehicular applications would be - Low latency requirements for safety applications Extensive growth of interactive and multimedia applications Increasing concerns about privacy and security Each vehicle equipped with VANET device will be a node in the Ad-hoc network and can receive & relay other messages through the wireless network. Collision warning, Road signal arms and in place traffic view will give the driver essential tool to decide the best path along the way. The V2V communication infrastructure assumes the presence of high bandwidth with low latency. VANET or Intelligent Vehicular Ad-Hoc Networking provides an intelligent way of using vehicular Networking. A VANET overview can be seen in Fig. 1.[1]

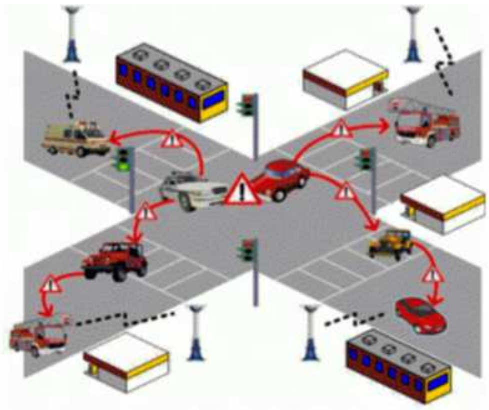

Fig. 1. VANET Scenario [1]

In this paper, we are trying to analyze the performance of two highly adopted ad-hoc routing protocols AODV, DSR and DSDV using the various parameters such as throughput, packets dropped and simulation time by taking the different node densities of 10 to 30 nodes. The performance of the proposed protocol has been studied using simulation tools mainly Network Simulator (NS) and MOVE (MObility model generator for VEhicular networks) over SUMO (Simulation of Urban Mobility).

II. RELETED WORK

Vijaya et. al [1] compares the performance of two prominent on- demand reactive protocols for mobile ad-hoc networks: DSR and AODV with traditional proactive DSDV protocol. The network performance such as throughput delivery ratio and end-to-end delay carried out using NS2 simulator. Anuj K. Gupta et. al. [2] is subjected to the on-demand routing protocols with identical loads and environment conditions and evaluates their relative performance with respect to the two performance metrics: average End-to-End delay and packet delivery ratio and investigates various simulation scenarios with varying pause times. Using the latest simulation environment NS 2, it evaluates the performance of three widely used ad-hoc network routing protocols using packet-level simulation. Singh Annapurna et. al. [3] compares the performance of three on-demand routing protocol i.e. DSR, DSDV and TORA for MANET by varying the size of the networks. The performance metrics used are Total traffic received, Traffic Load, Throughput, Number of Hops per route and Route Discovery time. The simula- tor used is OPNET simulator. Mohd. Izuan Mohd Saad et. al.[4] studied the effect of the different mobile node movement pattern in random-based mobility model group (Random Waypoint Mobility Model, Random Walk Mobility Model and Random Direction Mobil- ity Model)on the performance of Ad-hoc On-demand Distance Vector (AODV). To evaluate the performance, a detail simulation was conducted using the discrete-event simulator OMNeT++. Azizol Abdullah et. al. [6] compares three ad-hoc routing protocols named DSDV, DSR and AODV using NS2 simulator. Simulation results show that when number of nodes participating in the net- work is increased, packet delivery fraction of data packet delivered by all the protocols will become lesser. M.Sulleman Memon et. al. [5] contributes an effort towards anthology of one of the major segment of routing protocols i.e. unicast, their categories and the main type of unicast routing protocols such as DSDV from proac- tive plus DSR from reactive. Muazzam Ali Khan Khattak et. al. [6] analyze different performance parameters of three well known Ad- hoc network routing protocols (AODV, DSDV, DSR) with varying node density and velocity, under reliable TCP and unreliable UDP transport layer protocols. From simulation results it is observed that each protocol perform in different way with different node density and velocity. Comparing result for both UDP and TCP, it concludes that all the protocols perform well under TCP as far as packets received are concerned.

III. ROUTING PROTOCOLS

In VANET, the routing protocols are classified into two categories: Topology based and Position based Routing Protocols. Topology based routing protocols use links information that exist in the network to perform packet forwarding. They are further divided into Proactive and Reactive. The proactive routing means that the routing information such as next forwarding hope is maintained in the background irrespective of communication requests. Reactive Routing 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 [7]. Position based routing Protocols share the property of using geographic positioning information in order to select the next forwarding hops. In our simulation, we have used two Reactive Routing Protocols, namely AODV, DSR and one Proactive Protocols, namely DSDV.

A. AODV

The Ad hoc On-Demand Distance Vector (AODV) [8] is an on-demand routing protocol which does not maintain routes from every node to every other node in the network rather they are discovered as and when needed & are maintained only as long as they are required. AODV algorithm enables dynamic, self-starting, multi-hop routing between participating mobile nodes wishing to establish and maintain an ad hoc network. 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. AODV initiates a route discovery process using Route Request (RREQ) and Route Reply (RREP). The source node will create a RREQ packet containing its IP address, its current sequence number, the destination's IP address, the destination's last sequence number and broadcast ID. To process the RREQ, the node sets up a reverse route entry for the source node in its route table. This helps to know how to forward a RREP to the source. When the destination node or an intermediate node with a route to the destination receives the RREQ, it creates the RREP and unicast the same towards the source node using the node from which it received the RREQ as the next hop. When the RREP reaches the source node, it means a route from source to the destination has been established and the source node can begin the data transmission. If the RREQ is lost during transmission, the source node is allowed to broadcast again using route discovery mechanism. It favours the least congested route instead of the shortest route and it also supports both unicast and multicast packet transmissions even for nodes in constant movement.

B. DSR

Dynamic source routing (DSR) [9] protocol is one of the example of an on-demand routing protocol that is based on the concept of source routing. The DSR network is totally self organizing and self configuring. DSR uses no periodic routing messages like AODV, thereby reduces network bandwidth overhead, conserves battery power and avoids large routing updates. The DSR routing protocol discovers routes and maintains information regarding the routes from one node to other by using two main mechanisms: route discovery and route maintenance. The DSR regularly updates its route cache for the sake of new available easy routes. Route Discovery is the mechanism by which a node S wishing to send a packet to a destination node D obtains a source route to D. Route Discovery is used only when S attempts to send a packet to D and does not already know a route to D. Route Maintenance is the mechanism by which node S is able to detect, with the help of a source route to D, if the network topology has changed such that it can no longer use its route to D because a link along the route no longer works. If a link failure is found between source and destination, the source node tries to find another route to the destination or invokes Route Discovery DSR has a unique advantage of source routing. As the route is part of the packet itself, routing loops, either short – lived or long – lived, cannot be formed as they can be immediately detected and eliminated. The packet in DSR carries all information pertaining to route in its preamble (header) thus permitting the intermediate nodes to cache the routing information in their route tables for their future use.

III. RESEARCH METHODOLOGY USED

The scenarios used for analysis, simulation setup, performance metrics used for making various comparisons are discussed in this section. A. Simulation Tools To carry out the experiments in this paper, MOVE along with SUMO and NS2 is used. 1) Move: A tool MOVE (Mobility model generator for Vehicular networks) [11], [12] to facilitate users to rapidly generate realistic mobility models for VANET simulations. MOVE 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. The architecture of MOVE is shown in Fig. 2. The two main function of MOVE are: MAP Editor Vehicle Movement Editor the Map Editor is used to create the road topology. Currently our implementation provides three different ways to create the road map – the map can be manually created by the user, generated automatically, or imported from existing real world maps such as publicly available TIGER [13]. We have also integrated Google Earth into MOVE to facilitate the creation of nodes in a realistic setting. The Vehicle Movement Editor allows the user to specify the trips of vehicles and the route that each vehicle will take for one particular trip.

2) Sumo: "Simulation of Urban MObility" (SUMO) [14] is an open source, highly

portable, microscopic road traffic simulation package designed to handle large road networks. It allows the user to build a customized road topology, in addition to the import of different readymade map formats of many cities and towns of the world.

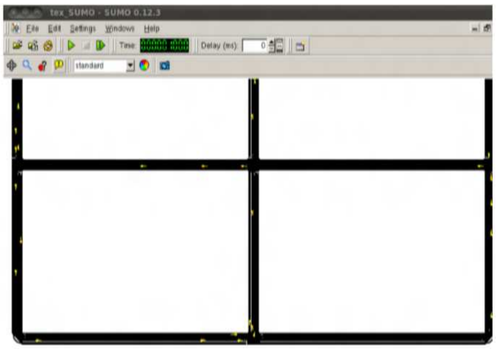

Fig. 2. shows SUMO visualization.

3) NS2: The Network Simulator (ns2) [15] is a discrete event driven simulator developed at UC Berkeley. We are using Network Simulator NS2 for simulations of protocols. It provides substantial support for simulation of TCP, routing and multicast protocols over wired and wireless networks. Ns- 2 code is written either in C++ and OTCL and is kept in a separate file that is executed by OTCL interpreter, thus generating an output file for NAM (Network animator) [16]. It then 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 simulation tools. The network simulator (ns) contains all commonly used IP protocols. The network animator (NAM) is use to visualize the simulations. It is packaged with a bundle of rich libraries for simulating wireless networks. All the mobile nodes in NS-2 quickly assume that they are the part of Ad-hoc network and the simulation mobile nodes connected with infrastructure networks are not really possible. For this study three performance metrics are selected namely:-

1)Throughput: Throughput describes as the total number of received packets at the destination out of total transmitted packets. It is the average rate of successful message delivery over a communication channel. It is the number of received packets per TIL (Time Interval Length). This data may be delivered over a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second or data packets per time interval length

(TIL). Total no. of received packets at destination *

Packet size

T = --

Total simulation time

2) **Packets Dropped:** The number of packets dropped at a given instance of time in the simulation run determines the efficiency of the protocol. The reason for packet drop may arise due to congestion, faulty hardware and queue overflow etc.

3) **Simulation Time:** It describes the total time taken by the simulator NS-2 to simulate the individual routing protocol.

IV. NS2 SIMULATON RESULT FOR VANET

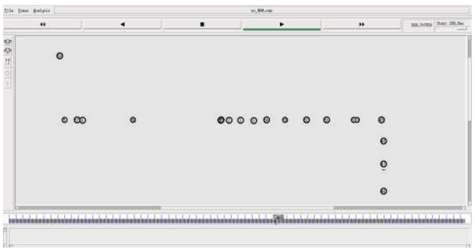

Fig. 3. shows NS2 visualization.

V CONCLUSION

This work mainly consists of two studies, one is analytical study and other is simulation study. From analytical study it is concluded that routing protocols in new modern arena of telecommunications, internet systems and in seamless communication play prominent role to develop better communication between end users. The selection of suitable protocol according to the network definitely increases the reliability of that network. The simulation study consisted of three routing protocols AODV, DSR and DSDV, analyzing their behavior with respect to three parameters, Throughput, Packets Drop rate and Simulation Time. The motive was to check the performance of these three routing protocols in VANET in the above mentioned parameters**.**

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