Routing Protocol and Simulation Study for Vehicular Adhoc Network Environment

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Abstract-VANET is a highly mobile wireless Adhoc network in which vehicles are simulated as nodes. It is a distributed and self-organized network without need for an infrastructure. The communication between the vehicles is normally accomplished through special electronic devices so that an Adhoc network of the vehicles is formed on the road. The goal of VANET is to achieve inter-vehicle communication and to provide safety and traffic management applications for the road users to enhance the efficiency of the transportation systems. Routing plays a vital role in communication between the vehicles in the network. The performance of the mobile environment is determined by routing protocol. This article presents the architecture, characteristics, applications, routing protocol and the simulation tools used to evaluate the performance of the routing protocol and the performance is evaluated in NS2 in terms of delivery ratio.

Keywords: VANET, Adhoc, routing, simulation

I. INTRODUCTION

VANET is the subclass of Mobile Adhoc Network in which the vehicles are integrated as nodes. The features of VANET are inherited from MANET in wisdom of self-management, self-organization, low bandwidth and no centralization nodes. But still the VANET has some unique characteristics such as rapid changing network topology, frequently disconnected network, large scale network, geographical type of communication, Interaction with On-Board Sensors and power consumption. The communication between the vehicles ensures the security and efficiency of transportation systems by acknowledgment of environment hazards such as fog, fire or road traffic condition (e.g.: emergency, congestion or construction). IEEE802.11p is used for safety and other applications on VANET. Intelligent Transportation System (ITS) is the major component of VANET. It includes a variety of application such as traffic flow control mechanisms, blind crossing and prevention of accidents, infotainment, and internet access to the moving vehicles. For these applications, the vehicles need reliable communication equipment to achieve high data rates and stable connectivity between the sender and the receiver.

II. VANET ARCHITECTURE

There are two types of communication takes place in VANET: they are V2I (Vehicle to Infrastructure Fig 2) and V2V communications (Vehicle to Vehicle communication Fig 1). The most important component is ITS (Intelligent Transport System) in which vehicles are equipped with some short range communication and medium-range wireless communications. Hybrid architecture of combing both types of communication together has also been implemented in VANET and the communication with them is possible through multi-hop links to remain connected to the world. VANETs comprise of radio-enables vehicles which acts as router for other vehicles.

Fig 1. Vehicle to Vehicle communication

Fig 2. Vehicle to Infrastructure communication

III. ROUTING IN VANET

Routing in VENET determines how the data is delivered from one vehicle to another vehicle in the network. The main goal of the routing protocol is to provide optimal paths between network nodes via minimum overhead. Many routing protocols are specified under VANET. The two various routing protocols classified based on the packet forwarding mechanisms are topology based and position based routing protocols.

i) Topology based routing protocol: It uses linked information stored in the routing table to forward the packets. Based on the information in the table, the routing protocol is divided into proactive and reactive. Proactive often called table driven. Each node updates its neighbor node information frequently. And this is the major drawback in VANET as this protocol makes the bandwidth is waste due to periodic updating of the table. The reactive protocol also known as on demand routing protocol the node updates its information only when the source nodes starts its discovery process.
ii) Position based routing protocol: GPS device is equipped with the vehicle to find its geographical position. Location service is also needed to find its geographical position of the destination node. When the source node wants to send data to the destination and if the destination is within the range of communication, it sends the packets directly. When the destination node is not within the transmission range then the source sends the data to the neighbor of the nearest destination node. The source node contains the table of one hop neighbor node. Using this table the source sends the data directly. Position based routing protocol are designed for both city and highway environment. This paper we review the some of the routing protocol suited for city environment. Table 1 shows the comparison of topology based and position based routing protocol.

<table>
<thead>
<tr>
<th>VANET Routing Protocol</th>
<th>Strategy</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topology Based</td>
<td>Links information based on the periodic updates in the table.</td>
<td>Less resource consumption Route is available from the table</td>
<td>Wastage of bandwidth</td>
</tr>
<tr>
<td>Position Based</td>
<td>Forwarding &amp; recovery strategy on flooding network</td>
<td>High Mobility No need to create routes</td>
<td>Route failure in tunnel area.</td>
</tr>
</tbody>
</table>

GSR (Geographical Source Routing)
The sender computes shortest path calculation on each junction and uses greedy forwarding strategy mechanisms to find the destination node. The sender determines the junction to be traversed using Dijkstra’s algorithm with the global knowledge of city topology provided by the street map. The computed path consists of sequence of junctions and packet to be forwarded to the destination. Moreover this protocol uses the reactive location service to retrieve the position of the destination.

GPSR (Greedy Perimeter Stateless Routing)
GPSR uses greedy forwarding and perimeter strategy; no calculation takes place between source and destination. The packet header contains the destination node and delivered to the destination using forwarding strategy. When the packet reaches the region where the greedy forwarding is impossible, the algorithm recovers by routing around the perimeter of the region. GPSR suffers from link breakage with some stale neighbor node in a greedy mode because of the high node mobility. The local maximum and link breakage are resolved by perimeter mode forwarding.

GPCR (Greedy Perimeter Coordinate Routing)
This protocol is proposed by Lochert et al. GPCR takes the advantage of streets and junction without using of map technique. GPCR uses two phases for delivery of information: Restricted Greedy Forwarding and Repair Strategy. GPCR forwards the data based on the road density of adjacent roads and the connectivity to the destination.

A-STAR (Anchor-based Street Traffic Aware Routing)
A-STAR uses dijkstra’s algorithm like DSR. It calculates full path for packet forwarding, and uses number of bus lines as weight parameter to select the path. It provides some sort of traffic for better decision of path selection based on the number of bus lines and also reduces the chance of local maximum. A-STAR differs from DSR and GPSR in two ways: First it implements traffic awareness by maps to identify the path for delivery of information. Second it employs recovery strategy when a local maximum occurs.

PyTAR (Greedy Traffic Aware Routing)
No path calculation takes place from source to destination instead at each junction the next junction selection taken depends on the number of vehicles between them. GyTAR uses greedy forwarding technique and recovery mode approach between junctions. A packet moves sequentially closer towards the destination along the streets where there are enough vehicles to provide connectivity. GyTAR are chosen dynamically, considering both the vehicular traffic and distance to the destination using map.

IV. SIMULATION TOOLS

A large number of routing protocols are proposed for VANET. The performance of the protocol for the selected environment is calculated in terms of delivery ratio and end to end delay by means of simulation tools. This section specifies various simulation tools to provide accurate result with all the characteristics of VANET.

MOVE
Mobility model generator for Vehicular networks (MOVE) is composed of a map editor and a vehicular movement editor. Map Editor is used to create the topology for network and vehicular Movement Editor generate traffic pattern in topology. It is a Java based application with GUI support built on SUMO (Simulation of Urban Mobility).

NS-2
NS is a discrete event simulator targeted at networking research. It is an object oriented simulator, Written in C++, with an OTcl interpreter as a frontend. The front end of the program is written in TCL (Tool Command Language). The backend of NS-2 simulator is written in C++ and when the TCL Program is compiled, a trace file and namefile are created which define the movement pattern of the nodes and keep track of the number of packet sent, number of the hops between the nodes, connection type etc at each instance of time.

OMNET++
Objective Modular Network Testbed in C++ (OMNeT++) is a component based, modular and open architecture discrete event network simulator which can run on all common platforms including Linux, Mac OS/X and Windows using GCC tool chain or Microsoft Visual C++ compiler. It was released in 1992 and publicly available since 1997. OMNET++ consists of two components: simulation kernel and utility classes. It provides models for wired/wireless networking protocols. It is commonly used in simulation of computer network and queuing network.

GloMoSim
Global Mobile Information System Simulator (GloMoSim) is a scalable simulation environment especially designed of MANET and its applications. It is open source, portable
supports millions of nodes using parallel simulation to reduce the execution time of the simulation model. It was retired in 2000 on the other side the commercial version of GloMoSim named as QualNet (Quality Networking) simulator is introduced.

QualNet
Quality Networking Simulator is highly scalable, fastest simulator for large heterogenous network that supports the wired/wireless network protocol. Qualnet executes any type of model faster than other simulators. The main advantage of this simulator is portable and run on both windows and Unix/Linux platforms.

Table II shows the comparisons of various simulators based on following characteristics.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>NS-2</th>
<th>OMNeT++</th>
<th>GloMoSim</th>
<th>Qualnet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distributed Network Simulation</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Scalability</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Very High</td>
</tr>
<tr>
<td>GUI</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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V. SIMULATION RESULT

The network model is designed in NS2 with DSR to ensure the packet delivery ratio in VANET which requires more than one hop communication with minimum end to end delay. The probability pattern is generated by using NS2 which simulates a 2000*1500 m² area with nodes ranges 10-40 of packet size 128 bytes and the simulation time taken is 50 seconds. The Fig 3 shows the delivery ratio of packets per seconds. The packet delivery ratio is compared with nodes 10, 20 and 40. When the network traffic increases which reduces the packet loss due to higher network density.

![Packet Delivery Ratio](image)

Fig: 3 Packet Delivery Ratio

VI. CONCLUSION

VANET provides comfort and commercial applications to the road users such as route guidance, weather information and internet access etc. The simulators lead to the user simulation to evaluate the simple or complicated solutions. We discussed the routing protocol for VANET and the simulation result using NS2 that analyze the performance of the network which delivers the packet without any packet loss and high delivery ratio.

References