Simulation of New AODV-FH Routing Protocol Based On AODV in VANET

Puneet Syal¹, Talwinder Kaur²

Research scholar¹ at Indo Global College Of Engineering, Abhipur, Punjab Technical University, Jalandhar, India
Assistant Professor² at Indo Global College Of Engineering, Abhipur, Punjab Technical University, Jalandhar, India

ABSTRACT - In last three decade, enormous improvement is done in research area of wireless adhoc network and nowadays, one of the most attractive research topic is inter vehicle communication i.e. realization of mobile adhoc network. VANET (vehicular ad-hoc network) is a classification of MANET in which vehicles act as mobile nodes and provide a different approach to Intelligent transport System (ITS). VANET is an emerging area for Intelligent Transportation System (ITS) which can result in increased traffic safety, collision warning through exchange of messages through wireless media. Efficient routing protocols are required for efficient communication among vehicles. There are various protocols for communication in VANET but I chose AODV as it ensures packet delivery from source to destination. Improvement is done in AODV and new protocol AODV-FH (Forward Hello). Simulation is performed on Ns-2.35. Based on the simulation results obtained, the performance of AODV-FH is analysed and improved performance in terms of increased throughput, increased packet delivery ratio, decreased network routing load and low number of advertisements.

KEYWORDS- Routing Protocol, MANET, VANET, AODV, NS2 etc.

I NTRODUCTION

MANETs consist of mobile/semi mobile nodes with no existing pre-established infrastructure. They connect themselves in a different, self-organizing manner and also built multi hop routes. If the mobile nodes are vehicles then this type of network is called VANET (vehicular ad-hoc network). One important property that distinguishes MANET from VANET is that nodes move with high average speed and no of nodes is assumed to be very large. Vehicular networks consist of vehicles and Road Side Units (RSU) equipped with radios. Plummeting cost of electronic components and permanent willingness of manufacturers to increase road safety and to differentiate themselves from their competitors vehicles are becoming “Computer on Wheels” rather than “Computer network on Wheels”. Convergence of forces from the public and private sector implies that in not-too-distant future we are likely to see the total birth of vehicular n/w. In 1999, U.S. federal communication Commission (FCC) allocated a block of spectrum in 5.850 to 5.925 GHz band for applications primarily intended to enhance the safety of our networks on roads systems. In companies like BMW, Renault and some other organizations have united to develop a car-to-car communication consortium, employed precisely to impose Vehicle to Vehicle (V2V) and Vehicle to infrastructure (V2I) communication, vehicle share safety information and access location based services[1].

The wealth of information that could be obtained from vehicular networks is quite large, ranging from location and speed of alerts and request for roadside assistance. Particularly many envisioned safety related applications require that the vehicles continuously broadcast their current position and speed in so called heart beat messages. This messaging increases the awareness of vehicles about their neighbors’ where about and warns drivers off dangerous situations. But the very exorbitant information also threatens to cause deployment to come to a grinding halt if there is adverse consumer reaction to technology. In this paper we start the discussion with the introduction of vehicular adhoc networks. Next we specify various unique characteristics of VANET that differentiate it from MANET. We then examine AODV routing techniques for VANET and make a improvement in it. Then we describe AODV-FH routing technique in detail and give simulation results of AODV-FH on NS2. Finally we end with the discussion and few useful references.

2. UNIQUE CHARACTERISTICS OF VANET AND COMPARISON WITH MANET

2.1 Unique VANET characteristics

Though Vehicular network share common characteristics with conventional ad-hoc sensor network such as self organized and lack of central control. Vehicular Ad hoc networks have unique challenges that impact the design of communication system and its protocol security[2]. These challenges include:
1. Potentially high number of nodes.

Regarding VANETs as the technical basis for envisioned Intelligent Transportation System (ITS) we expect that a large portion of vehicles will be equipped with communication capabilities for vehicular communication. Considering additional potential road-side units into account, VANET should be scalable with a very high number of nodes.

2. High mobility and frequent topology changes

Nodes potentially move with high speed. Hence in certain scenarios where vehicle passes each other, the duration of time that remains for exchange of data packets is rather in small number and intermediate nodes in a wireless multi-hop chain of forwarding nodes can move quickly.

3. High application requirement on data delivery.

Important VANET applications are for traffic safety to avoid road accidents; potentially including safety-of-life. These applications have high requirements with respect to real time and reliability. The end-to-end delay of seconds can result a safety information meaningless.

4. No confidentiality of safety information.

For safety the information contained in a message is of interest for all road users and hence not confidential.

5. Privacy.

Communication capabilities in vehicles might reveal information about the driver, such as identifier, speed, position and mobility pattern. Instead of the need of message authentication and non-repudiation of safety messages, privacy of users and drivers should be respected in particular location privacy and anonymity.

2.2 Comparison of MANET and VANET

Mobile Ad-hoc networks and Vehicular Ad-hoc networks are very much similar on various technical grounds but following are some parameters on the basis of which we can contrast both environments.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Parameters</th>
<th>MANET</th>
<th>VANET</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Cost of production</td>
<td>Cheap</td>
<td>Expensive</td>
</tr>
<tr>
<td>2.</td>
<td>Change in n/w topology</td>
<td>Slow</td>
<td>Frequent and very fast</td>
</tr>
<tr>
<td>3.</td>
<td>Mobility</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>4.</td>
<td>Node density</td>
<td>Sparse</td>
<td>Dense and frequently variable</td>
</tr>
<tr>
<td>5.</td>
<td>Bandwidth</td>
<td>Hundred kbps</td>
<td>Thousand kbps</td>
</tr>
<tr>
<td>6.</td>
<td>Range</td>
<td>Upto 100 m</td>
<td>Upto 500 m</td>
</tr>
<tr>
<td>7.</td>
<td>Node Lifetime</td>
<td>Depends on power resource</td>
<td>Depend on lifetime of vehicle</td>
</tr>
<tr>
<td>8.</td>
<td>Multihop routing</td>
<td>Available</td>
<td>Weakly available</td>
</tr>
<tr>
<td>9.</td>
<td>Reliability</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>10.</td>
<td>Moving pattern of nodes</td>
<td>Random</td>
<td>Regular</td>
</tr>
</tbody>
</table>

4. ROUTING PROTOCOLS FOR VANET

In a vehicular environment three possible types of architectures are .See fig1

While it is all but impossible to come up with a routing approach that can be suitable for all VANET applications and can efficiently handle all their inherent characteristics, attempts were made to develop some routing protocols specifically designed for particular applications like safety applications, content delivery in further vehicular networks, provision of comfort applications. Many routing techniques were proposed for traditional ad-hoc networks but due to different characteristics of VN, they fail to fit in the scenario. In this paper we classify the routing into these categories:
4.1 Ad-hoc routing and analysis of new protocol AODV-FH for VANET

As mentioned earlier MANET and VANET share the same principles, thus most ad-hoc routing protocols are applicable such as AODV and DSR. Moreover most of the studies have shown that both these protocols suffer from highly dynamic nature of nodes i.e. they give low communication throughput. here we give detailed mechanism of AODV-FH and after simulation studies and analysis present the results.

4.1.1 AODV-FH Mechanism

Route Discovery-AODV-FH performs route discovery by broadcasting RREQ to all its neighboring nodes .Minimum routing table refresh time is set. The broadcasted RREQ contains address of source ,destination their sequence numbers, broadcast id and also a counter which counts how many times RREQ has been generated for a particular node, when a source broadcast a route request it acquires a RREP from its neighbors or that neighbors rebroadcast RREQ to their neighbors by incrementing in the hop count, node drops repeated RREQ to make the communication loop free. At last the RREP with less number of hop count is accepted for transmission of data

4.1.2 AODV-FH Route Table management

AODV route table management is needed to avoid those entries of nodes that do not exists in the route from source to destination. Optimum Neighbour expiry time is chosen so that new corresponding nodes can be added in the route table . Each time before sending an RREQ it checks whether the present node in the routing table is active or not by sending HELLO messages. If node is active then only an RREQ is sent.

1) NEIGHBOUR EXPIRY
It is time after which a source node concludes that its neighbour has expired and it changes the validation for paths to that node. But it does not mean that if that node is present in our neighborhood we will not consider it our neighbour.

2) ALLOWED HELLO LOSS
Allowed hello loss means number of HELLO messages we are assuming to fail due to physical characteristics of network. This is generally very less in various protocols because HELLO messages have very less failure rate.

3) CURRENT TIME
Current time is real world time of environment in which vehicle is moving. This is generally taken form C++ scheduler function in NS 2 simulator.

4) HELLO INTERVAL
It is time gap after which a node sends HELLO messages to its neighbors for presence and to know their presence in the neighbourhood. It should not be too small because it will reduce the bandwidth of network by sending large number of HELLO messages. It should not too large because it will reduce the performance by insufficient number of HELLO messages.

Below given line describe how we have reduced neighbor expiry time:

\[ nb\_expire = current\ time + (0.25 * \text{ALLOWED\_HELLO\_LOSS} \times \text{HELLO\_INTERVAL}) \]

4.1.3 AODV-FH Route Maintenance

When a node receives an RERR message AODV-FH will first check for the data packets in the defected route. If defected route contain any data packet it retrieves them in a queue and deletes the route. Then it uses the concept of Packet Salvaging and repair the defected route. Then it finds an alternate route to the destination from that defected node in order to complete the communication process.

5. Simulation Environment
Sub Urban City scenario is created with the help of SUMO (Simulation of urban mobility) for simulation. The ns-2.35 simulator is used for the experiments.
6. RESULTS AND ANALYSIS

Simulations were conducted by keeping the number of nodes constant and varying the maximum velocity of the nodes. The data is obtained for 24, 40, 60 nodes.

<table>
<thead>
<tr>
<th>TABLE 2</th>
<th>SIMULATION PARAMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
<td>Value</td>
</tr>
<tr>
<td>Simulation time</td>
<td>110 s</td>
</tr>
<tr>
<td>Routing protocols</td>
<td>AODV, AODV-FH</td>
</tr>
<tr>
<td>NS-2 version</td>
<td>Ns-2.35</td>
</tr>
<tr>
<td>Communication range</td>
<td>550m</td>
</tr>
<tr>
<td>Packet size</td>
<td>1024</td>
</tr>
<tr>
<td>Map topology</td>
<td>1652m x1652m</td>
</tr>
<tr>
<td>Map source</td>
<td>Open street map</td>
</tr>
<tr>
<td>TCP sources</td>
<td>4 pairs of nodes with TCP and TCP sink.</td>
</tr>
</tbody>
</table>

Fig-3 Number of advertisements

Graph (Fig-3) depicts the information about the number of the advertisements which are basically the HELLO messages sent to establish connection between vehicles. Less HELLO messages are sent by new protocol AODV-FH as compared to old protocol AODV. This will reduce the congestion in the network and increase the performance.

Fig-4 Network routing load %

Graph (Fig 4) depicts the data about the network routing created in the network while communication. It is crystal clear from the graph that network routing load for AODV protocol is very much higher than my new protocol, AODV-FH uses less messages to manage communication, to check availability of neighbors and error reporting messages.

Fig-5 Packet delivery ratio %

Graph (Fig-5) delineates the information for the packet delivery ratio of the two protocols. A high ratio is achieved by using AODV-FH protocol for different number of nodes. Now more number of packets are successfully delivered from source to the destination.
Graph (Fig 6) illustrates the information about the throughput achieved by AODV-FH protocol as well as AODV protocol. It is clear that new protocol performed well with higher throughput as compared to AODV.

7 CONCLUSION AND FUTURE SCOPE

This paper presented a novel strategy of efficiency improvement of AODV routing protocol in VANET. Neighbour expiry time plays an important role in the communication process as VANET environments are highly dynamic with high mobility of nodes. A substantial effort is done to improve the neighbor expiry time. Now recent routes will not be used by the node because on expiry of neighbors it will invalidate all the routes to those neighbors. Maintenance of table is for less time as compared to AODV. Moreover the concept of packet salvaging proved to be very efficient in repairing a faulty node. These improvements resulted in increased throughput, increased packed delivery ratio, reduced routing load and reduced number of advertisements which makes the new protocol far better than existing one for VANET scenario. In future further enhancements in security of messages can be carried out along with these improvements.

REFERENCES