Enhanced Position Based Routing in VANET

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Abstract
Vehicular Ad Hoc Networks (VANET) is a subclass of Mobile ad hoc networks which provides a differentiate approach for intelligent transport system (ITS). The routing protocols fall into two major categories of topology-based and position-based routing. In position-based routing, each node is aware of the positions of its direct neighbors by periodically sending out airframe messages that indicate the current position of the node. In addition, with the aim of sending a packet to a destination node, the sender requires information on the current geographic position of the destination node. This research modifies the GPSR protocol by including the learning phase. The learning phase is used to determine the cost of the edge. Vehicular Ad Hoc Networks (VANET) is a subclass of Mobile ad hoc networks which provides a differentiate approach for intelligent transport system (ITS). The routing protocols fall into two major categories of topology-based and position-based routing. In position-based routing, each node is aware of the positions of its direct neighbors by periodically sending out airframe messages that indicate the current position of the node. In addition, with the aim of sending a packet to a destination node, the sender requires information on the current geographic position of the destination node. The research modifies the GPSR protocol by including the learning phase. The learning phase is used to determine the cost of the edge.

Keywords: VANET, Routing Protocol, GPSR.

I. Introduction

Recently, it has been widely accepted by the academic society and industry that the cooperation between vehicles and road transportation systems can significantly improve driver’s safety and road efficiency and reduce environmental impact. In light of this, the development of vehicular ad hoc networks (VANET) has received more attention and research efforts. Much work has been conducted to provide a common platform to facilitate inter-vehicle communications (IVCs) [1,2]. IVC is necessary to realize traffic condition monitoring, dynamic route scheduling, emergency-message dissemination and, most importantly, safe driving [3]. It is supposed that each vehicle has a wireless communication equipment to provide ad hoc network connectivity. VANETs are considered as a special class of mobile ad hoc networks (MANETs), yet they have several key features distinguishing them. Network nodes in VANETs are highly mobile, thus the network topology is ever-changing. Accordingly, the communication link condition between two vehicles suffers from fast variation, and it is prone to disconnection due to the vehicular movements and the unpredictable behavior of drivers [1].

Fortunately, their mobility can be predictable along the road because it is subject to the traffic networks and its regulations. VANETs have normally higher computational capability and higher transmission power than MANETs. Those unique characteristics of VANETs raise important routing challenging issues that should be resolved before deploying these networks effectively.

The most challenging issue is potentially the high mobility and the frequent changes of the network topology [4,5]. The topology of vehicular networks could vary when the vehicles change their velocities and/or lanes. These changes depend on the drivers, road situations and traffic status, and are not scheduled in advance. The routing protocols and mechanisms that may be employed in VANETs should adapt to the rapidly changing topology. Besides that, they must be efficient and provide quality-of-service support to permit different transmission priorities according to the data traffic type [1].
II. Vehicular Ad Hoc Network (VANET)

Vehicular ad hoc network is a special form of MANET which is a vehicle to vehicle & vehicle roadside wireless communication network. It is autonomous & self-organizing wireless communication network, where nodes in VANET involve themselves as servers and/or clients for exchanging & sharing information. The network architecture of VANET can be classified into three categories: pure cellular/WLAN, pure ad hoc, and hybrid. Due to new technology it has taken huge attention from government, academy & industry [6].

The primary goal of VANET is to provide road safety measures where information about vehicle’s current speed, location coordinates are passed with or without the deployment of Infrastructure. Apart from safety measures, VANET also provides value added services like email, audio/video sharing etc. The VANET has two types 1) V2V (Vehicle to Vehicle) 2) V2I (Vehicle to Infrastructure) communication [7]. Basically automobile industries are uses V2V communication than V2I. Vehicle to Vehicle communication approach is most suited for short range vehicular networks. It is fast and reliable and provides real time safety It does not need any roadside infrastructure.V2V does not have the problem of vehicle shadowing in which a smaller vehicle is shadowed by a larger vehicle preventing it to communicate with the Roadside infrastructure In V2V the connectivity between the vehicles may not be there all the time since the vehicles are moving at different velocities due to which there might be quick network topology changes. The anonymity problem: The addresses of vehicles on highways are unknown to each other. Periodic broadcasts from each vehicle may inform direct neighbor about its address, but the address-position map will inevitably change frequently due to relative movements among vehicles [7].

III. Routing in VANET

Different routing strategies have been defined based on prior ad hoc network architectures by targeting the specific VANET needs of scenarios and applications. These protocols can be grouped into topology based it reactive, position based, cluster based and broadcasting. Most of the VANET applications critically rely on routing protocols. Thus, an optimal routing strategy that makes better use of resources is crucial to deploy efficient VANETs that actually work in volatile networks. Finding well-suited parameter configurations of existing mobile ad hoc network (MANET) protocols is a way of improving their performance, even making the difference between a network that does work or does not, e.g., networks with high routing load suffer from congestion and cannot ensure timely and reliable delivery of messages. The major challenges associated with VANET are lack of infrastructure and shorter communication session due to rapid change in the network topology. Therefore routing protocols play a significant role in achieving successful inter-vehicular communication [8].

Many routing protocols have been developed for VANETs environment, which can be classified in many ways, according to different aspects; such as: protocols characteristics, techniques used, routing information, quality of services, network structures, routing algorithms, and so on. Some research papers classified VANETs routing protocols into five classes: topology-based, position-based, geocast-based, broadcast, and cluster-based routing protocols, this classification is based on the routing protocols characteristics and techniques used [9], [10], [11]. As well, others classified VANETs routing protocols according to the network structures, into three classes: hierarchical routing, flat routing, and position-base routing. Moreover, they can be categorized into two classes according to routing strategies: proactive and reactive [12]. On the other hand others classified into two categories: geographic-based and topology-based, according to the routing information used in packet forwarding. Also based on quality of services classification, there are three types of protocols that dealing with network topology (hierarchical, flat, and position aware), concerning with route discovery (reactive, proactive, hybrid and predictive), or based on the MAC layer interaction [13].

Although VANET are a subset of MANET, all routing protocols that are applicable on MANETs do not run well or function optimally on VANETs, the main reason for this are the special characteristics of VANET like high node/vehicle speed and predictable random motion. In VANET each node or vehicle acts both as a router i.e. part of the network and as well as a receiver of the data. There are two main types of routing protocols for mobile ad hoc networks [14]:

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1. Location-based protocols.
2. Topology-based protocols.

Location-based protocols use node location (for example GPS coordinates) as additional information to find suitable route. However, this requires location services and servers. Hence, another complexity would be introduced to the system, and therefore, we will focus on topology-based protocols for simplicity.

There are two classes for topology-based mobile ad hoc routing protocols:

1. **Proactive routing protocols**: updates the routing table continuously with routes to all possible destination nodes. Examples of Proactive RP's: Fisheye State Routing (FSR).
2. **Reactive routing protocols**: updates the routing table on demand with only the needed routes to destination. Examples of Reactive RP's: Ad hoc On-Demand Distance Vector (AODV), Dynamic Source Routing (DSR), and Temporary-Ordered Routing Algorithm.

All these protocols are similar in a sense that they all use a kind of response-reply mechanism. However, they differ how packets are sent and how routing information is stored. The Dynamic source routing protocol (DSR) and the optimized link state routing protocol (OLSR) are well known unicast routing protocols for MANETs and have been successfully adapted to VANETs as well. DSR is an on-demand routing protocol which searches for a route only when needed. Each node maintains the known routes in its cache.

A route consists of the full source route, containing all the intermediate nodes in the route. New routes are discovered by a source by flooding the network with route request messages. When the destination receives a route request, it sends a route reply. The route reply send by the destination accumulates all the nodes through which the route rely propagate. When the routes rely reaches the source, it gets the source route to the destination from the reply. On the other hand, OLSR is a proactive routing protocol, which maintains routes between any two nodes in the network. HELLO message are used for maintaining the routes. The main advantage of this is that each node always has a route to every other node in the network. This advantage comes as a result of large message overhead for maintaining the routes. DSR has low overhead and is suitable for networks in which not all nodes need a route to every other node in the network and the user traffic is low [10].

**IV. Proposed Work**

In the existing Work the shortest path is found using the Dijkstra algorithm. The performance of the existing algorithm can be enhanced by using the GPSR algorithm. The GPSR is the greedy perimeter stateless routing protocol, and this protocol is capable of finding the shortest or optimal path in efficient manner. This efficient path along with the learning phase is an enhanced algorithm as compared to existing algorithm. In this algorithm the source node will find the node near to the destination and if the source is not able to find such nodes then the node will find the local maxima node. The cost to each edge is provided by the learning phase of the proposed algorithm. The proposed process can be understood by the following algorithm:

**Proposed Algorithm**

1. The source node say S and destination node say D within the network of node N
2. Each node knows its location
3. If D is neighbor of S
4. Then transfer the data
5. Else
6. Use learning assign cost to each edge
7. If (node find using greedy mode of GPSR to transfer the data)
8. Then transfer the data
9. Else use local maxima mode to select the node
10. Transfer the data
11. End if
12. End if

The above algorithm can be used to transfer the data from source to destination in an efficient manner.

**V. Results**

The paper implements the proposed protocol by using NS2.33 which is installed over fedora 17. We have implemented the GPSR protocol and the learning based GPSR (proposed) protocol. The GPSR protocol codes are available on internet. We have downloaded these codes and installed over NS2.33 by changing

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various files. Then the GPSR protocol is modified to implement the proposed protocol. The Vanet MobiSim is used to get the mobility of vehicles.

Various parameters used for analysis are described below:

- **Packet Delivery Ratio (PDR)**
  The ratio of the number of delivered data packet to the destination. This illustrates the level of delivered data to the destination.
  \[
  \frac{\sum \text{Number of packet receive}}{\sum \text{Number of packet send}}
  \]

- **End-to-end Delay**
  The average time taken by a data packet to arrive in the destination. It also includes the delay caused by route discovery process and the queue in data packet transmission. Only the data packets that successfully delivered to destinations that counted.
  \[
  \frac{\sum (\text{arrive time } - \text{send time})}{\sum \text{Number of connections}}
  \]

- **Throughput**
  The throughput of a receiver (per-receiver throughput) is defined as the ratio of the number of bits received over the time difference between the first and the last received packets.

The Table 1 and table 2 shows the result of GPSR and proposed protocol.

**Table 1: Analysis of PROPOSED Protocol**

<table>
<thead>
<tr>
<th>No of Nodes</th>
<th>PDF</th>
<th>E2Edelay</th>
<th>Throughput</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>30.50</td>
<td>0.5734</td>
<td>3522.33</td>
</tr>
<tr>
<td>100</td>
<td>94.53</td>
<td>0.5763</td>
<td>4146.88</td>
</tr>
</tbody>
</table>

**Table 2: Analysis of GPSR Protocol**

<table>
<thead>
<tr>
<th>No of Nodes</th>
<th>PDF</th>
<th>E2Edelay</th>
<th>Throughput</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>29.15</td>
<td>0.5835</td>
<td>3497.4</td>
</tr>
<tr>
<td>100</td>
<td>94.43</td>
<td>0.5843</td>
<td>4026.53</td>
</tr>
</tbody>
</table>

The graphical analysis i.e. comparison of various protocols is shown from figure 1 to 3. The figure 1 shows the comparison of PDR on various number of nodes for various protocols. The figure 2 & 3, shows comparison of E2Edelay, Throughput respectively.

**Figure 1: Comparison of PDR**
better packet delivery ratio is achieved by the proposed protocol as compared to existing GPSR protocol. The proposed protocol reduces the end 2 end delay and increases the throughput. The reduced end 2 end delay and increased throughput results in the better performance of the proposed protocol as compared to existing protocol.

VI. Conclusion

The paper modifies the GPSR protocol by including the learning phase. The learning phase is used to determine the cost of the edge. In the existing work the shortest path is found using the Dijkstra algorithm. The performance of the existing algorithm can be enhanced by using the GPSR algorithm. The GPSR is the greedy perimeter stateless routing protocol, and this protocol is capable of finding the shortest or optimal path in efficient manner. This efficient path along with the learning phase is an enhanced algorithm as compared to existing algorithm. In this algorithm the source node will find the node near to the destination and if the source is not able to find such nodes then the node will find the local maxima node. The cost to each edge is provided by the learning phase of the proposed algorithm. The simulation is done using the NS2. The comparison is done on two scenarios having 50 and 100 nodes. The simulation results show that the proposed protocol provides the same or somewhat better packet delivery ratio is achieved by the proposed protocol as compared to existing GPSR protocol. The proposed protocol reduces the end 2 end delay and increases the throughput. The reduced end 2 end delay and increased throughput results in the better performance of the proposed protocol as compared to existing protocol. In future, the local maxima mode of the GPSR protocol can be eliminated. The proposed protocol can be compared with other existing protocols on various other parameters. The proposed protocol can be extended to work in hybrid mode.

References


