

Routing Algorithm for Vehicular Adhoc Networks in Highway Scenario Environment

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Abstract- The most challenging task for VANET is routing algorithm design due to rapid changes in topology and high speed mobility of vehicles. In this paper, we study the performance of mobility model and routing algorithms. The algorithm presented in this paper has more efficient packet forwarding capability from source to destination node. The RSU's are set at different transmission range to provide better communication and improve the performance of packet forwarding for communication from V2V (Vehicle to Vehicle) and V2R (Vehicle to Roadside). The proposed routing algorithm reduces packet overhead, end-to-end delay and minimizes the packet loss.

Keywords— Include at least 5 keywords or phrases

I. INTRODUCTION

A VANET is a wireless network that is formed between vehicles on the basis of need. To participate in a VANET, vehicles must be equipped with wireless transceivers and computerized control modules that allow them to act as network nodes. Each vehicles wireless network range may be limited to a few hundred meters, so providing end-to-end communication across a larger distance requires messages to hop through several nodes. Network infrastructure is not required for a VANET, although permanent network nodes may be used in the form of Road Side Unit (RSU). These RSU open up a wide variety of services for vehicular networks, such as acting as a drop point for messages on sparsely populated roads, serving up geographically-relevant data, or serving as a gateway to the Internet. In urban areas, gaps between roads are often occupied by buildings and other obstacles to radio communication, so communication along roads is sometimes necessary.

As shown in the Figure 1, vehicular network contains vehicular nodes (VN), vehicles equipped with On Board Units (OBU), and fixed node called Road Side Units (RSU). These RSUs are connected to

infrastructure network that will be available for every vehicle and fixed on road side. OBU and RSU can communicate with the vehicles using wireless techniques. RSU can also communicate with each other using Internet as a communication link between them.

Routing has been an intensive major research area in MANETs. AODV, DSD, DSR and OLSR [1] are node-centric MANET protocols in which topological end-to-end paths are created. The solutions have been proposed to improve the VANET performance, which exploit the knowledge of relative velocities between nodes and the constrained movements of vehicles [2; 3; 4]. Geographical routing protocols, e.g., GPSR [5], GFG [6], and GOAFR [7], use node positions to route data between endpoints. Solutions proposed in [8] and [9] to improve recovery strategies in VANETs by either proactively detecting potential dead-end positions or using channel capabilities of wireless networks to decrease the number of hops on the recovery paths. The concept of anchor-based routing in sensor networks has been adapted to VANET environments. GSR [10] and SAR [11] integrate the road topologies in routing using those concepts. In these protocols, a source computes the shortest road-based path from its current position to the destination. To alleviate this issue, A-STAR [12] modifies GSR by giving preference to urban scenario served by transit buses each time a new intersection will be added to the source route. CAR [13] finds connected paths between source-destination pairs, considering vehicular traffic, and uses guards to adapt to movements of nodes. We note that real-life measurements with commercial GPS receivers [14] showed errors in the reporting of GPS positions in urban environments. ALGORITHM protocols follow paths made of road segments; thus, they are more resilient to vehicle node position errors of a few meters. The integration of the initial navigation system into GPS receivers is expected to

improve the detection and handling of GPS position errors.

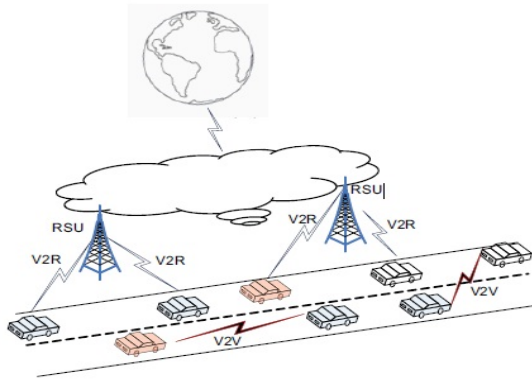


Figure 1: VANET architecture.

II. PROPOSED POSITION BASED ROUTING ALGORITHM

Linda et. al. [15] proposed a flooding scheme for the highly mobile ad hoc network in which GPS is used to maintain the set of neighbors in every vehicle. The flooding mechanism has drawback that, it is useful when there is a highly mobile ad-hoc network is present. However, the situation is not exactly the same for vehicular ad hoc network. There may or may not be highly mobile ad hoc network region. We have proposed a routing algorithm that is similar to above one but also useful for the case when there is not enough traffic present to form an ad hoc region. The Proposed Position Based Routing Algorithm is used for real-time vehicular traffic information to create road-based paths. The Routing protocol is designed and implemented for path creation. The algorithm assumes that each vehicle is equipped with a GPS receiver, digital maps and a navigation system that maps GPS positions on roads. The proposed scheme is a reactive source routing protocol for VANETs that creates road-based paths (routes) on demand by using RSUs and vehicles. The RSUs and vehicles form a backbone network between RSU with enough vehicular traffic to ensure network connectivity. The routes, which are represented as sequences of nodes, are stored in the data packet headers and are used by intermediate nodes to forward packets between nodes. It is assumed that the broadcasting by any vehicle is limited to TTL value, i.e. upto only single hop. On receiving the packet by any intermediate vehicle, the TTL value is incremented by 1 on rebroadcasting of packet.

The movement of vehicles is shown in Figure 2. In Figure 2, the RSUs are placed along the road side, and solid/dashed circle represent the maximum transmission range of RSU and vehicles respectively.

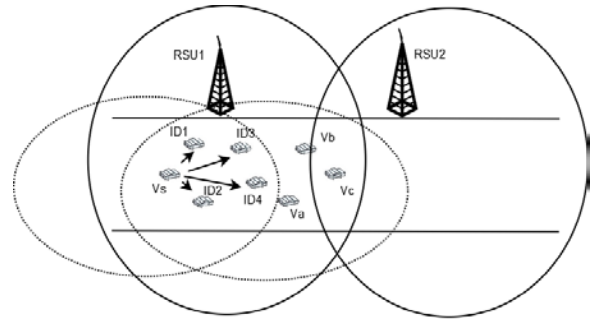


Figure 2: Movement of the vehicles on the road.

The GPS system of vehicles maintained a list of all neighboring vehicles ID's. Since this list forms an ad hoc region with the source node, then source node perform the broadcasting to discover a path towards destination. This broadcasting of packets will be received by all the neighboring vehicles.

Let packet send by source node (Vs) is received by neighboring vehicles V1, V2, V3 and V4. Let the distance between Vs to V1, V2, V3 and V4 be d1, d2, d3 and d4 such that $d1 < d2 < d3 < d4$. The distance computation can be carried out with the help of GPS system. The source node (Vs) knows the position (or distance) of all its neighbors. Then the system determines a waiting time depending on the distance (d) between sender to all of its neighbors. The waiting time is shorter for more distant receivers. In this case it is the neighboring node (V4), since it is more farther than rest of the neighboring nodes (i.e. V1, V2, and V3) as shown in Figure 2. The vehicle V4 rebroadcast the same packet as it has minimum waiting time to all of its neighbors.

The packet rebroadcast by V4 is received by vehicles (V1, V2, and V3) as well as other neighbors (Va to Vc) of V4 that form an ad hoc region with V4. On receiving the duplicate packet from V4 the vehicles V1, V2, V3 assumes that there is another vehicle (i.e V4) that is farthest from them and is entitled for rebroadcasting. Thus, vehicles V1, V2, and V3 drop the packet for further rebroadcasting. The same packet sent by V4 is also received by other neighbors (i.e. Va to Vc) of V4. Since these neighbors of V4 are new in route discovery, the neighboring nodes which are farthest from V4 is now the next candidate for further rebroadcast of the packet and process continues.

III. PERFORMANCE EVALUATIONS

3.1 Simulation Setup

We are considering highway traffic scenario to generate realistic mobility model. The simulation scenario is set 3*3 km of highway scenario of Bareilly,

U.P., India as a region instance to generate the movement patterns of vehicles. The Google earth map of any region is available on the internet for public use. We need open source microscopic space-continuous time-discrete vehicular traffic generator package SUMO to generate the movements of the vehicle nodes. SUMO uses a collision-free car-following model to determine the speed levels and the positions of the vehicles. We input into SUMO the map and the specifications about the speeds limits and the number of lanes of each road segment on the map. We discard the first 1000s of the SUMO output to obtain more accurate node movements. The output from SUMO is converted into input files for the movement of nodes in the NS-2 simulator.

3.2 Simulation Parameter

We compare proposed routing algorithm with two existing VANET routing protocols like AODV and GPSR. We have evaluated the various mobility model using different routing protocols for Inter Vehicular Communication System given in [162; 163; 164]. In next, we present the evaluation method, the metric for comparing the protocols, and the analysis of simulation results.

TABLE I
 SIMULATION PARAMETERS

Variable	Values
Simulation area & duration	3*3 km, 300 seconds
Number of vehicle	50 – 100 – 150
Vehicle and RSU transmission range	100 m - 500 m
Traffic source	CBR (0.5 - 5kbs)
Packet size	512 bytes
MAC protocol	IEEE 802.11, DCF

IV. RESULTS ANALYSIS

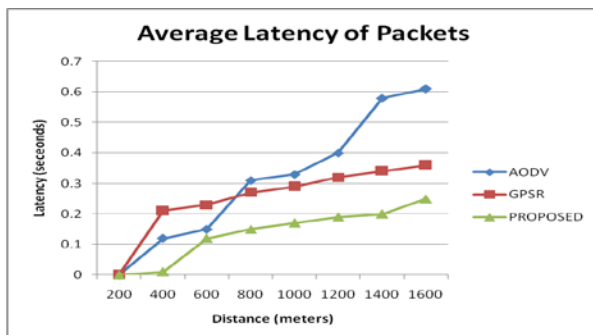


Figure 3 Latency versus Distance

Figure 3 shows the results for average latency of packets. This refers to the delay suffered by packets before reaching their destinations. AODV suffers from

higher latency as the distance increases due to having to fix broken routes or establish entirely new routes to destinations. However GPSR forwards packets in a greedy manner towards its destination thus is less affected by latency. The proposed protocols perform better than the other protocols because of the forwarding optimization.

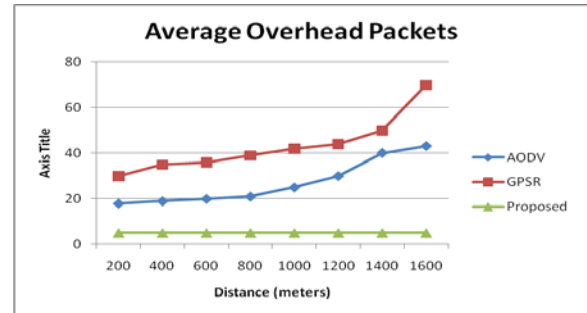


Figure 4 Overhead Packets versus Distance

One significant result is the average overhead packets as in Figure 4. For proposed protocol, the value is constant due to the fixed number of nodes used in the simulations, and also, overhead packets are minimized because it does not use the beaconing rate of nodes. For GPSR, the value is constant up to certain distance but slightly increases due to increase of distance. With its stateless routing, number of overhead packets for GPSR is only affected by the beaconing rate of nodes. On the other hand, AODV requires more control packets as the distance increases in order to maintain the communication links.

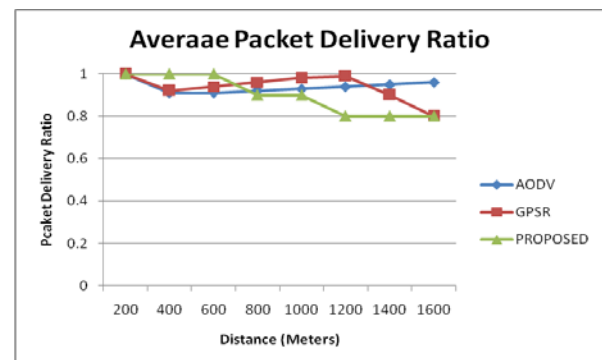


Figure 5 Packet Delivery Ratio versus Distance

Referring to Figure 5 proposed algorithm also produced a better average packet delivery ratio. This means that most of the packets that were sent would reach their destinations, thus producing a lower packet drop rate. As for AODV and GPSR, the packet delivery ratio drops noticeably as the distance increases. One of the reasons is that the increase in

overhead packets would cause the network load to increase significantly, therefore causing more packets to be dropped. The poor performance of AODV in terms of packet delivery ratio is also caused by the high mobility nature of a vehicular ad-hoc network.

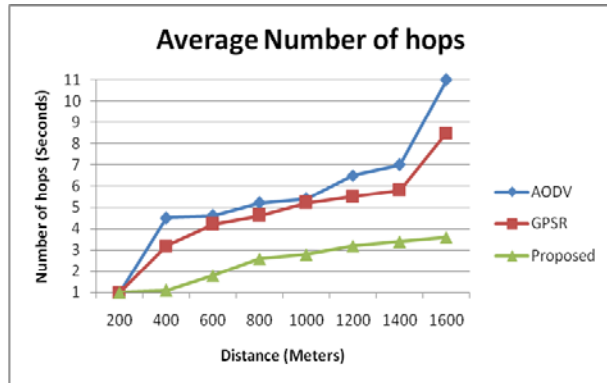


Figure 6 No. of Hops versus Distance

Figure 6 shows the average number of hops a packet would take in order to reach its destination. Proposed produced lower hops as compared to GPSR and AODV whereby their number of hops increased substantially with distance. Proposed algorithm uses the optimized forwarding method wherein packets are forwarded to the furthest node that is closest to the destination. AODV on the other hand traverse packets through all nodes that are on the same path towards the destination. This could be one of the reasons that produced the difference in results.

V. CONCLUSION:

For safety reason in a VANET environment the key requirements are high packet delivery rate at minimal latency. This ensures that all data packets are received with little to prevent accident from occurring. The proposed algorithm uses real-time vehicular traffic information to create road based paths from source node to destination node. The optimize forwarding was used to find forwarding node along the road pattern that form the path to deliver the data packets. The simulation results shows that our proposed algorithm outperform existing approaches in terms of the average delivery ratio, average delay, packet overhead and average path length. The delay of the packet delivery is improve if the routing protocols take into account the density of vehicles in each possible route as well as travel direction and movement of the vehicles.

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