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Maintaining Connectivity in Vehicles Using Back Bone Assisted

M.Thangavel , D.Jayapriya
M.Kumarasamy college of Engineering, Karur, Tamilnadu, India

ABSTRACT— Vehicular Ad-hoc Network (VANET) technology has enticed great attention in recent days with the recent advancement in wireless local area network communication technology. VANET technology has changed the vehicles into an intelligent system carrier with their wide applications such as safety on roads, multimedia content sharing, various commerce on vehicles, etc. The rapid change in network topology and the high mobility of vehicles has lead to a frequent disconnection of network and the multihop information dissemination. Many routing techniques like flooding and minimum weighted routing with the geographical location has been followed to obtain the shortest path connectivity, but resulted in higher number of hop counts. The greedy routing technique is introduced here to obtain the routing with minimum number of hop counts, while considering the connectivity on the roads. The back bone node is introduced here to take care of the link breakage in the network and the frequent disconnection of the nodes. By considering the movement around the source and the destination, the back bone nodes enables the routing in the changed direction to keep the connectivity stable. The result of the simulation shows the use of the proposed system with its improved packet delivery ratio and the shortest end to end delay.

KEYWORDS— Greedy routing, end to end delay, back bone nodes, destination discovery, vehicular ad hoc network (VANET).

I. INTRODUCTION

The automotive industry is undergoing a huge phase of revolution. Recent advancement in wireless communication technologies has brought a major transition of vehicles from a simple moving engine to an intelligent system carrier. A Vehicular Ad-Hoc Network is a form of Mobile ad-hoc network that provide communications among nearby vehicles and between vehicles and nearby fixed equipment, such as roadside equipment [1] [2]. Intelligent Vehicular Ad-Hoc Networking defines an intelligent way of using Vehicular Networking. VANET uses multiple ad-hoc networking technologies such as WiFi IEEE 802.11p, WiMAX IEEE 802.16, WAVE IEEE 1609, Bluetooth, IRA and ZigBee for simple, accurate, and effective communicationbetween vehicles on dynamic mobility. Vehicle communications are broadly classified as vehicle-to-vehicle communication and vehicle-to-infrastructure communication. This communication in VANET is

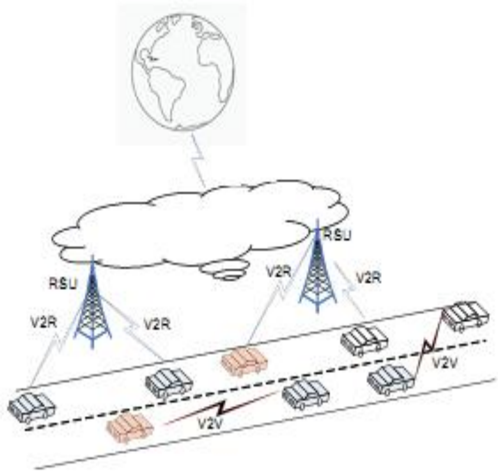

Fig. 1. VANET Architecture

usually between the vehicles and vehicle to roadside units (as shown in Fig 1). VANET provide a wide range of services such as freeway management, crash prevention and safety, driver assistance, and infotainment of drivers, various advertisement, marketing, and business services. VANET helps in providing safety measures to vehicles, effective communication between vehicles and entertainment services. Vehicular ad hoc networks are mostly used as the equipment of Intelligent Transportation Systems (ITS). Various wireless technologies are used for communication in VANET such as dedicated short range communications (DSRC), a type of WiFi and other technologies such as cellular systems, satellite systems, and WiMAX technologies.
Different terrains cause separate challenges to vehicular routing. The traffic issues in a city network would not be

exactly the same as in a highway or in a delay stream network [3]. The highways may have sparse vehicular density, whereas cities have to deal with vehicular congestion. In the evening there might be highest traffic of vehicles, whereas it is quite opposite in case of midnight and is observed as the most silence period, when considering a day. With these different traffic scenarios, the characteristics of VANET are also considered.

The most difficult thing about is to predict the traffic in the roads in any situations. Base on the movement of the vehicle and also the drivers approach towards the roads and the traffic has a great impact on the node density and network connectivity of a vehicular network. A routing protocol has to rely on some parameters to decide the routing path [2]. By proving the information in time to the drivers and the concerned authorities, the VANET chip in safer and efficient roads in future. VANET also promotes in various technical activities in the vehicular ad hoc network fields, various communication standards, communication supportive roads safety of vehicles, traffic monitoring in real time, intersection management technologies, future telematics, an integrated use of telecommunications and informatics applications, and Intelligent Transportation System based services.

A. *Unique characteristics of VANETs*

- High mobility with road topology constraints: The vehicles in VANETs move non-randomly along roads at high speeds [17].
- Rapid change in network topology: The network topology in VANETs tends to change frequently, because of the highly variable speeds between vehicles [16].
- Frequently disconnection of network: Because of the rapid change in network topology, the connectivity of VANETs could disconnect frequently [18].
- Geographical localization: VANET applications require identification of the vehicles in a certain region, instead of the specific vehicles. The Vehicles uses the Global Positioning System (GPS) to identify their locations with high accuracy.
- Time-sensitive delay exchange: The safety-related applications require data packet transmission in a timely manner. Thus the security schemes cannot harm the network performance of VANETs.
- Abundant energy and storage: The nodes in VANET have abundant energy and computation resources, since each vehicle is equipped with a battery.
- Better physical infrastructure: The VANET nodes are better protected than those nodes in other MANETs, due to their size. This property has to be considered to improve protocols and schemes for VANETs.
- Interaction with sensors: The sensors helps in providing node location and their nature of movement that are used for routing purposes and effective communication link.

II. RELATED WORKS

A. *Unicast Routing Protocol*

In VANETs, the main goal of unicast routing [2] is to transmit data from a single source to a single destination through wireless multi-hop transmission or carry-and-forward techniques. The wireless multi-hop transmission technique also called as multi-hop forwarding relays data as soon as possible from source to destination between the intermediate vehicles in a routing path [19][20]. The carry-and-forward technique reduces the number of data packets by making the source vehicle to carry the data as long as possible in the routing path. The delivery delay-time cost is longer for carry-and-forward technique than wireless multi-hop transmission technique. The routing protocol designing are classified into two categories. They are min-delay routing protocol and delay bounded routing protocol. Min-delay routing protocol minimizes the delivery delay-time of packets from source to destination. Delay-bounded routing protocol maintains a low level of channel utilization within the controlled delivery delay-time.

B. *Geographic Source Routing*

Geographic source routing (GSR) [5] is the first protocol to use a map of the streets, and is mainly proposed for city environments. Knowing the location information about each node by using a static street map, GSR computes a route to a destination by forwarding messages along streets. Dijkstra's algorithm [13] based on the distance metric is used in GSR to compute the shortest path to the destination from a source node. The sequence of junction IDs known as anchor points (AP), forwards the packets to the destination in the computed path. These anchor points shows the underlying road topology and represents the road intersections where decisions are made. The header of each data packet sent by the source is inserted by the list of junctions. The packets are then forwarded from one AP to the next AP using the greedy forwarding scheme over the selected path. The insertion of the entire path in the packet's header causes additional packet overhead and hence it cannot be preferred if there is a long route between the source and the destination. When two junctions are involved on the street map where there is no enough number of vehicles, the connectivity of the shortest path is not possible to provide proper road connectivity. Thus they face a local maximum situation as the packets are discarded directly on one road segment that prevents them from moving towards the next anchor point, though it is provided with an alternative longer path.

C. *Greedy Forwarding Techniques*

Greedy forwarding technique [4] tries to bring the message closer to the destination in each step using only local information by the geographic routing principle. Each node forwards the message to the neighbour that is most suitable from a local point of view. This can be the one who minimizes the distance to the destination in each step that is referred as Greedy technique.

The proposed system uses the greedy forwarding technique for the transmission of the data from the source to the destination [6]. Thus this routing algorithm achieves minimum end to end delay by decreasing the time interval between the nodes and highly increased packet delivery ratio by use of the hop greedy routing technique, thus making this protocol the best routing technique [9]. An easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type your text into it.

III. BACK BONE ASSISTED HOP GREEDY ROUTING

This session deals with the back bone nodes and their connection awareness between the vehicles in the VANET. The proposed protocol is designed according to the VANET network so as to maintain the connectivity between vehicles with the minimum number of intermediate intersection between the source and the destination [7]. In whole the hop greedy routing protocol is designed to make sure the data packets are successfully delivered by providing low end to end delay between the nodes. The back bone node system design is explained below.

A. *Dividing Zones and Boundary*

This section explains as how the traffic network in the city is divided into several zones and how the boundary intersections are located inside the zone. Each vehicle in the network is assumed to have its position shared with the satellite and hence known to all the users by the use of GPS. Every intersections and zones are provided with unique Ids so that the nodes in the network identify the locations.

B. *Formation of Back-Bone Nodes*

The traffic in the road network is always not the same. There will be high traffic or some void regions in the network. This change of traffic scenarios in the network may lead to the wrong selection of intermediate nodes. This makes the data packets transferred to the wrong nodes or there will be loss of packets. Such types of nodes that help in the transfer of packets without loss in connection are called Back-bone nodes. These nodes are responsible for the connection at the road segments and at the intersections.

The Back-Bone nodes are of three types and are given as stable nodes, primary nodes and secondary nodes. The stable back-bone node is selected often for the transmission from the fleet of vehicles at the traffic signal when the light is turned on to red that is closer to the intersection. This system uses the stable nodes for transmission. The rest primary and secondary nodes are selected from the moving vehicle in the traffic as soon the light turns to green. The selection of primary node will be within the intersection while the secondary node is always located outside the zonal intersections. A vehicle is chosen randomly from the number of vehicles within the intersection for transmission as the back bone node. These primary nodes take responsibility to select the secondary node by checking the characteristics of the vehicle moving around and give back its responsibility of transmission to the new primary node as soon as it enters the intersection.

The packets are forwarded by the stable nodes. The message packets are queued and retried by the stable nodes between the intersections. If there are any empty regions or no availability of vehicular nodes in the network then the vehicles from all the directions declare themselves as primary nodes. This provides connections in void regions and is known as void-guards.

C. *Hop Greedy Routing Algorithm*

The hop greedy routing algorithm is introduced in this proposed system thus providing minimum number of hops counts between the source and the destination when connectivity is taken into consideration [4]. This algorithm works similar to the single source minimum weight algorithm. The particular traffic map is considered and is taken as the graph G. The vertices are considered as V [G] and the edges are given as E [G] in the graph. The vertices are provided with the axis (u,v) in the edges in the road segment as E(u,v). The edge in the interection calculates the hop count and delta count for the transmission of packet data. The calculation of hop count is

$$hc=[L/T]+1$$

Here L is considered as the length of the edge and T as the range of transmission. The hop count given here is the line of sights between u and v. But if the edges are of curved path or in some irregular section then the hop count is given as the number of line of sights visible in the road segment. The delta count is given as

$$dc=d*hc$$

$$d=Dunconn/Dconn$$

Here d represents the ratio of the delay at the road segment disconnected to the delay when the road segment is connected by the nodes. The weight is calculated [13] between the nodes with the hop count and the delta count and the transmission of message packets occurs. The position of the vehicular nodes is updated periodically by the use of back bone nodes. The unicast request messages is used along with this routing protocol for the elimination of the selection of the reliable node among the congestion of vehicular nodes in dense traffic and also the packet loss while transmitting the data packets [8].

IV. Performance Evaluation

In the performance evaluation, we have evaluated the performance of the back bone assisted nodes using the ns-2.31 simulator tool the simulation results of this routing protocol is taken in accordance to different traffic scenarios [10] like dense and sparse vehicle density in roads.

A. *Simulation Scenario*

Here the simulation scenario is taken with two four way roads in a highway with 22 nodes in the traffic scenario. The vehicular nodes flowing in the roads are 19 and the total numbers of roadside units (RSUs) are 3. Once the simulation is done by the network simulator tools the vehicles in the traffic network moves and hence the vehicles transmit the data packets between them by using the back bone nodes. The vehicular properties such as the vehicle speed, its direction are calculated and the next node is selected and transmitted by the use of the hop greedy routing algorithm.

B. *Metrics Considered*

Packet delivery ratio (%): This is the total number of data packets received at the destination to the number of data packets transmitted from the source.
End to End delay: This is the delay that occurred between the generations of data packets from the source to the successful reception at the destination.

C. *Results and Analysis*

In this section, the results of the packet delivery ratio, end to end delay and the throughput is simulated and its results are analyzed. Based on the movement of vehicles in accordance to different traffic situations, the initial vehicular node distance and the movement of the source and the destination is calculated and the packets are transmitted between them [14][15]. The packet sending rates depends upon the number of packets generated by the source vehicle.

1) Packet delivery ratio (%):

Fig. 2 shows the packet delivery ratio with respect to the simulation time. The main factor to be considered is the packet drop between the vehicles. By the use of the back bone nodes the packet drops are considerably reduced and the high percentage of the packets is successfully

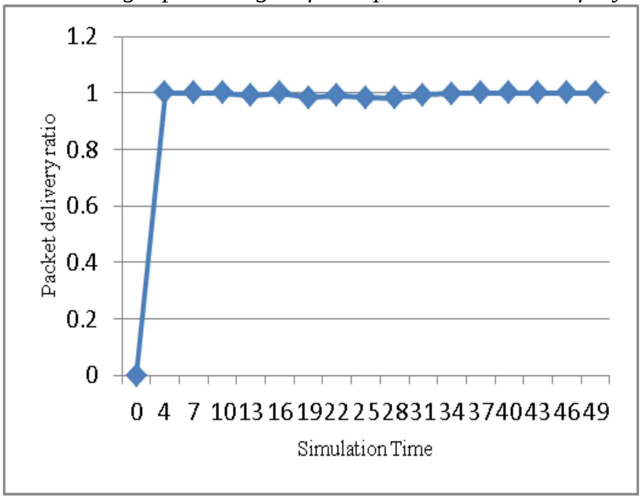

Fig. 2. The Packet Delivery Ratio, which is given by the number of data packets received at the destination to the number of data packets transmitted from the source.

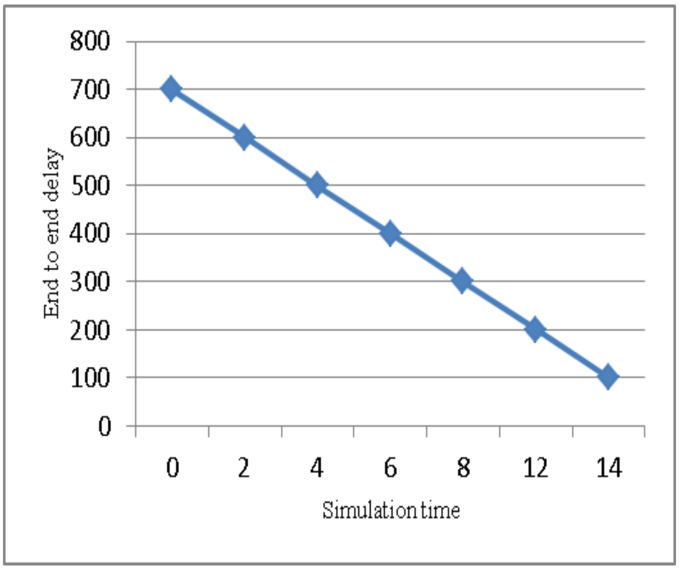

Fig. 3. The End to End Delay is the time interval by the data packets between the source and the destination.

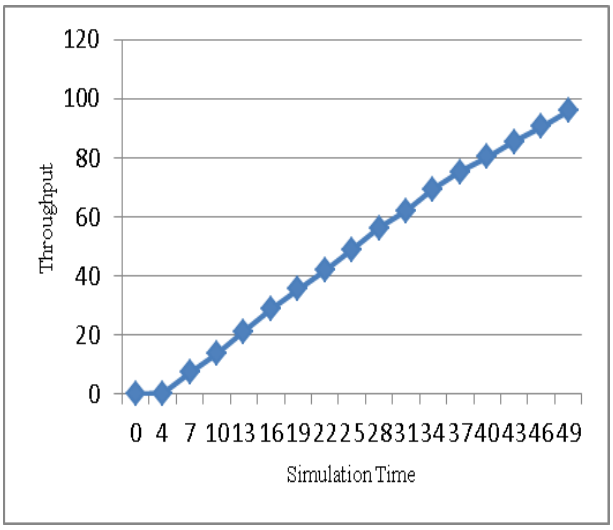

Fig. 4. Throughput gives the number of successful transmission from the source to the destination.

delivered. The figure shows the steep increase in the packet delivery in a very few seconds the transmission is started. The proposed routing technique shows the stable packet delivery ratio. Thus the back bone nodes successfully deliver the data packets from the source to the destination.

2) End to End delay:

Fig. 3 shows the average end to end delay with respect to the simulation duration. The source sends one packet per second. To get the simulation results the values are noted between variable time intervals as shown in the figure. Thus by noting the results at such intervals the reliable results are observed. From the simulation, the end to end delay is decreased immediately after the simulation is started. Hence the delay between the generation of data packet at the source and the reception of the packets at the destination is decreased considerably. The delay is measured for the back bone assisted hop greedy routing protocol and is found efficient than other routing protocols. With all the drawbacks at different traffic scenario like link breakage and unavailability of forwarders at void regions, this routing protocol works efficient and show very low average end to end delay at the simulation.

D. THROUGHPUT

Fig. 4 shows the throughput of the back bone assisted hop greedy routing protocol. The throughput gives all the parameters of the quality of services such as the packet delivery ratio and the average end to end delay. The packet delivery ratio of the throughput gives the successful reception of the packets at the destination side from the packets generated by the source. The average end to end delay gives the time interval between the generations of data packets by the source to the reception of the packets at the destination. Thus all the parameters of the transmission of the data packets in the vehicular adhoc network are simulated by the throughput. The throughput in the simulation graph gives good results than all other routing protocols. Hence the proposed algorithm is found efficient in terms of routing of data packets between the source and the destination vehicles.

IV. CONCLUSIONS

In this paper the climacteric problems in vehicular adhoc network such as node selection between the intersections, proper location selection, unavailability of forwarders, link breakage are studied. By the proposal of the back bone assisted hop greedy routing protocol these problems are dealt. This routing protocol focuses on the selection of the minimum number of intersections, thus enabling the reduction of the average end to end delay. The hop greedy routing algorithm helps to find the reliable nodes and also reduces the hop count with the improved connectivity. The proposed algorithm introduces the back bone nodes for addressing the connectivity issues and the void regions. This also uses the unicast request messages for eliminating the congestion of nodes and the packet loss. The update procedure is also employed to deal effectively with the movement of the vehicular nodes. The simulation results also witnesses the effectiveness of the proposed algorithm with the packet delivery ratio, average end to end delay and the throughput.

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