MOBILITY AND TRAFFIC MODEL DATA DISSEMINATION IN VEHICULAR NETWORKS

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Abstract- The latest rise of Vehicular Adhoc networks (VANET) has attracted many researchers where multi hop dissemination of data has been the most relevant issue to be solved. In these networks, the mobile nodes form temporary network without any fixed infrastructure. This paper proposes the data disseminated from the source to destination nodes with the traffic model as provided in VANET. GPSR protocol uses a greedy forwarding algorithm that disseminates the data to the destination using the efficient possible path. If the greedy forwarding fails, perimeter forwarding will be used to find routes around the perimeter of the region. This paper also includes traffic control mechanisms. It divides the mobility models into an intra-segment component, an inter-segment component and a route management and execution component.

Keywords – ***VANET, packet delivery delay, beacon, collision detection***

I. Introduction

Mobile ad hoc networks (MANETs) are self-configuring and self-organizing multi-hop wireless networks, composed by a set of mobile nodes that move around the network and cooperate in transmitting packets among the nodes. MANET performs efficient and robust procedures by providing routing functionalities for mobile nodes which act as vehicles, named as Vehicular Ad Hoc Networks (VANETs) [6]. Compared with MANETs, the velocity of vehicles in VANETs is much higher since vehicles move faster than walking persons.

Vehicular ad hoc networks (VANET) [5] using 802.11-based WLAN technology have recently received considerable attention. VANETs and Mobile Ad Hoc Networks (MANETs) some similar characteristics such as short range of transmission, low bandwidth, omni-directional broadcast and limited storage capacity. The characteristics of VANET are

1. High Dynamic topology
2. Frequent disconnected Network
3. Mobility Modeling and Prediction
4. Communication Environment
5. Hard Delay Constraints

Currently, there are mainly two types of routing protocols in VANETs: topological routing and geographic routing. In topological routing, mobile nodes use topological information to manage routing tables or search routes directly. In geographic routing, each node knows its own position and makes routing decisions based on the position of the destination and the positions of its local neighbors.

There are problems in the current routing protocols for vehicular networks. 1) The performance of VADD [3] is quite sensitive to the vehicle density. Under high vehicle density, there is a high probability that the next path along the shortest delay trajectory toward the destination is available when the packet reaches an intersection. This makes the actual packet-delivery route deviate far from the optimal one, leading to a dramatic increase in the packet-delivery delay. 2) The real shortest delay trajectory may not be taken under inaccurate delay estimation of each road. Both MDDV[2] and VADD[3] estimate the packet-delivery delay along each road based on some offline statistical parameters, such as the average vehicle velocity and vehicle density on the road at different times of a day. 3) The SADV, which is a static-node assisted adaptive data dissemination protocol for vehicular networks. Which enables packets to be stored at an intersection until the optimal path is available. If the static node is full means it can overflow. This is the drawback of using static node.

II. RELATED WORK

The idea behind Vehicle Assisted Data Delivery (VADD) is based on carry and forward networks but the important issue is the selection of intermediate node that has the lowest delay in packet delivery. Although geographical forwarding approaches such as GPSR which always chooses the next hop closer to the destination, are very efficient for data dissemination from source to destination in ad hoc networks.

VADD has the following basic principles:

1. Transmission via the possible wireless channel with less delay.
2. If the packet is to be sent through a specified path, the path with high packet delivery ratio is chosen
3. As VANET encounters unpredictable nature of paths, we choose dynamic path selection throughout the dissemination of data.

The performance of VADD is described below

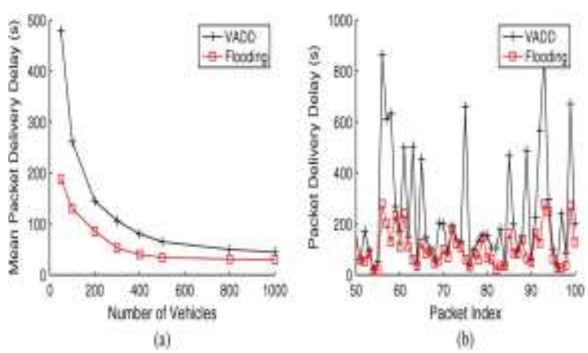

Fig: 1. Packet delivery delay of VADD. (a) Mean packet-delivery delay. (b) Packet-delivery delay (100 vehicles)

As shown in Fig. 1(a), when the vehicle density is high, the mean packet-delivery delay of VADD is close to that of flooding. T he gap increases with decrease in the vehicle density. Moreover, VADD becomes unstable under low vehicle densities. Fig. 1(b) shows the comparison of the delivery delay of individual packets between VADD and flooding when 100 vehicles are simulated in the area. We observe that the packet-delivery delay of some packets is much larger than that of flooding, while the delay of some other packets is close or even equal to the optimal value. There are two reasons for this performance degradation.

1) VADD chooses the best currently available path at each intersection. As there exist low vehicle density, the optimum path may not be a best option to choose but has to deliver the packets via detoured paths. In the worst case, the packet may go through a much longer path as indicated by the peaks in Fig. 1(b).

2) The estimation of the packet forwarding delay through each road is based on some offline statistical data as it is expensive to have each vehicle get up-to-date vehicle densities from some infrastructures. As the vehicle density on each path vary with time, which greatly influences the packet forwarding delay, the shortest delay path is calculated based on the statistical data may not reflect the real optimal one.

SADV is a adaptive data-dissemination protocol that uses static node at intersections. When there is no vehicles available designated on the optimal path to deliver the packets, a packet is forwarded to the static node that transmits it when a optimal delivery path is available [1]. The adjacent static nodes measure the delay that is encountered when forwarded in real time so that the optimal path can be chosen based on the routing decision adapting to the dynamic vehicle densities. As a result, a multi-path routing mechanism is used in SADV that reduces the delay in data delivery effectively.

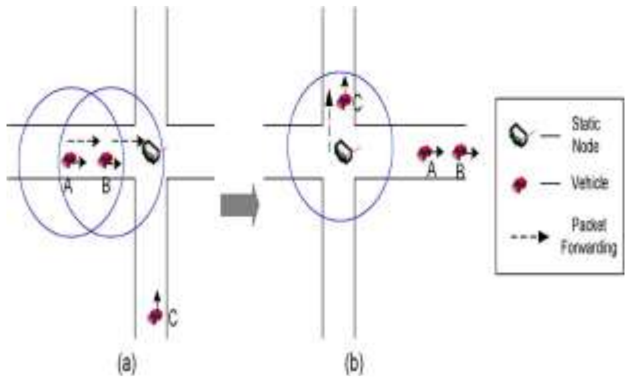

Fig. 2 Static-node assisted routing in a VANET

As illustrated in Fig. 2, a packet is sent from A to a remote location. Once the packet is relayed from A to B, B needs to determine the next vehicle to forward. Assume that the shortest delay path to deliver the packet is northward. As there is no vehicle within the communication range of B along the direction, it relays the packet to the static node. The static node stores the packet for a while and forwards it to C when it passes the intersection and goes toward the northward road. From the figure, we can see that without the help of the static node, the packet will be carried by B to the eastward road if B does not meet C at the intersection, which may lead to delay in packet-delivery path [1].

III. GREEDY PERIMETER STATELESS ROUTING

Greedy Perimeter Stateless Routing (GPSR) is one of the best examples of position based routing. GPSR [10] uses closest neighbors information of destination in order to forward packet. This method is also known as greedy forwarding. Here the nodes should possess the information about its current physical position and also the adjacent nodes. The adjacent node also helps the current node to make forwarding decisions without discussing topology information. GPSR protocol normally devised in to two groups: greedy forwarding and perimeter forwarding.

Greedy Forwarding

The main characteristic of this strategy is that the data packets have the ability to know their physical position and their path to the destination. Here the greedy region/hops are selected to forward the packets to the intermediate nodes that are getting closer to the destination node. Nearest neighbors physical position is gathered by utilizing beacon algorithms or simple beacons. When the data packet is disseminated from the source to destination via adjacent node, the forwarding node receives a beacon message which has the information about the address and position that is updated in the location table. If the beacon message is not received by the forwarding node within a specific time interval, it assumes that the adjacent node is not active or not in the range to send it. This makes the entry to be removed from the location table. The main use of this strategy is it holds the physical position of node where the packets are transmitted in a very short time interval. Besides its advantages there are few drawbacks of this strategy i.e. there are few topologies that limits the packet to move to a specific range or distance from the destination. This model will not succeed when there are no nearest adjacent nodes to disseminate the data to the destination.

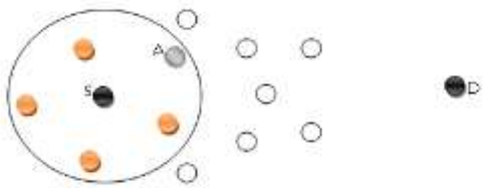

Fig: 3 Greedy Forwarding (A is S's neighbor closest to D)

Perimeter Forwarding

Perimeter forwarding is used where greedy forwarding fails. It means when there's no next hop closest neighbor to the destination is out there then perimeter forwarding is employed . Perimeter forwarding uses nodes within the void regions to forward packets towards destination. The perimeter forwarding used the right hand rule. In "right hand rule", the voids regions are exploited by traversing the trail in counterclockwise direction so as to succeed in at specific destination. According to this rule each node involved to forward packet round the void region and every edge that's traversed are called perimeter. Edges may cross when right rule finds perimeter that are enclosed within the void by utilizing "heuristic approach". The drawback is that it removes inconsiderately of these edges which are repeated and this might cause the network partitions. To avoid this drawback, another strategy is adopted that's described below.

Planar Graph

There exists a situation in a single graph where more than two edges cross each other called as planar graph. The types of planar graphs developed to remove the crossing edges are "Relative Neighborhood Graph (RNG)" and "Gabriel Graph (GG)". RNG is designed such that whenever radio range of two edges intersects each other, it shares the same area. In the Fig 4 given below, the edges x and y share the same area as the vertices x and y. The edge x, y are removed by using RNG because another edge from x towards v is already available [10].

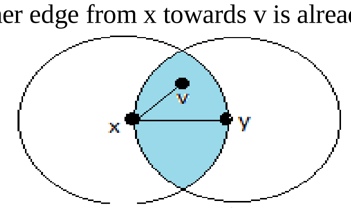

Fig 4: Example of RNG

Gabriel Graph (GG) has been designated to detect and remove the crossing edges between the shared areas of nodes having similar diameter.

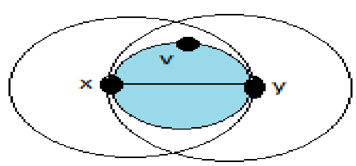

Fig 5: Example of GG

As the diameter of nodes x or y is greater than the midpoint diameter as shown in Fig 5, the edges corresponding to the nodes x and y cannot be removed. So there is less network disconnection in the GG as compared to RNG [10].

IV. PROPOSED WORK

The research paper focused on the data visualization tools that are implemented in business intelligence. Very large QVWs represent a disproportionate amount of knowledge (highly compressed), which can translate into tons of knowledge in motion. QlikView is one of the easiest to understand and flexible Business Intelligence tools for turning data into knowledge.

Though Adhoc networks are used for variety of applications, there is a necessity to assess the performance of the application using simulation model which paved way for a realistic mobility model for VANETs to provide precise results. The objective of the model is to create a traffic model which should account for unique vehicle motion without incurring overhead by simulating the wireless network traffic.

Here consider two approaches to modeling a system in which collisions can occur. In the particle system approach, designers model a system that allows nodes to move freely and use collision detection to react to collision events. This reactive approach is appropriate for systems in which nodes are "dumb" in the sense that they do not attempt to alter their trajectories according to environmental conditions. In our vehicular approach, we model a system of collision avoidance. We assume that vehicles avoid collisions if possible. Further, we include traffic control mechanisms that force drivers to follow a deterministic admission control protocol when encountering an intersection.

This model does not preclude the occurrence of a collision event. A collision event can occur if one or more vehicles create a situation in which another vehicle cannot avoid collision given its mobility constraints. Such a collision can be made to impact the traffic flow in the vehicular network. Another essential element for modeling vehicular traffic is the notion of a road segment, or link. Formally, a road segment is any portion of a road between two intersections. Road segments can be described by the following vehicle-independent attributes: shape, length, width, name and speed.

V. INTRA-SEGMENT & INTER-SEGMENT MOBILITY IMPLEMENTATION

Intra-segment Mobility

This model has the ability to control the motion of the vehicle from the perspective from which the vehicle enter a road segment until it exit the segment. In this model, a vehicle moves at the same speed as the vehicle ahead, if there is a vehicle within sufficient range of the current vehicle. Two parameters are the vehicle speed that is following and the space between the two intervening vehicle. The car-following model does not specify a vehicle's behavior when there is no other (nearby) vehicle to follow. We assume that if a vehicle is not within a window of inter-vehicle spacing defined by the car-following model, it accelerates at its specified rate until reaching the vehicle's maximum speed for the current segment. The acceleration rate can be constant, dependent on the current speed or dependent on the type of driver.

The intra-segment model must also specify how non-following vehicles behave when encountering traffic control. We consider two primary forms of traffic control: stop signs and stoplights. Some forms of traffic control, such as railroad crossing gates, can be generalized to one of these types of traffic control; others, such as yield signs and speed-limit changes must be modeled differently. When there is a stop sign or red signal, a vehicle coming to the intersection must slow down before the signal. Whenever an yellow light flashes, the vehicle can cross the intersection but has to stop when the light turns to red. This can be done only when the vehicles are running at a deceleration rate which is based on speed. The car will alter its speed according to the following rules:

- The car encounters an intersection and the next road segment on which it will travel is full. In this case, the car stops before the intersection and remains stopped until there is room in the next road segment.
- There is a car in front of the current car. In this case, the node will slow down to the speed necessary to maintain a speed-based following distance between the current node and the node in front of it.
- The car encounters traffic control. In this case, the car will slow down (at a uniform acceleration) before an intersection with a red stoplight or a stop sign; if the stoplight turns green, the car attempts to accelerate if possible.
- The car turns onto a new street. In this case, the car slows down before the intersection to make the turn at a reasonable speed (5 mph), and then accelerates, if possible, to the highest speed it can attain given the other constraints.

Inter-segment Mobility

The inter-segment mobility model determines the behavior of vehicles between road segments; i.e., at intersections. This model can classify intersections according to the number of intersecting road segments, the types of road segments, traffic control, if any, at the intersection. In essence, the model must perform admission control at each intersection where the traffic-control rules vary according to the intersection type. Assume that Route Management and Execution has selected the next segment even before the intersection and that the vehicle following determines what action it has to take at the intersection. When there is a traffic signal missing at the intersection, we assume that there is a congestion scenario. In such intersection, the admission control mechanism determines if there is space for the vehicle coming behind to enter the adjacent lane in the road segment. If space available, the vehicle enters else it has to wait until space is available. The component should have the method to avoid postponement of passing vehicles. The vehicles can allow passing the intersection only if it does not result in congestion with another vehicle. When the path is full, any vehicle is not allowed to enter an intersection.

As the intersection at the road path uses stoplights for traffic control, the segment should consider the possible cases of green, yellow and red lights. One of these color lights can be used as guard signal. Whenever a vehicle comes near the intersection displaying red light, the vehicle must slow down to stop before the intersection. When the person sees a yellow light, the vehicle is allowed to cross the intersection only if it finds space to pass to the next road segment else it should stop until the space becomes available. Finally, when the person encounters a green light, the vehicle may cross the intersection without lowering the speed on the vehicle when he finds that the next road segment is not full else it should stop until the segment is empty. Assuming that the vehicle can make the turn, it must slow down to the maximum turning speed for that vehicle before executing the turn.

Algorithm

We use A* shortest path algorithm to find a near-optimal shortest path that reduces the range of problem space using a heuristic function that estimates the distance to the goal. For the purposes of this component, we use Manhattan distance (i.e., sum of the distances along the two orthogonal axes between origin and destination) between the current location and the destination as the heuristic function for computing the estimated remaining distance. To reduce the number of turns along a path, and to increase the likelihood of a fast route, the algorithm penalizes turns and non-interstate routes by increasing the costs of paths meeting these criteria.

VI. CONCLUSION

As the vehicular network is composed of mobile nodes, the performance of data-delivery may degrade under different vehicle densities where the network is frequently disconnected. In this paper, we have presented traffic model, which reduces the delay of data-delivery by two mechanisms. The first is intra segment mobility model, which uses the car following model of vehicular motion. Two important parameters for this model are the speed of the vehicle being followed and the space between the two adjacent vehicles. This model also specified how non-following vehicles behave when encountering traffic control. The inter-segment mobility model determines the behavior of vehicles between road segments; i.e., at intersections. This model classified the intersections, according to the number of intersecting road segments, the types of road segments, and the type of traffic control, if any, at the intersection. In essence, the inter-segment mobility model must perform admission control at each intersection. Compared to SADV, it increases the performance of data delivery without traffic in the simulation area.

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