Service Discovery of Intersection for VANET

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Abstract—In recent years, the Vehicular Ad-hoc Networks(VANET) is growth rapidly. There are many applications of the theories and architecture how to combine the intelligent transportation systems (ITS). Especially, the VANET is utilized in city-road and freeway. There are scholars using geographic scope to define the section. The several scholars are using cluster-based to distinguish the responsible of transmission. Some scholars use the density of the drive path. In tradition Mobile Ad-hoc Networks(MANET) plan the path using the distinguished geographic. But the way is not adapted the section that it use the center-based for VANET. This paper main goal is distinguished the section of intersection. The result of the experiment analysis is showed that it is increasing the unit of throughput. That also combines the theory of the section of the geographic-based, the cluster-based and the density-based commonly.

I. INTRODUCTION

Vehicular ad hoc networks(VANET) is communication and connectivity for vehicle. There are many researcher utilized different theories to architecture VANET. For example, there are researchers use intersection-based and direction-based with VANET. The concept of intersection-based and direction-based is used in Intelligent Transportation System(ITS).

ITS is application in city or highway for vehicle. Through ITS, vehicle sent and received message to get import information and avoid traffic jam. Especially, when accident occur in rush traffic, through ITS we can avoid the traffic jam and send the import information announcement other vehicles.

The goal of this paper is we design protocol to increase the unit of throughput. We will use intersection-based and direction-based to design our protocol. We use intersection with small-scale that it transmit message quickly. We also try to combine different theories in our protocol in the future work.

The rest of the paper is organized as follows. Related work of the paper is given in Section II. Our protocol is designed in Section III. Performance evaluation of the protocol is given in Section IV and concluding remarks are made in Section V.

II. RELATED WORK

In [1], the authors consider that the road complexity and traffic variety may cause many potential problems that existing routing protocols can’t address. The authors propose routing protocol for small-scale and large-scale. In small-scale routing, they consider connection and connectionless geographic. They propose a two-phase routing protocol (TOPO) that incorporates road map information for large-scale. The protocol defines an overlay graph with roads of high vehicular density and access graphs that are connected to the overlay. But large-scale is hard to define for the VANET.

In [2], the authors integrated network architecture that the vehicles are dynamically clustered according to different related metrics. They proposed mechanisms that encouraging results are obtained in terms of high data packet delivery ratios and throughput, reduced control packet overhead, and minimized delay and packet drop rates. But the cluster side and header is hard to define.

In [3], the authors focused on that the Vehicular ad hoc network (VANET) is an emerging wireless communications technology that is capable of enhancing driving safety and velocity by exchanging real-time transportation information. They proposed intersection-based routing protocol finds a minimum delay in various vehicle densities. They also consider the vehicles reroute each packet according to real-time road conditions in each intersection, and the packet routing at the intersections is dependent on the moving direction of the next vehicle.

In [4], the authors consider a self-organizing dynamically reconfigurable wireless network without a fixed infrastructure or central management, mobile ad hoc networks (MANETs) that the service discovery between vehicles is also supported by server- and client-based technologies. But MANETs can’t adapt the VANET. So, we will utilize the concept of the MANET to design our protocol.

In [5], the inter vehicular connectivity is analyzed among different length of vehicles that are running along the city roads. Considering the traffic signals, connectivity among the vehicles waiting at different intersections is analyzed taking the safe distance into account. Besides, car following model is used to formulate the connectivity among vehicles with different speed on a multi lane road with several intersections.

So, we utilize small-scale, dynamic and intersection-based and concept of MANET to propose our protocol.

III. PROPOSED PROTOCOL

We propose a protocol for intersection in this section. We utilize the area from the large scale to small scale. We also consider the concept of dynamic and utilize MANET. Our protocol can easy to look the direction for vehicle in intersection and decrease the transmitted time.

In our previous research[5], any vehicle at the intersection may drive straight, turn to left or right after reaching at a traffic
square. We use source to destination for example. As shown in Fig. 1, a vehicle located at A may go straight toward Q or may turn to right and move along the lane P or may turn to left and move along the lane R.

The area between two intersections, it only has two directions: direction and opposite direction. The figure is shown in Fig. 2. The vehicle in this area only drive one direction. So we can focus on the intersection.

In the intersection, we can divide the area to \( n \times n \) square, where \( n \) is the number of the lane. We use 2 lane of the intersection for example as shown Fig. 3.

In Fig. 3, the vehicle can move three direction in intersection. The block arrow means that vehicle move the direction. The blue area means that vehicle moves area probably. The white area means that vehicle can’t move area.

The event occur in the area between intersections, we hope transmit the message to next intersection quickly. We will consider three situations of area: same direction, different direction and no vehicle.

1. Same direction.
As shown Fig. 4, the area has many vehicles that the vehicle communication range can connectivity in same direction. For example, the event occur and the 1st vehicle send the message to the 2nd vehicle, the 2nd vehicle send the message to the 3rd vehicle, the 3rd vehicle send the message to the 4th vehicle, and the 4th vehicle send the message to the 5th vehicle. The 5th vehicle will send the message to vehicle with nearby intersection that the vehicle can receive the event information and change the direction early to avoid the event situation or traffic jam.

2. Different direction.
As shown Fig. 5, the area has not vehicles in some segment that the vehicle communication range can not connectivity in same direction. So the situation need to through the vehicle of the opposite direction to send the message. For example, the event occur and the 1st vehicle send the message to the 2nd vehicle in the same direction. The 2nd vehicle need send the message but no vehicle in the same direction, so send to the 3rd vehicle of the opposite direction. The 3rd vehicle send the message to the 4th vehicle in same direction. The 4th vehicle will send the message to the 5th vehicle that original direction (If it has no vehicle in last original direction then send the vehicle of the same direction with the 4th vehicle). The 5th vehicle will send the message to vehicle with nearby intersection that the vehicle can receive the event information and change the direction early to avoid the event situation or traffic jam.

3. No vehicle.
As shown Fig. 6, the area has not vehicles in some segment that the vehicle communication range can not connectivity in same direction. So the situation, the vehicle that received the message, need to carried the message to next intersection. For example, the event occur and the 1st vehicle send the message to the 2nd vehicle in the same direction. The 2nd vehicle need send the message but no vehicle in the same direction then send the message to the 3rd vehicle in the opposite direction. The 3rd vehicle need send the message but no vehicle in the same direction and the opposite direction. The 3rd vehicle carried the message to next intersection, will send the message to vehicle with nearby intersection that the vehicle can receive the event information and change the direction early to avoid the event situation or traffic jam.

IV. PERFORMANCE EVALUATION
In this section, our propose method analysis is evaluated using NS2 VanetMobiSim [6] simulator. The simulation environment and respective results are described as follows.

A. Simulation Setup
In order to evaluate our proposed models, we used VanetMobiSim [6], which is an efficient simulator and supports...
the vehicular mobility to a higher degree of realism. Besides, we consider NS2 simulator [7], as it provides packet level simulation over transport layer and supports ad-hoc routing protocols, propagation models, and data broadcasting. In NS2 simulator, mobility of nodes may be specified either directly in the simulation file or by using a mobility trace file. In our simulation, the trace file is generated by using VanetMobiSim.

The scenario, we set intersection of the area is 1000 m$^2$. The number of vehicles in our simulation is taken to be 20Km/h~60Km/h with variable speeds. The speed of the vehicles is categorized into three zones. The speed of zone-1 vehicles ranges is 20 km/, zone-2 vehicles ranges is 40 Km/, and zone-3 vehicles ranges is 60 Km/h. The Communication range of each vehicle is taken at 100m~250m and safe distance between any two vehicles is taken to be 5m~10m. Length of each vehicle is considered to be 5m and 10m. In NS2 simulator, IEEE 802.11 MAC with two ray ground propagation model and AODC routing is used to simulate the packet delivery ratio, throughput and average end-to-end packet delay.

**B. Simulation Result**

In this subsection, we present the simulation results in terms of duration of end-to-end packet delivery ratio, for different number of vehicles without changing the lanes.

As shown in Fig.7, the duration of end-to-end packet delivery ratio for different speed of the vehicles and speed is evaluated. It is observed that the duration of packet delivery decreases, if vehicles move slower. In our simulation, it is observed that the speed is 60Km/h and the number of the vehicle is 60 there is high packet delivery ratio. When the vehicles move without changing the lanes, the duration of packet delivery fluctuates with different size of the traffic as shown in Fig.7. In the speed is 40Km/h and 60Km/h with the number of vehicles is 80 that the packet delivery ratio is less than the number of vehicles is 80. It is caused packet message collision by the node of high density.

In our experiment use the Ad hoc On-Demand Distance Vector(AODV) Routing. We use that the speed is 60Km/h and the number of the vehicles is 20 to 60. We compared our model with Dynamic Source Routing(DSR) and Destination Sequenced Distance vector(DSDV).

In Fig.8, we observed the our model have high packet delivery ratio than DSR and DSDV. In the number of the vehicles is 20, our model and DSR the packet delivery ratio is close. We consider the realistic road, we can change the direction. So we use the number of vehicle is 60 and the velocity is 60km/h with to compare different transmission range in our model and DSR. We observed packet delivery ratio, throughput and average end-to-end delay.

We use four transmission range: $R_c = 100m, 150m, 200m,$ and $250m$, respectively. In Fig.9, we observed transmission
range in our model that the packet delivery ratio is high than DSR.

In Fig.10, we observed transmission range in our model that the throughput is high than DSR.

In Fig.11, we observed transmission range in DSR that the average end-to-end delay is high than our model.

V. CONCLUSIONS

In this paper, we use intersection-based to design our protocol. We consider the small-scale for intersection and between intersection we consider the same direction,different direction and no vehicle situation. We use speed, density and communication of vehicle between intersection to simulate packet delivery ratio, throughput and average end-to-end delay. The result shown we can combine the theory of the section of the geographic-based, the cluster-based and the density-based commonly. In our future work, we will analyze the connectivity among vehicles taking drivers behaviors into account with other important theory of VANET.

REFERENCES