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CLUSTERING BASED ROUTING PROTOCOL WITH MAC COLLISION IMPROVEMENT IN VANETS

Linumol Skariah[#1], Dileep Sasidaran[*2]

M.Tech Student[1],Assistant professor[2]

M Tech Communication , ECE Department , A P J Abdul Kalam Technological University

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

[1]linuannaz@gmail.com

[2]dileepsasidaran@gmail.com

***ABSTRACT*— Vehicular adhoc networks [VANETs] is an emerging new technology to integrate the capabilities of new generation wireless networks to vehicles.VANET applications are enabled by different routing protocols and such routing protocols are quite challenging due to rapidly changing topology and high speed mobility of vehicles.In this paper propose a novel routing protocol by using the information of mobility along with a MAC collision improvement. Simulation results of the proposed routing protocol show its performance dominance over the existing approach.**

Key words: Vehicle clustering,VANETs,routing protocol , security.

I.INTRODUCTION

Vehicular ad hoc network[VANET],a subclass of mobile ad hoc networks[MANETs],is a promising approach for future intelligent transportation system. VANETs can use any wireless networking technology as their basis. We know that vehicular ad hoc network [VANET]is not a new topic, it continues to provide new research challenges and problems. The main objectives of VANET is to help a group of vehicles to build up and uphold a communication network among them without using any central base station or any controller. Traffic jams and road fatalities can be reduced by providing proper information about the road conditions and its surrounding environment to vehicle drivers in secure way. The increase in critical driving problems leads to road accidents and traffic congestions.

VANETs provide two types of communication, namely, vehicle to vehicle communication(V2V) and vehicle to RSU(V2R) communication. The goal of V2V communication is to prevent accidents by allowing vehicles in transit to send position and speed data to one another over an ad hoc mesh network. In V2R communication, vehicles communicate directly with RSUs which are fixed aside roads.

A key requirement for the realization of VANET applications is the availability of efficient and effective routing protocols for message dissemination. Due to the problem of efficient routing protocol, vehicles may be unable to share important messages and enjoy the benefits of the advanced technologies offered by VANETs. To identify these problems, many VANET routing protocols have proposed. The existing protocols are classified into five different categories, namely broadcasting protocols, route-discovery protocols, position based protocols, clustering based protocols, and infrastructure based protocols.

Taken out of all types of protocols, clustering based protocols appear to be the most promising one. Clustering is a process that divides the network into interconnected sub-structures called clusters. Each cluster has a cluster head as a coordinator within the sub-structure, which acts as a medium for data transfer between the nodes.

The remaining section of the paper is organized as follows section II gives a brief idea about the related works on this system ,section III will describe the proposed approach , section IV presents the simulation results under our proposed routing protocols then finally the paper can be concluded in section V.

II.RELATED WORK

Many types of VANET routing protocol have been proposed, we propose a novel routing protocol by using the information of mobility along with a MAC collision improvement. There exists many related

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works on the routing protocol in VANETs. They are described as follows.

Dan Lin, Jian Kang and Anna Squicciarini proposed'A moving zone based routing protocol using pure vehicle to vehicle communication in vehicular ad hoc network' in this paper moving object techniques allow us to provide a realistic cluster based representation, in that vehicles are grouped together according to their actual moving patterns. This system only with communication overhead, but there is no solution for security. Also it proposed a comprehensive routing solution that delivers messages in VANETs via a self organized moving zone based architecture formed using pure vehicle to vehicle communication. This approach integrates moving object modeling and indexing techniques to vehicle management. A captain vehicle is elected for each zone and is responsible for managing the information and the vehicle just need to update their movement functions when their moving direction or speed changes dramatically.

Clustering based directional routing protocol in VANETs proposed that vehicles in the same road segment and moving at the same direction are grouped in one cluster, and the vehicle nearest to the center of the cluster is the cluster head, Here clustering based directional routing protocol techniques are used, but in this approach heavy communication is overhead. Then K.Mershad and M. Gerla proposed 'we can deliver messages to far vehicles' Here message delivery is conducted with the support of the infrastructure. The main restraint of this approach is that the time consumption and clustering needs to assistance of road side units which may not be available in many environments.

III PROPOSED APPROACH

We in this section present our modified routing scheme in detail. In the beginning, our greatest wish is to reduce the transmission delay as much as possible since a lot of vehicle applications are delay sensitive. And it's also essential to enhance link connectivity due to the various speed and direction of different vehicles. We first assume the information of vehicle speed and direction can be collected by GPS and other vehicular sensors. There exists a transmission range and each vehicle can communication with each other within the transmission range.

In common case, we naturally consider that routing with the shortest path is the best which will reduce the number of hops at utmost. The same idea has been used by GPSR routing protocol which can be called the greedy forwarding strategy. However, the actual situation is not always the case and we take Fig.1 for example. The source vehicle 1 wants to transmit packets to destination vehicle 10. The path obtained by GPSR routing protocol is [v1, v5, v6, v10] and it needs three hops. Recall the DCF mechanism in 802.11p, vehicles in the same cluster must experience a MAC layer contention process to use the wireless channel and every time just one packet can be sent. We can see that vehicle 6 has five neighbors in its communication range so it might experience a serious MAC delay than vehicle 8 which only has two neighbors. Therefore, this path may spend more time than the path [v1, v5, v8, v9, v10] which will spend four hops to arrive the destination. Now we first estimate the MAC delay by analyzing the contention process of the MAC layer.

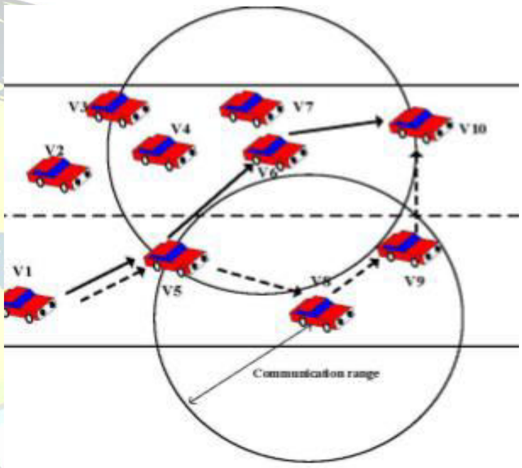

Fig1. An example for different routing selection

A. MAC Delay Analysis

IEEE 802.11p is the standard protocol in VANETs which illustrates the main technical standards for the PHY layer and MAC layer . The basic scheme is DCF which known as carrier sense multiple access with collision avoidance (CSMA/CA). In this situation, vehicles must sense the channel state before transmitting packets. The contention process in MAC layer can be simplified as follows. Firstly, vehicle initiates a random backoff procedure until the medium is idle for DIFS (DCF Inter-Frame Space) time. If the medium is busy, it must wait and continue the backoff procedure until the medium is idle once again. When the backoff time equals a zero value, a vehicle should first send a RTS (Request to Send) packet, then vehicle wait a CTS (clear to Send) packet in order to make sure the contention is success. Once a vehicle receives the CTS packet in a slot time, the contention is success and it can transmit a packet immediately.

On the contrary, if no CTS packet received or vehicle detects a collision within a slot time, the vehicle turns back to the backoff state and start a new round of backoff. Usually, the common

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algorithm of backoff procedure in CSMA/CA is wellknown BEB (Binary Exponential Backoff) algorithm. In BEB, the backoff window doubles when the contention failed and there exists a minimum contention window and a maximum contention window. The backoff time is generated randomly from the window. Through the introduction to the contention process above, we can see that the number of backoff times need to bereduced as little as possible in order to reduce the delay.

IV.SIMULATION RESULTS

In this section, our proposed routing protocol is evaluated and compared with the famous GPSR routing protocol. We consider a highway model environment with vehicles are distributed randomly for simplicity. The highway model environment is 1000m length and has six lanes in two directions. The wireless communication range is set to 250m. The velocity of vehicles is variable from 30km/h to 80km/h.
The experiments were conducted by using the network simulator NS-2. We use NS-2 to simulate scenarios with and without traffic light controls. The vehicle behavior in the simulator is very close to that in the real life .NS-2 implements 802.11 physical and MAC models for vehicle to vehicle communication and the maximum transmission range is set to 500m.
The simulation runs for 50 seconds to tuck in all vehicles and allow vehicles move around on the network for a bit. After 50s, vehicles problem message requests and the total simulation time is 200S.The proposed routing protocol determines the mobility information and MAC contention information which differs moving zone protocol. Simulation results of the proposed routing protocol show its performance superiority over the existing approach.

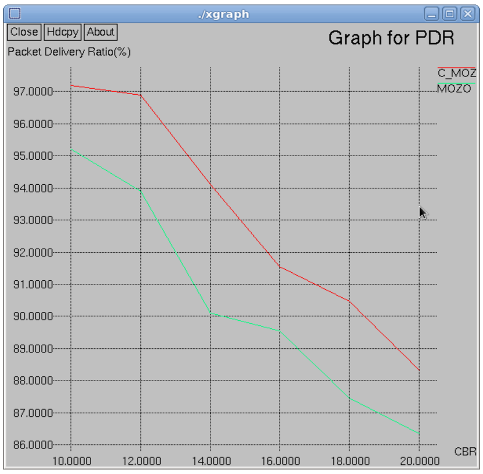

Fig.2 Packet delivery ratio

Fig.2 plots the packet delivery ratio of our proposed routing protocol and moving zone routing protocol versus the number of vehicles in different average vehicle speed. From this figure, we can see packet delivery ratio of two routing protocols increases when the density of vehicles increases. This is obviously because we can choose a more appropriate vehicle node for packet forwarding when there are more vehicles.
Besides, when the number of vehicles is less, there are few effective paths can be selected so the packet delivery rate is similar to that of the two protocols. We can also see that packet delivery rate gets worse with the continuous increase of vehicle speed which is expected. When the number of vehicles is large, the path in our proposed routing protocol is more reliable.
A route maintainance strategy is considered in our proposed routing protocol as well in order to avoid link disconnection. The link disconnection is more common in VANETs because of the influence of vehicle speeds and directions. The method in our routing protocol is based on the vehicular electronic devices which can provide a large amount of vehicular information.
VANET is a subgroup of MANET where the nodes refer to vehicles. Since the movement of vehicles are restricted by roads, traffic regulations we can deploy fixed infrastructure at critical location. 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. In Vehicle to vehicle communication approach is more suited for short range vehicular networks. It is fast and reliable and it provides real time safety.

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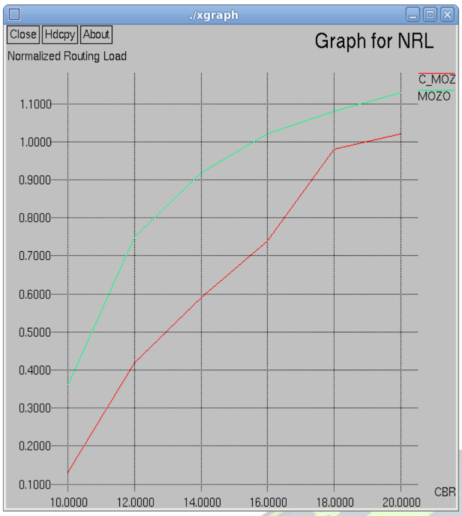

Fig.3Normalized routing load

Fig.3 illustrates the normalized routing load of vehicles in different average vehicle speed. The metrics of normalized routing load measures the reliability.Here the normalized routing load in moving zone protocol is higher than our proposed routing protocol,which illustrates the proposed routing protocol is more stable once again.

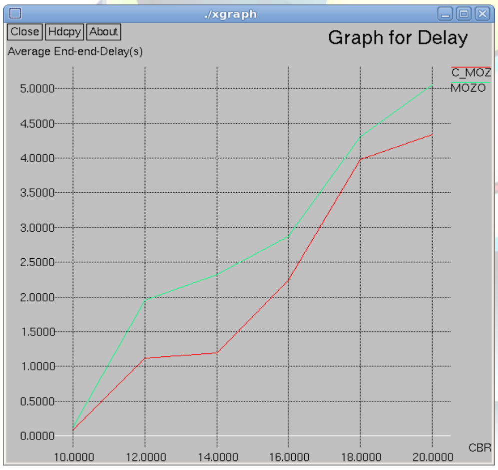

Fig.4 Average end to end delay

Fig.4 illustrates the average end-to-end delay of our proposed routing protocol and Moving zone routing protocolversus thenumber of vehicles in different average vehicle speed. End-to-end delay refers to the time that packets transmitted among two vehicles plus the delay in MAC layer. From the figure, we firstly see that the delay increases as the vehicle density increases both in moving zone routing protocol and our proposed routing protocol. It's reasonable because the contention of MAC layer will become more competitive while the number of vehicles increases and the time cost in contention becomes bigger. Secondly, when the speed of vehicle increases, the delay will increase accordingly as high speed leads to link instability. Thirdly, end-to-end delay under our proposed routing protocol is small. It's expected for the following reason. As the mobility information and MAC delay estimation are considered in our proposed routing protocol, the choice of next hop will become more reasonable than moving zone which only considers the distance. Thus, our proposed routing protocol performs better than on end-to-end delay.

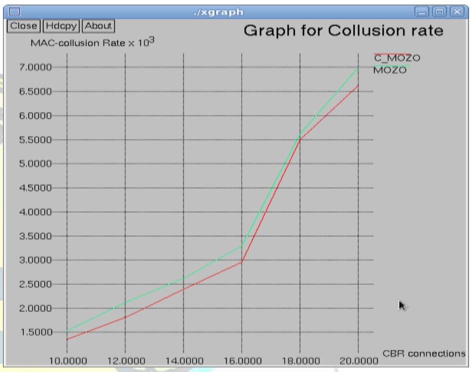

Fig.5 MAC collision rate

Fig.5 shows the MAC collision rate improvement. Comparing to moving zone routing protocol the MAC collision rate is less in our system.

IV.CONCLUSION

In this paper,we have proposed a novel routing protocol by using the information of mobility along with a MAC collision improvement.In the research area of VANETs, it becomes more conscious matter related to security and routing choice . Further this study can be extended by exploring new challenges and their solutions for smooth vehicle to vehicle communication in VANETs. The method in our routing protocol is based on the vehicular electronic devices which can provide a large amount of vehicular information. We add mobility information(speed and direction) and MAC delay estimation in next hop selection strategy to make the route more reliable and decrease delay. We also discuss the route maintenance strategy in detail. Finally, simulations prove that our proposed routing protocol performs much better in forms of average end-to-end delay, packet delivery rate , MAC collision rate

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