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Mobility Prediction and Routing in Vehicular Ad hoc Network

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ABSTRACT

Vehicular Ad hoc Network (VANET) is a promising subclass of Ad hoc Network which is showing huge potential in today's systems. The key difference between Mobile Ad-hoc Network (MANET) and VANET is the special mobility pattern and rapidly changing topology. The survey of Mobility Prediction and Routing Protocols in VANET is important, because of constantly and rapidly changing topology. Thus main issues in VANET are mobility prediction and routing, to support the smart Intelligent Transportation System (ITS). In this paper we discuss the basic concept of VANET and importance of mobility prediction and routing protocols in VANET. Also we survey different routing protocols in existence. Finally the paper concludes with the applications and issues of VANET.

Keywords- **VANET, Mobility Patterns, Mobility Prediction, Routing.**

1. INTRODUCTION

Wireless Ad hoc Network allows more flexible mode of communication than traditional wired networks as user is not limited to a physically fixed location. Moreover unlike cellular networks there is no fixed communication infrastructure. In Vehicular Ad hoc Network (VANET) which is a subclass of Wireless Ad hoc Networks, the nodes are the vehicles and Road Side Units (RSU). Thus the links are subject to frequent disconnections and can get little time for communication. Hence it is necessary to minimize disruptions caused by constantly changing topology. This in turn presents an increased difficulty for the routing protocols, as rapid reconstructions of routes are necessary. The implementation of Mobility Prediction and Routing Protocols in VANET is important, because of constantly and rapidly changing topology. By making use of the non random mobility patters of the node we can predict the future state of the network and take appropriate measures accordingly in timely fashion. Hence we can reduce overhead by eliminating the transmissions of control packets and time required to process them, which are needed to reconstruct the route.

2. VANET

Vehicular Ad hoc Network (VANET) is a rapidly evolving and challenging subclass of Mobile Ad hoc Networks, which uses the vehicles and Road Side Units (RSU) as the node, for communication and exchange of the data. VANET is a promising approach to implement an Intelligent Transportation System (ITS). The main goal of VANET is providing safety and comfort to the user. Each vehicle in VANET is having a communication device installed in it for receiving and sending the messages over wireless VANET. Collision warning, Road congestion and in place traffic view will give the driver essential tool to decide the best path along the way. VANET integrates multiple Ad-Hoc networking technologies such as Wi-Fi IEEE 802.11 b/g, WiMAX 802.16, Bluetooth, IRA, ZigBee for easy, efficient and effective communication between vehicles with dynamic mobility

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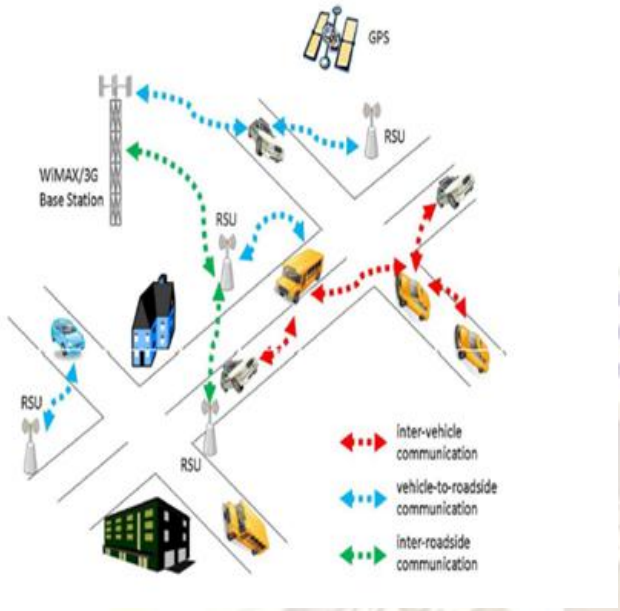

Fig.1 General View of VANET

3. MOBILITY PREDICTION

Mobility Prediction of a node is "the estimation of their future locations". The definition of "location" depends on the kind of wireless network. In infrastructure networks, location means the access point to which the mobile terminal is connected. Many location prediction methods are proposed. The main advantage of location prediction is to allocate, in advance, the convenient next access point before the mobile terminal leaves its current one, in order to reduce the interruption in communication between terminal mobiles. A simple MOBILITY PREDICTION can be illustrated as given below; Fig. 2 represents an Ad Hoc network with four nodes which are A, B, C and D.

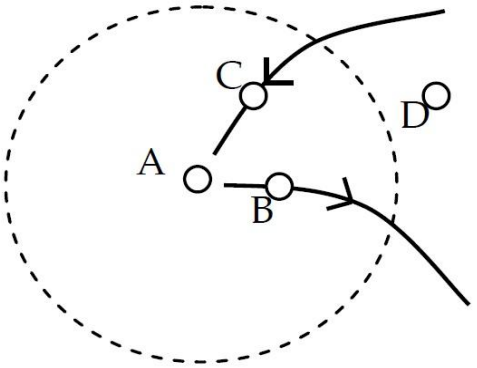

Fig.2 Simple Mobility Scenario in Ad- hoc network

A is stable, C moves slowly towards A and B moves rapidly away from A and D. If A chooses B as intermediate node, then the communication will not last long time since the link (A, B) will be rapidly broken, due to the mobility of B. But if A, takes into account the mobility of B and C, it will choose C as intermediate node because the expiration time of the link (A,C) is superior to that of (A, B), since C have chance to remain in A transmission range, more than B. The fact that A chooses C as next hop to reach D contributes to the selection of the most stable path. According to this example we can predict the next location of the vehicle and by selecting the most stable path, mobile node can avoid future link failure which improves routing. In typical VANETs, nodes exhibit some degree of regularity in the mobility pattern. For example, a car traveling on a road is likely to follow the path of the road, is likely to maintain its heading and speed for some period of time before it changes them. By exploiting a mobile node's non-random traveling pattern, we can predict the future state of a network topology and thus provide a transparent network access during the period of topology changes. Generally in mobility prediction enhancement, GPS position information is used to estimate the expiration time of the link between two adjacent nodes. Based on this prediction, routes are reconstructed before they expire. The main goal of location prediction is to provide a seamless

connection service by reacting before the connectivity breaks.

4. ROUTING TECHNIQUES

In VANET each node acts as an independent router. Each node or as we can say router updates the list of nodes dynamically with changes in network topology, due to this we can't use traditional routing algorithms without any modifications. Another notable factor is the presence of very large resources in nodes which makes techniques like flooding relatively easy to use. In our paper we have considered three types of routing techniques they are:-

1.1. Broadcast Routing

One of the popular routing techniques which are used in VANET is broadcast. Broadcast is usually done if we want to transmit data to maximum nodes possible, which is the case when an accident or an event occurs. Broadcast uses concept of 'Flooding' to a large degree which is supported by the large resources present on the nodes. Surveys have revealed that broadcast is more efficient when small numbers of nodes are involved.

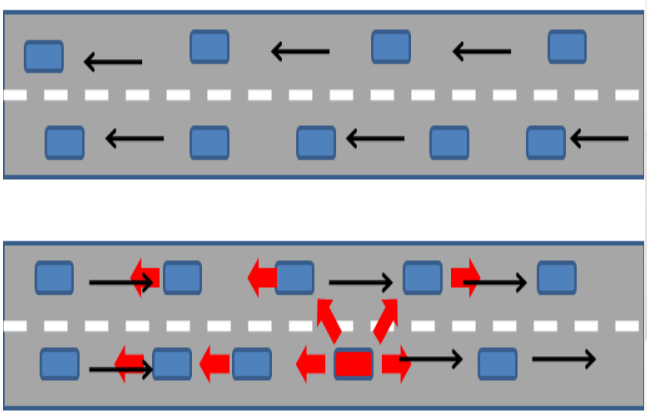

Fig.3 Broadcast Routing

1.2. Geocast Routing

Geocast Routing focuses on particular regions which are focused on and information is delivered to that specific area only using geocast satellites. The area which is selected for transmission is called as 'Zone of Relevance' or ZOR. Only nodes in the ZOR are delivered and vehicles outside it are ignored to avoid unnecessary unplanned actions. The packets are flooded in the region and to reduce the amount of overhead and network congestion by defining a forwarding zone. Geocast however has its own set of problems in form of network partitioning and unfavorable neighbors which can pose problem for transmission, due to such different problems and difficulties this Geocast routing has less efficiency and that's it rarely used while implementing of routing mechanism in vehicular ad hoc networks.

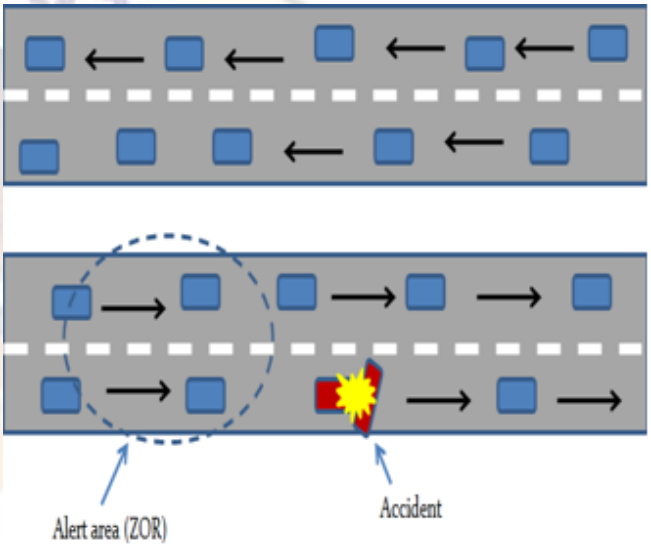

Fig.4 Geocast Routing

1.3. Cluster Based Routing

In the Cluster Based Routing, a virtual partition or a cluster is created between nodes or vehicles. This is done for providing high scalability as well as flexibility. This is done by creating cluster (group) of nodes with the provision of one head node that is called 'Cluster Head' which is responsible for intra- as well as inter-cluster coordination respectively. Thus the cluster head is interface between two or many clusters participating in communication and is responsible for secure communication and co-ordination within cluster and network as well. Each cluster has only one cluster-head and act as gateway for moving nodes

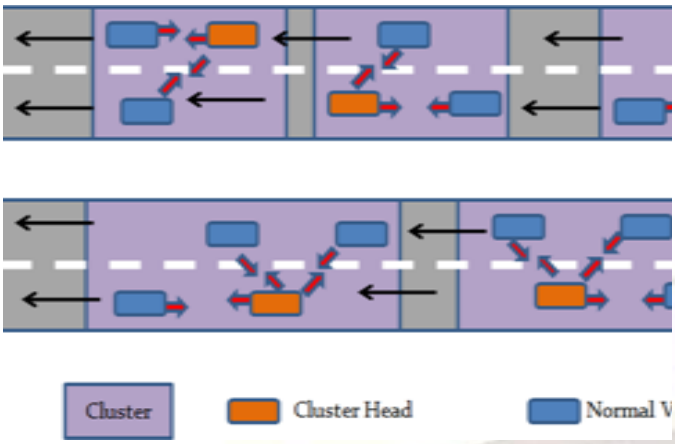

Fig.5 Cluster Based Routing.

5. APPLICATIONS

VANET represents a challenging class of mobile ad-hoc networks that enables vehicles to intelligently communicate with each other according to the architecture implemented i.e. WLAN/Cellular, Ad hoc, Hybrid. As more and more research is going on in the VANET, very innovative and newer applications are emerging. So according to the service the applications provide, the applications of VANET are classified into three main categories and they're,

1.4. Safety Oriented Applications

These applications are to monitor the surrounding roads, approaching vehicles, surface and curves of the road and other safety related issues. Some of the Safety Oriented Applications are Slow/Stop Vehicle Advisor (SVA), Congested Road Notification (CRN), Vision Enhancer, etc. The SVA is an application in which a slow or motionless vehicle will broadcast alert message to its neighborhood vehicles (nodes). The CRN detects and notifies about road congestions and accident situations, which can be used for efficient route and journey planning. Also in post-crash notification, a vehicle involved in an accident would broadcast warning messages about its position to trailing vehicles so that it can take decision with time in hand as well as pass information to the highway patrol for support. In Vision Enhancer, drivers are given a clear view of vehicles and obstacles in heavy fog or heavy rain conditions and can learn about the existence of vehicles hidden by obstacles, buildings, and by other vehicles. Safety applications also include immediate collision warning, emergency message dissemination, left/right turn assistant, lane changing warning, intersection decision support, etc. In safety applications communications are usually of broadcast type.

1.5. Convenience Oriented Applications

These applications are mainly of Traffic Management type. They deal with the traffic management issues, to establish the Intelligent Transportation System (ITS). So these applications can also be called as Non-safety Oriented Applications. Some of the applications can be Parking Availability Notification (PAN), Location Finder, Toll Collection, etc. Parking Availability Notification helps to find the availability of space in parking lot in a certain geographical area as per the weather conditions. For the convenience of the vehicle, highway and urban area maps are available. Location Finder can help unknown passenger to find the shopping center, hotels, gas stations, etc., in the nearby area along the road, with the help of GPS, sensors and database from the nearest roadside base station. Toll Collection is yet another application for vehicle toll collection at the toll booths without stopping the vehicles. In non-safety applications communication is on demand, only request-response based.

1.6. Comfort Oriented Applications

These applications can be considered as the Commercial Applications. These provides the driver and the members in vehicle with the entertainment and services such as web access, streaming audio and video, etc.

6. ISSUES IN VANET

Security of message content is a big issue VANET. The content of a received message has to be verified within a short time to be able to use the information as soon as possible. Authentication service deals with assuring that the communication is authentic. Vehicle should react to

events only with disseminating messages generated by legal senders. Therefore authentication is an issue in VANET.

Scalability means that the number of users and/or the traffic volume can be increased. It can be achieved with performance degradation or even network outage and without changing the system components and protocols. Related to routing, efficient data dissemination and data sharing in VANETs is a challenge. Because of small communication time, it is difficult to assure the reliable message reception and acknowledgement between communication vehicles on opposite directions. So reliability is an issue in VANET.

CONCLUSION

In this paper, we surveyed the importance and role of Vehicular As hoc Network (VANET). We also studied the different architectures available for VANET i.e. WLAN/Cellular, Ad hoc, Hybrid. We have surveyed the importance of Routing in VANET and five types of Routing Techniques as Broad cast, Cluster Based, Geocast, Position Based and Topology Based. We also explained the concept of Mobility Prediction and the importance of Mobility Prediction in VANET. In future we plan to investigate the performance of the prediction technique for different classes of users.

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