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EFFICIENT TRAJECTORY PROTOCOL FOR MULTICASTING IN VEHICULAR AD HOC NETWORKS

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ABSTRACT

Vehicular ad hoc network is a wireless ad hoc network which carries some important functions such as message forwarding and route determination. In areas where there is sparse density of vehicles the network gets disconnected which affects the communication between the vehicles. In the existing system position based forwarding scheme have been used in which the data will be forwarded based on its position. Initially network will be dividing into small zones. Routing will select by the nodes which are placed in the same zone. Dynamically zones will change, because of node mobility in the network. Hence it is difficult to monitor the zone nodes periodically and Over Head will be high. In this paper multicasting technique is introduced based on trajectories. Here the information will be forwarded to group of destinations. Each node estimate the delivery delay to the access point (AP) based on trajectory. Also predict the future position of the nodes. Finally the source will determine which route has less delay and then it predicts route for data forwarding. Multiple nodes are involved in network for route selection. So easily we can select better route for data forwarding in a multicast way and hence the delay is reduced.

Keywords: trajectory, multicast, encounters.

1. INTRODUCTION

VANET (Vehicle Adhoc Networks) is emergent technology that they justify increasing the attention of the industry and the academic institutions. The growth in the number of vehicles on the road has put great stress on transportation systems. Due to this sudden growth of vehicles the driving has made unsafe and dangerous. Existing transportation infrastructure requires improvements in traffic safety and efficiency. The Intelligent Transportation Systems (ITS) have been considered to enable such traffic applications as traffic safety and traffic monitoring.

The increasing requirement of this network is a driving force for leading car manufacturers and governments to increase their efforts toward creating a standardized platform for vehicular communications. In particular, the 5.9 GHz spectrum band has been allocated for licensed Short Range Communication (DSRC) between vehicles. More vehicles will be embedded with devices that facilitate communication between vehicles, such as Wireless Access in Vehicular Environment (WAVE).When vehicles are implemented with WAVE; they can communicate with nearby cars and access points within their coverage area. The vehicles with very short radio range cannot cover large scale areas since they use multi-hop routing protocols, which are significant from traffic safety applications that require short distance coverage- to wide area coverage.

The vehicular communications (VC) develop the security and privacy for example, traffic in the road conditions (emergency, construction sites, or congestion). The security and the privacy are considered as major factors in systems of inter communication vehicles. Inter-Vehicle communication is a new pattern of ad-hoc network. The increasing evolution of the communication techniques, especially in the area of processing of signals and microelectronics it allowed the development of small devices with low consumption of energy.

2. EXISTING WORK

In [1], Bychkovsky *et al*. determines the possibility in which vehicles can access open Wi-Fi access points for the Internet access in vehicular networks. Cabernet proposes one-hop Internet access schemes using open Wi-Fi access points in vehicular networks, whose target is different from TBD’s, that is the multihop ad hoc networking in VANET.VADD [2] evaluates the data forwarding method based on a stochastic model in order to achieve the lowest delivery delay from vehicle to AP. Delay Bounded Routing [3] proposes data forwarding schemes to satisfy the user in which the nodes are routed efficiently by means of the base station in order to determine the random mobility with lowest delivery delay and it minimizes the channel utilization.

OPERA analyzes an opportunistic packet replaying using two-way vehicular traffic on road segments. The data packets forwarded in one direction on a road segment can advance toward the end point of the road segment using other vehicles moving in the opposite direction. On the other hand, TBD uses only vehicles moving in the same direction on the road segment for the clarity of the link delay modelling.

Dragos Niculescu has determined the trajectory based forwarding, in which it is mainly used to forward the packets in a dense adhoc network. The major process carried out here is, it decouples the path and it provides cheap path diversity. This method addresses the issue of scalability and dynamic network topology. The forwarding method illustrates the routing of packets in a specified manner by global and local positioning algorithms where it gathers the information when GPS is not available.

TBD [5] utilizes vehicle trajectory information along with vehicular traffic statistics for shorter delivery delay and better delivery probability for multihop vehicle-to-infrastructure data delivery. TSF [6] determines the forwarding for multihop Infrastructure to Vehicle data delivery, based on vehicle trajectory. Dedicated Short Range Communication (DSRC) is a permissive technology for the next generation communication-based safety applications. The important function of vehicular safety communication is the routine broadcast of messages among all equipped vehicles. Hence channel congestion control and broadcast performance are needed to be addressed in the overall protocol design.

Usually, the Vehicle Routing Problem with Time Windows (VRPTW) aims to route vehicles in which all customers are served within their respective time windows. It evaluates whether the vehicle arrives in the time windows or not. The main task is to reliably receive the deliveries on-time. The routing problem has soft time windows and stochastic travel times, which leads to stochastic arrival times by means of classical Vehicle Routing Problem.

3. SYSTEM MODEL

Here, we present the basic network model of VANET in order to determine the problem statement. Further the assumptions are made based on the specification of various nodes.

A. Network model

In VANET, the communicating node will either be vehicles or base stations. Vehicles can be public (i.e., public transportation means, e.g., buses) or private (belonging to individuals or private companies), base station can belong to private service providers.

Given that the majority of the network nodes will consist of vehicles, the network dynamics will be characterized by quasi-permanent mobility with high speeds and in most cases very short connection between neighbours (e.g., in the case of crossing vehicles). The vehicle speeds on highways are usually higher than 80km/hr. Another aspect of network dynamics is that vehicle trajectories are mostly well defined by the roads, which has some advantages (for message dissemination) and disadvantages (for privacy). Here the communication is carried out between vehicle to roadside base station and inter vehicle communication.

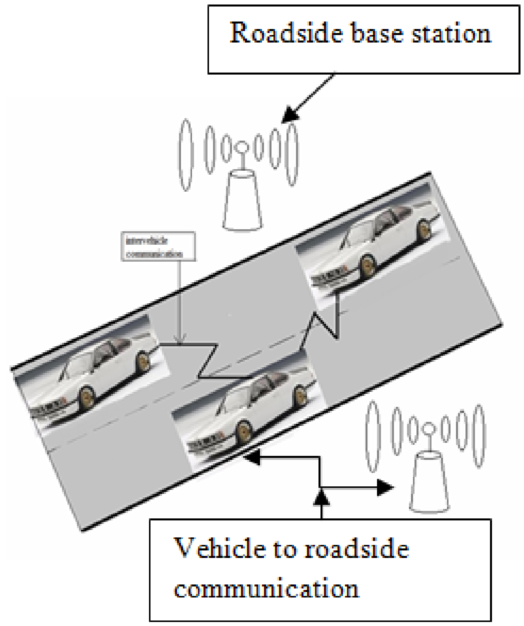

Figure-1. Vehicles and roadside base station determines the communication in vehicular networks.

B. Methodology

The existing methodology used the position based forwarding technique in which it indicates the position and it determines the information about the road topology. According to this protocol a source vehicle wishing to send a data packet to a target vehicle, calculates the shortest routing path to reach this target vehicle using geographical information of road map. The vehicle source selects a sequence of intersections through which the data packet must travel to reach the target vehicle. The sequence of intersections is formed by a set of specific geographical points of data packet passage, and it sends messages from one intersection to another in a network.

In this paper, efficient trajectory protocol for multicasting (ETPM) is to be proposed. Here a novel message forwarding metric is proposed in which it characterizes the capability of a vehicle to forward a given message to a group of destination node. Here a vehicle can simply forward a message to a vehicle that has a higher multicast delivery gain over the vehicle itself.

To compute this, the key challenge is to predict the chance of encounter between two vehicles and to determine their security issues. The salient feature of ETPM is that it is a fully distributed approach in which vehicle trajectories are shared through inter vehicle exchange and a vehicle makes its message forwarding decision based on the trajectories. Data forwarding in VANET is different from MANET,

- VANET are moving on the physically constrained areas.
- The moving speed is also limited by the speed limit. In this methodology position based vector protocol is

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used, in which it delivers the message with high reliability and to optimize the packet behaviour with high mobility.

C. Predicting intervehicle encounter

The occurrence of an encounter between two vehicles requires some specific conditions. There should be a trajectory intersection between the two trajectories. Two vehicles will encounter only when they are within the range. Here the specific number of intersections has been considered in order to determine the Multicasting efficiently.

The encounters occur in two types

- First the encounter occurs at road intersection.
- Second when two vehicles move in different directions on the same road, the intersection takes place.

D. Metrics included

a) Routing traffic

Transmissions occur in the routing Packet expressed in bits per second.

Routing Traffic = number of packets- (number of received packets + number of packets lost).

b) Delay

The time required for a packet to arrive at a destination.

Delay = time of receipt of packet - transmission time of packets.

4. ETPM PROTOCOL ROUTING

Basically the routing function includes route calculation, Maintenance of the routing protocol and execution of routing protocols. The packet along the network is passed through, in which it selects the best path for forwarding.

A. Speed and position updater

- Vehicles will update its position and Speed in a certain time interval.
- Then it will share the information to its neighbour's continuously.
- This process will continue until the process completion.

B. Update multicast routing table

- In multicast Routing protocol source node can send a data to multiple destinations accessed along the network.
- Initially nodes will send a request to all the nodes, if a destination node receive the request it will generates the routing information otherwise it will forward to next neighbours, then the source node receives the request.
- When source receive the request for all destinations which are the nodes participating in the routing all are updates the routing table.

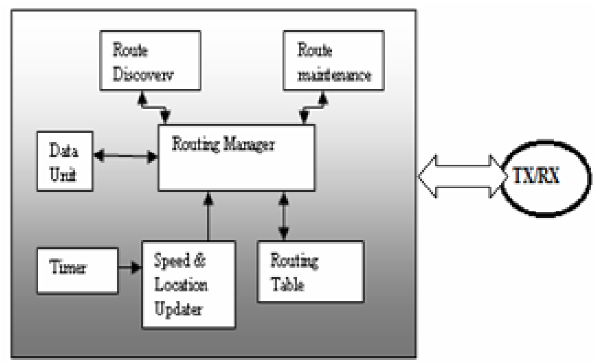

Figure-2. Routing architecture of ETPM protocol

C. Select a route for data forwarding

- After collecting the routing information nodes will start to forward the data to given route.
- The route will change if any link is failed between any nodes in network.

5. DATA FLOW PROCESS IN ETPM TECHNIQUE

The following Figure illustrates the data flow process in which it determines the topology and then it collects the information nodes will select which node has finest speed and suitable position for covering more number of nodes. Based on the trajectories node will select the best Cluster Head (CH) node for Data forwarding. CH selection will continuously happen because high speed rate of the vehicles.

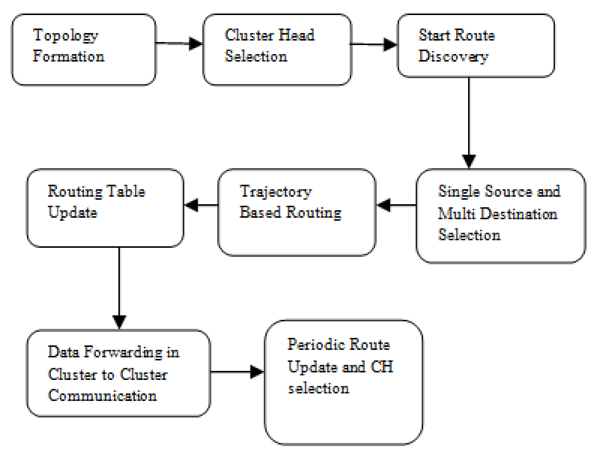

Figure-3. Data flow diagram.

The necessary route details will be provided by the route table and hence the following route is to be selected in order to transmit and the methodology is formulated as,

Step-1: Create topology formation

Step-2: CH Selection.

In the cluster head selection process, nodes update the speed and position periodically. All the nodes share this information to all the neighbours

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Step-3: Multicast Routing Mechanism source node can send a data to multiple destinations.
Step-4: Initially nodes will send a request to all the nodes, if a destination node does not receive then it will forward to next neighbours.
Step-5: Multicast Routing table Updating (Trajectories)

- Route selection
- Route maintenance

Step-6: Trajectory data will be gathered from all vehicles and stored in CH.
Step-7: Then it multicasts data to others.

6. SIMULATION AND RESULTS

Here we are comparing the ETMP with the Trajectory based protocol. In ETMP, when two vehicles encounter each other, each of the vehicles will share the information of currently maintained trajectories that the other vehicles does not have.

Table-1. Default settings of system parameter.

Parameter	Default value
Road network	The number of intersection is 40
No of vehicles	200
No of multicast Groups	30
Communication Range	100 meters

The simulation has been carried out based on the vehicular GPS traces. When the vehicles encounter the amount of data which is to be transferred is recorded. Here the number of intersections in the road network is 40 and the communication range is 100 meters.

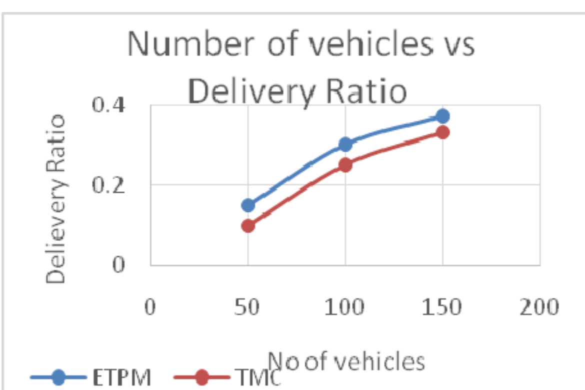

Figure-4. Number of vehicles vs. delivery ratio.

In this, we can see that ETMP has a better delivery ratio compared to TMC. The number of vehicles is varied for different scenarios and its corresponding delivery ratio is calculated. The graph is plotted by taking number of vehicles in the X axis and the delivery ratio in the Y axis.

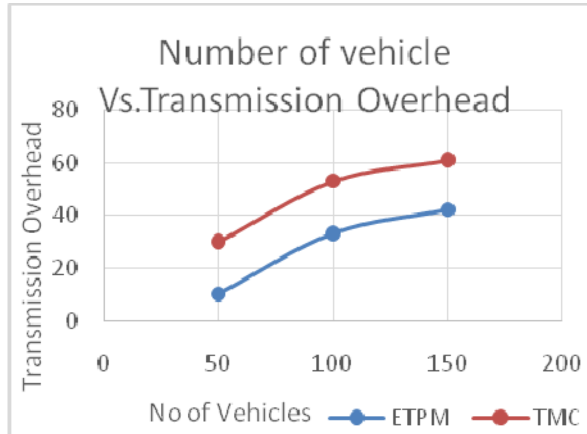

Figure-5. Number of Vehicles Vs Transmission Overhead.

The Transmission overhead is calculated for different number of vehicles. The two protocols ETPM and TMC are compared. It is seen that the transmission overhead is reduced in the TMC protocol compared to the ETPM protocol. When the information is to be sent, it is received along with the header or footer hence it consumes the maximum bandwidth so the transmission overhead is to be reduced.

The delivery delay is plotted against the number of vehicles. It is seen that the delivery delay reduces when the number of vehicles increases also the same performance is compared with the ETPM protocol which shows that for the same number of vehicles, the delivery delay of TMC is less than that of ETPM.

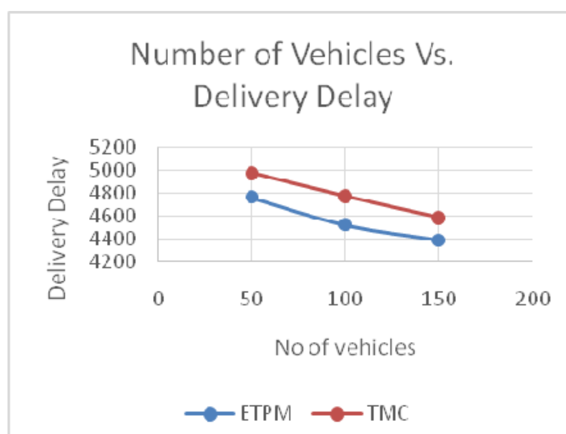

Figure-6. Number of vehicles Vs delivery delay.

6. CONCLUSIONS

In this paper we propose Efficient Trajectory Protocol for multicasting (ETPM) to multicast data delivery in vehicular networks. Here we are predicting the delivery probability in which the encounter occurs when the vehicle are within range. The salient feature of ETPM is that it is a fully distributed approach in which vehicle trajectories are shared through inter vehicle exchange and a vehicle makes its message forwarding decision based on the trajectories. Our performance results demonstrate that ETPM can achieve the packet delivery ratio close with a much lower transmission overhead and delay.

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