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RELAY NODE BACKBONE SCHEME IN VEHICULAR ADHOC NETWORK

D. Silambarasan*

Dr. P. Suresh, M.Sc.,M.Phil.,M.S.,Ph.D.**

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Freeway Mobility Model;

WAVE;

RSU;

Abstract

Vehicular Ad hoc networking is a peculiar networking communication which transmits messages and warnings between vehicles and access points which incorporates rural, urban and highways. These communications bring all the road side systems to work together by establishing routes and communication links. It offers intelligent transportation, comfort, security and infotainment applications. In VANET the vehicles are the nodes and it forms high mobility topology. Timely delivery of messages is the most vital aspect in vehicular networks to reduce road side issues. So selecting the node for messaging transmission is a critical job for correct delivery. There are variant ways for selecting and this paper discuss about relay node selection in which the vehicles are elected automatically as Relay nodes. It has many benefits in relay node selection as the packet delivery is high, loss is low and end to end delay is reduced. This paper examines the highway regime and it chooses the freeway mobility model.

* **Research Scholar, Periyar University, Salem - 11.**

** **Head, Department of Computer Science, Research Supervisor & Convener, Salem Sowdeswari College, Salem**

I. Introduction

The network is setup with the principles of mobile ad hoc which dynamically create the nodes in the highway for exchanging data. It is firstly introduced for "car-to-car" communication where the message can be relayed between them.

Features

- "V2V & V2R" architecture will exists to provide safety, navigation and other roadside services.
- It is key for Intelligent Transportation System.
- It is considered as safer and more efficient by providing timely information and makes travelling more convenient.
- V2R provides better service in sparse networks and in long distance.

Requirements in VANET

- Authentication and Integrity

Transmitted data should be verified and checked for authorized identification and correct delivery.

- Confidentiality

Transmission should be secret by using encryption schemes.

- Privacy and Anonymity

Messages should be transferred to authorize vehicles and not to be used by misbehaved vehicles.

- Access Control

Should have the ability of receiving available services offered by remote vehicles.

- Non-Repudiation

Senders of message should not deny their identities which will lead to wrong location of events, weaken negotiation and cooperation.

- ID Traceability

The capability to retrieve real identities of vehicles and owners who sent messages.

- Scalability

Accepting number of communicating vehicles without any loss in transferring since traffic loading will increase the complexity and decrease the performance.

- Efficiency and Robustness Capability to provide service under different attacks.

- Availability Ensure communication even in bad conditions or false events.
- Resistance against 'In-Transit-Traffic & On-Board-Tampering'

In-transit traffic tampering- Malevolent vehicle can corrupt data of other vehicles.

On-board tampering- Vehicle can know special detail about some the position and velocity.

Characteristics of VANET

Dynamic topology - The speed and direction will change frequently.

Periodic connectivity - Connectivity between devices can connect or disconnect at any time.

Mobility Patterns - Vehicles follow a certain patterns to move.

High power and storage - Nodes have a unlimited amount of power and storage capacity.

Components of VANET

- Vehicles,
- Electronic hardware components,
- Intelligent actuators- engine,
- Transmissions,
- Suspension,
- Integrated vehicle control,
- Sensor devices-radar,
- Video camera,
- GPS,
- On Board Units,
- Roadside devices,
- Control of vehicle groups and fleets.

II. Literature review

G. Korkmaz *et al* [1] proposed a fully Ad-Hoc Multi-hop Broadcast protocol. This protocol highly eliminates the infrastructure dependence of the UMB protocol by intersecting the broadcast mechanism. In this, while there is an intersection in the path during dissemination, the directional broadcasts to all segments are initiated without the a priori topology information. The simulation results confirm that the proposed protocol has a very high success rate and efficient channel utilization. And it is also concluded it can be employed in non-infrastructure support.

H. Huang *et al* [2] designed a new called Efficient Directional Broadcast (EDB) for VANET with the help of directional antennas. EDB is comprised of two things namely directional broadcast on the road and at the intersection. In EDB, generally the furthest receiver is responsible to forward the packet in the opposite direction where the packet arrives. A real mobility model is generated by mapping the GPS data of 4200 taxis of Shanghai. EDB has many advantages such as long transmission range, space reuse, low redundancy and collisions. The result shows that EDB not only increases the delivery ratio but also decreases the network resource consumption.

Mohammad Jalil Piran *et al* [3] introduce a sensor network in the Vehicular ad hoc network. By exposing the new technologies such as wireless sensor networks is a solution to reduce the rate of data loss. This paper employs 'Wireless Sensor networks' for Vehicular Ad Hoc or VASNET. It is a self-organizing Ad Hoc consists of numerous sensor nodes. The sensor nodes can be placed in two ways. By modelling in the vehicle-vehicle and by deployed in predetermined distances in the road. By installing base stations VASNET provides capability of wireless communication between vehicular and stationary nodes. This paper discusses the fundamentals and challenges faced in VASNET.

J.B. Kenney *et al* [4] analyse the 'Dedicated short-range communication technology' for the use in vehicle-to-vehicle and vehicle-to-roadside communication. Vehicles use a numerous of wireless technologies to communicate with other devices. These technologies depend on the standards. The standards discussed in this paper are 'DSRC standards, IEEE 802.11p amendment for wireless access in vehicular environments , the IEEE 1609.2, 1609.3, and 1609.4 standards

for Security, Network Services and Multi-Channel Operation, the SAE J2735 Message Set Dictionary, and the emerging SAE J2945.1'.It explains the content and status of the major standards which support interoperable DSRC in the United States.

Izhak Rubin *et al* [5] proposed a Directional Vehicular Backbone Network protocol to distribute the message between the vehicle to vehicle and vehicle to Road side unit in a highway. By using Global Positioning system with election algorithm vehicles which lies in the closest to the nominal positions are selected as a relay nodes. This paper concentrate on two things: using varying inter-RN nominal position ranges to show the effectiveness, demonstrate the superior performance of the DVBN protocol which is opposed to the VBN protocol that employs omni-directional antennas. Simulations are carried out to show under which broadcast the throughput increases.

III. Methodology

Working Principle of VANET

VANET turns every car into a wireless router or node, allowing distance from 100 to 400 metres of each to connect and create a network with a range. As one falls out of the signal and leave the network others can join in. The first systems that will begin this may be a police and fire services to communicate for security purposes.

A special electronic device called On Board Unit will be placed inside each vehicle which will act as a node in the Ad-Hoc network to pass messages between the vehicles and also can receive and relay messages through the wireless called Road side Unit. This operates without any fixed infrastructure. The RSU transmission range is 1000 m as per the USDOT. There are also multimedia and internet connection within the wireless coverage of every car.

An OBU is a mobile node and RSU is a static node. An RSU can be connected to the Internet through the gateway. It can communicate with each other directly or by multi hop. The two types of infrastructure domain access are RSU and Hot Spot. OBUs' may communicate with net via this RSU or HS. Also it can communicate by cellular radio networks such as "GSM, GPRS, UMTS, Wi-MAX, and 4G".

The IEEE 802.11p (2010) standard with Wireless Access for Vehicular Environment (WAVE) – IEEE 1609.3 is used for communication. It has the bandwidth of 10 MHz and bit rate of 27 Mbps. It includes data exchange between high-speed vehicles and the roadside infrastructure in the licensed ITS band of 5.9 GHz. In this protocol, the vehicles send information about their traffic parameters such as speed, distance from other vehicles etc. to nearby vehicles. And it has CSMA/CD collision protocol to avoid collision during node transmission.

Relay Node selection

The source node in the highway generates the messages in case of collision, road disorder or dangerous accident. The message is sent to the nearby Roadside Unit. The RSU select any one of the vehicle within its coverage area (1000 m) as a relay node to pass the message. To disseminate the data to all other nodes within its coverage area (250m), the relay node broadcast the message through the 'On Board Unit' equipped in it and thus form the relay node driven backbone network. Both these formation extend the RSU coverage area and limits the number of RSU to be installed. It is a one hop communication between the RSU and the relay node in this model and thus it offers a quick dissemination of data.

The selection of the relay node depends on the speed, distance from the danger zone and the lane number which the node is travelling. The node which is travelling in the other lane will not be disturbed. And all other nodes can be able to slow its speed or stop travelling depends on the situation on seeing the messages. If the relay node goes beyond the coverage area another relay is selected until the timer expires and the message is deleted from the buffer.

Relay Node Selection Module

The structure would be fulfilled if the participating vehicles are selected as the Relay Nodes. These relay nodes are used to forward the messages to the vehicles. So any fault by the RN's in the forwarding process might make the complete system to fail. Hence, the relay node selection algorithm must be most effective. In this paper the relay nodes are chosen based on speed, distance, position and Lane number.

For speed - The slow moving vehicle will elected since it reside in coverage area for a

longer time.

For position - The distance between the relay nodes within the RSU is lesser than the nearer RSU so data transfer is effective.

For distance - The distance from the vehicle must be closer to the danger prone.

For Lane number - The lane number is included to disseminate the message in the particular lane.

Algorithm

Receive msg from Source (V-ID, Lno, msg).
Check V-ID of the source in RSU.
For V-ID in the RSU
If (Spd < 90 km/h & > 60 km/h, N_{pos} - RSU_{pos}= low, N_{dis}- S_{dis}=low, N_{lno} = S_{lno},) then
Set V-ID = RN.
Store RN in RSU.
Return.

Where, V-ID = Vehicle ID,

Lno = Lane Number,

Msg = Message.

RSU = Road Side Unit,

Spd= Speed,

N_{pos} = Node Position.

RSU_{pos} = Road Side Unit position,

N_{dis} = Node distance.

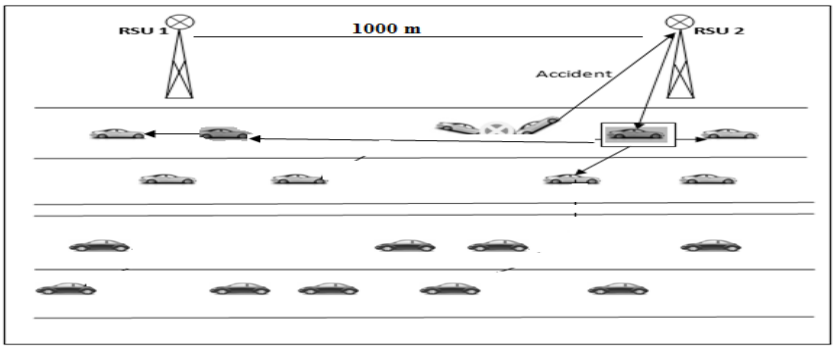
S_{dis} = Source distance,

N_{lno} = Node Lane Number.

S_{lno} = Source Lane number,

RN = Relay node, Low = 50-100m.

If more than two nodes match the constraints, then the vehicle which is registered first while entering into the coverage will be given first preference to act as a relay node.



Message transformation with relay node

The source node generates message in case of collision and sends it to nearby RSU. The RSU elect relay node on the basis of proposed constraints and relay node broadcast the message to all its neighbours in its coverage area.

IV. Conclusion

In the proposed relay node scheme the vehicle in the other lane is not disturbed. And the communication extend above 1000m via the relay node driven thus the installation of RSU is limited. The End To End delay will be increased due to network congestion in other schemes but in the relay node scheme the delay is getting reduced though the node increases. The message has to be disseminated before the node leaves from the coverage area as it is in high mobility in VANET. As per the relay node selection algorithm the slow moving vehicle is choose as a relay node so the packet delivery ratio will be high.

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