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VANET Routing with Cognitive Radio Network over High Density Road

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Abstract - VANET is vehicular Ad-hoc network which is used for intelligent transport system for the drivers the ad-hoc network is used to transmit various types of message over the network. DSR routing protocol is utilized for message transmission .VANET scenario is used for mainly V2V and V2R purposes. In various scenarios message transmission is done according to vehicle density available on the road. Communication through high density roads is more successful rather than communication through low density. The main issue of communication through high road density is due to high load on road, message communication get overhead due to less amount of network bandwidth to overcome this issue Cognitive Radio bandwidth is utilized for data transmission by channel sensing and messages are transmitted through Cognitive Radio channels.

Keywords: VANET, V-2-V & V-2-R Communication, CRN, DSR.

I. INTRODUCTION

1.1 VANET

VANET uses cars as mobile nodes in a MANET to create a mobile network. A VANET turns a participating car into a wireless router or node which allowing cars 100 to 300 meters of each other to connect and create a network with a wide range. As cars fall out of the signal range and drop out of the network, other cars can join in, connecting vehicles to one another so that a mobile network is created. It is estimated that the first systems that will be using this technology are police and fire vehicles to communicate with each other for the purpose of security.

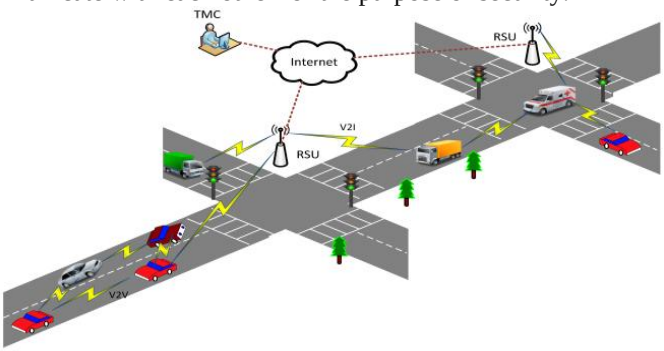


Fig 1: VANET

The connectivity is done among one vehicle to other vehicle and vehicle to road side infrastructure and vehicle or road side infrastructures to the central authority responsible for the network maintenance

1.2 CHARACTERISTICS OF VANET

VANET is an application of MANET but it has its own distinct characteristics which can be summarized as:

- High Mobility

The nodes in VANETs usually are moving at high speed. This makes harder to predict a node's position and making protection of node privacy whose position is rapidly changing .

- Network topology

Due to high node mobility and random speed of vehicles, the position of node changes frequently. As a result of this, network topology in VANETs tends to change frequently.

- Unbounded network size

VANET can be implemented for one city, several cities or for countries. This means that network size in VANET is geographically unbounded.

- Frequent exchange of information

The ad hoc nature of VANET motivates the nodes to gather information from the other vehicles and road side units. Hence the information exchange among node becomes frequent.

- Wireless Communication

VANET is designed for the wireless environment. Nodes are connected and exchange their information via wireless. Therefore some security measure must be considered in communication. Time Critical: The information in VANET must be delivered to the nodes with in time limit so that a decision can be made by the node and perform action accordingly.

- Sufficient Energy

The VANET nodes have no issue of energy and computation resources. This allows VANET usage of demanding techniques such as RSA, ECDSA implementation and also provides unlimited transmission power.

- Better Physical Protection

The VANET nodes are physically better protected. Thus, VANET nodes are more difficult to compromise physically and reduce the effect of infrastructure attack.

1.3 ROUTING IN VANET

- Protective routing protocol

Proactive routing protocols employ standard distance-vector routing strategies (e.g., Destination-Sequenced Distance-Vector (DSDV) routing) or link-state routing strategies (e.g., Optimized Link State Routing protocol (OLSR) and Topology Broadcast-based on Reverse-Path Forwarding (TBRPF)). They maintain and update information on routing to all nodes even then also when the path is not used. Route updates are periodically performed regardless of network load, bandwidth constraints, and network size.

- Reactive routing protocol

Reactive routing protocols such as Dynamic Source Routing (DSR), and Ad hoc On-demand Distance Vector (AODV) routing implement route determination on a demand or need basis and maintain only the routes that are currently in use, thereby reducing the burden on the network when only a subset of available routes is in use and this limit the bandwidth wastage.

- Position-based routing

Position-based routing protocols require that information about the physical position of the participating nodes be available. This position is made available to the direct neighbors in the form of periodically transmitted beacons. A sender can request the position of a receiver with the help of a location service. The routing decision at each node is then based on the destination's position contained in the packet and the position of the neighbor of the forwarding node.

- Forwarding

A geographic unicast transports packets between two nodes via multiple wireless hops. When the requesting node wants to send a unicast packet, it finds the position of the destination node by looking at the location table. A greedy forwarding algorithm is then used to send the packet to the neighboring vehicle or nodes, detailing the minimum remaining distance to the destination vehicle and this process repeat at every vehicle along the forwarding path until the packet reaches its destination.

- Protocols for dedicated short-range communication (DSRC)

Protocols, namely Coordinated External Peer Communication (CEPEC) and Communications Architecture for Reliable Adaptive Vehicular Ad Hoc Networks .(CARAVAN) use mapping and timeslot allocation to minimize the occurrence of denial of service attacks or attacks that burden the limited bandwidth present in vehicular networks.

1.4 COGNITIVE RADIO

A cognitive radio is an intelligent radio that can be modified and designed progressively. Its handset is intended to utilize the best remote channels as a part of its region. Such a radio naturally distinguishes accessible directs in remote range, then in like manner changes its transmission or gathering parameters to permit more simultaneous remote correspondences in a given range band at one area. This methodology is a type of element range administration. A CR "screens its own particular execution ceaselessly", notwithstanding "perusing the radio's yields"; it then uses this data to "focus the RF environment, channel conditions, join execution, and so forth.", and changes the "radio's settings to convey the obliged nature of administration subject to a proper mix of client necessities, operational restrictions, and administrative requirements".

1.4.1 System Model in CR

- Throughput

Throughput is normally defined as time average of the number of bits per second that can be transmitted by every node to its destination. It depends for example on the spectral (bandwidth) efficiency in a given bandwidth and how efficiently the interference is avoided or suppressed, and is thus related to the use of bandwidth and transmitted energy. Area spectral efficiency (ASE) is the total data rate of users per unit bandwidth per unit area (bits/s/Hz/m2) for a specified BER.

- Delay

The delay attribute indicates the acceptable transfer time of a packet from source to its destination. Mean delay is the average end-to-end delay of packets transmitted and 95- percentile delay is the time within 95 percent of packets has reached the destination. Delay is caused by network congestion and transmission problems that cause errors, as well as hardware and software inefficiencies Based on this encyclopedia, delay may be caused by following: Network congestion caused by excessive traffic. Processing delays caused by inefficient hardware. Queuing delays occur when

buffers in network devices become flooded. Propagation delay is related how long it takes a signal to travel across a physical medium.

- Reliability

The reliability attribute indicates the tolerance for error rates and the needed amount of control information which is the amount of information needed to create and maintain network connectivity, including the information of spectrum holes and the network state information. It can be alternatively stated as the amount of information needed among users to implement an order optimal policy. In 3G systems, reliability is defined in terms of the residual error rates for the following cases: loss probability, duplication probability, mis-sequencing probability and corruption probability.

- Precedence

The precedence indicates the relative importance of maintaining the service commitments under abnormal conditions. Three values of precedence are 1 (high priority), 2 (normal priority), and 3 (low priority). In cognitive radio system primary users have higher priority than secondary users and they are privileged to the spectrum usage. Also fairness between secondary users in a network can be thought to belong to this class. Resources in the network should be fairly divided to users.

II. RELATED WORK

Ali J. Ghandour a, 2013 [1] Presented the Wireless Access in Vehicular Environments (WAVE) protocol stack has been recently defined to enable vehicular communication on the Dedicated Short Range Communication (DSRC) frequencies. Some recent studies have demonstrated that the WAVE technology might not provide sufficient spectrum for reliable exchange of safety information over congested urban scenarios. In this paper, we address this issue and present novel cognitive network architecture in order to dynamically extend the Control Channel (CCH) used by vehicles to transmit safety-related information. Author propose a cooperative spectrum sensing scheme, through which vehicles can detect available spectrum resources on the 5.8 GHz ISM band along their path, and forward the data to a fixed infrastructure known as Road Side Units (RSUs).

Srikanth Pagadarai,2009[2] Presented quantitative and qualitative results of TV spectrum measurement expedition paper used these measurements to characterized vacant TV channels on major interstate highways and show the trends in the availability of vacant channels from a vehicular dynamic spectrum access perspective and describes general geo-location database approach to create spectral map of available channels in given geographical area. Paper present the results possessed by applying such technique. Paper presented discussion on the implications of the non-contiguous channel availability in the TV spectrum on the design of perceptional radio transceiver from the perspective of vehicular communications.

Marco Di Felice, 2011[3] Presented Cognitive Radio (CR) technology has received significant attention from the research community as it enables on-demand spectrum utilization, based on the requests of the end users An application area of CR technology is vehicular Ad Hoc Networks (VANETs). In this paper it proposes two contributions pertaining to CR-VANETs. First is an experimental work on spectrum availability and detect accuracy in moving vehicle. Second is collaborative spectrum management framework called Cog-V2V? Which detect spectrum in licensed band and allows sharing spectrum information? In this paper it shows the design of collaborative detecting and decision algorithm and to share spectrum information.

Alexander W. Min, 2009[4] Presented cognitive radio networks spectrum Sensing is rectification to opportunistic spectrum access during intercepting any unacceptable interference to primary user's communication. Although cognitive radios function as spectrum sensors and move around all of existing approaches assume stationary spectrum sensors, thus giving inaccurate sensing results. To solve this problem in this paper it considers the impact of sensor mobility to increase spatiotemporal diversity in received primary signal strengths and improves the sensing performance.

Wooseong Kim, 2011[5] Presented Dedicated short Range Communications (DSRC) and IEEE 802.11p (standard to add wireless access in vehicular environments (WAVE)). In this paper it proposes Co-Vanet, a cognitive vehicular ad hoc network that allows vehicles to access wifi channels. Co-vanet is 1st that use cognitive radios in VANET. In conventional cognitive radio strategies it uses unlicensed band. In Co Vanet, network topology and channel environment change frequently due to high node mobility. The main contribution of this work is Cognitive Ad hoc Vehicular Routing Protocol (Co-Route) that utilizes geographical location and sensed channel information.

III. METHODOLOGY

VANET scenario is used for transmission of various messages in the vehicle communication. Various phases have been derived from proposed work that are described below

Phase 1

In this phase VANET scenario is initializing by defining the no. of nodes.

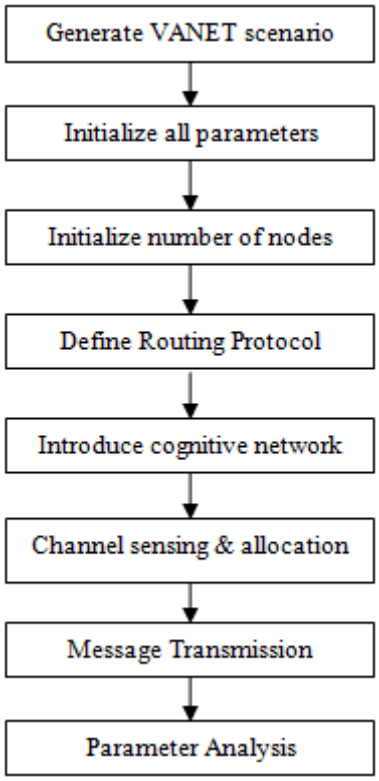
Phase 2

In this phase communications between different vehicles and roadside unit will take place using DSR protocol for the communication process.

Phase 3

In this phase cognitive radio bandwidth has been utilized for the transmission of packets from vehicle to vehicle and vehicle to RSU and RSU to vehicle by sensing the channel. The Channel which is free can be allocated for communication.

Flow of work



IV. APPROACHES USED

- **Intelligent Transportation System (ITS)**

An Intelligent Traffic System (ITS) involves a much closer interaction between all of its components: drivers, pedestrians, and public transportation and traffic management systems. Adaptive signal systems, driver advisory and route planning and automated vehicles are some of the goals set up to increase the efficiency of actual systems. a decentralized architecture is developed for city traffic control where intersections are port-based agents. A self-adaptive system would be able to respond quickly to the changes in the road conditions, modifying signal policies and rerouting drivers to prevent congestions. Research issues include distributed control architecture and optimization, inter-agent communication and driver models. Different traffic simulators are being used together with the port-based agent architecture.

- **Dynamic Source Routing(DSR)**

Dynamic Source Routing (DSR) is a routing protocol for wireless mesh networks. It is similar to AODV in that it forms a route on-demand when a transmitting node requests one. However, it uses source routing instead of relying on the routing table at each intermediate device. Determining source routes requires accumulating the address of each device between the source and destination during route discovery. The accumulated path information is coached by nodes processing the route discovery packets. The learned paths are used to route packets. To accomplish source routing, the routed packets contain the address of each device the packet will traverse. This may result in high overhead for long paths or large addresses, like IPv6. To avoid using source routing, DSR optionally defines a flow id option that allows packets to be forwarded on a hop-by-hop basis. This protocol is truly based on source routing whereby all the routing information is maintained (continually updated) at mobile nodes. It has only two major phases, which are Route Discovery and Route Maintenance. Route Reply would only be generated if the message has reached the intended destination node (route record which is initially contained in Route Request would be inserted into the Route Reply).

- **Cognitive Radio Network(CRN)**

A cognitive radio is an intelligent radio that can be programmed and configured dynamically. Its transceiver is designed to use the best wireless channels in its vicinity. Such a radio automatically detects available channels in wireless spectrum, then accordingly changes its transmission or reception parameters to allow more concurrent wireless communications in a given spectrum band at one location. This process is a form of dynamic spectrum management. This functions as an autonomous unit in the communications environment, exchanging information about the environment with the networks it accesses and other cognitive radios (CRs). Some "smart radio" proposals combine wireless mesh network—dynamically changing the path messages take between two given nodes using cooperative diversity; cognitive radio—dynamically changing the frequency band used by messages between two consecutive nodes on the path; and software-defined radio—dynamically changing the protocol used by message between two consecutive nodes, hence make a CRN.

V. CONCLUSION

In Vehicular ad-hoc network, Safety message has to transmit for the security reasons on the vehicle and road transportation. In this work we used DSR routing protocol for message transmission. In various scenario message transmissions is done according to vehicle density available on the road. Based on the real time road density, vehicle establish reliable route of high density for packet delivery. The main issue in existing work of communication through high road density is due to high load on road, message communication get overhead due to less amount of network bandwidth to overcome this issue Cognitive Radio bandwidth is utilized for data transmission by channel sensing and messages are transmitted successfully through cognitive radio channels. We got various types of parameters & on the basis of these parameters we conclude that our system gives us better results.

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