ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 5, May 2015

Adaptive Beacon Broadcast and Adaptive Congestion Control for Safety Critical Message Transmission in VANET

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ABSTRACT: Vehicular ad hoc network (VANET) is developing technology in vehicular environment. It is sub group of mobile ad hoc network (MANET). VANET is a technology that uses moving vehicles as nodes in network to create mobile network**.** In this paper, we present the concept of adaptive beacon broadcast and adaptive congestion control for safety critical message in vehicular ad hoc network (VANET). When large number of vehicles transmits beacons at a higher frequency then bandwidth can be exhausted very easily, so number of packet collision occurs. To avoid this situation adaptive beacon broadcast and adaptive congestion control concept is present in this paper. Adaptive Beacon Broadcast has dynamically partition the beacon interval to enhance the efficiency and fairness of using multiple data rates for beacons. Performance of the proposed system is evaluated by delay and throughput.

KEYWORDS: VANET, DSRC (Dedicate short range communication), adaptive congestion control, Adaptive beacon broadcast, periodic beacon broadcast, event-driven message.

I. INTRODUCTION

Vehicular Ad hoc Network (VANET) is a wireless network, consisting group of vehicles. Vehicles equipped with a wave communication device can establish the wireless communication among them. The moving vehicles form a dedicated self organized wireless network with high node mobility. VANET is a subclass of MANET. Now a day, roads are wet and very difficult to maintain the distance between two communicating vehicles with particular speed and it leads to inefficient communication. The Wireless Access for Vehicular Environment (WAVE) provides vehicle to vehicle and vehicle to road communication and the broadcast connectivity provides safety at the time of driving. The VANET is established to improve the safety applications of vehicles and manage the traffic problems. The architecture of VANET classified into pure cellular/WLAN, pure ad hoc and hybrid. The vehicle-to-vehicle and vehicle-to-roadside wireless communications, VANETs are a cost-effective platform to enhance traffic safety, traffic efficiency and driving experience.

The Primary goal of VANET is to provide road safety measures where information about vehicles current speed, location coordinates are passed with or without the deployment of Infrastructure. VANET also provides value added services like email, audio, video sharing etc. There are three communication types in VANET are shows in fig1 i.e. vehicle to vehicle (V2V), vehicle to road side (V2R), infrastructure to vehicle communication. The first communication type vehicle to vehicle communication in which vehicle communicates with each other by sending the message. The second communication type is vehicle to road side (V2R) in which vehicle communicates with road side unit. Third type is vehicle to infrastructure (V2I) or infrastructure to vehicle (I2V) in which message share between vehicle and road side unit. Also vehicle is providing information about navigation and internet is as shown in fig 1.

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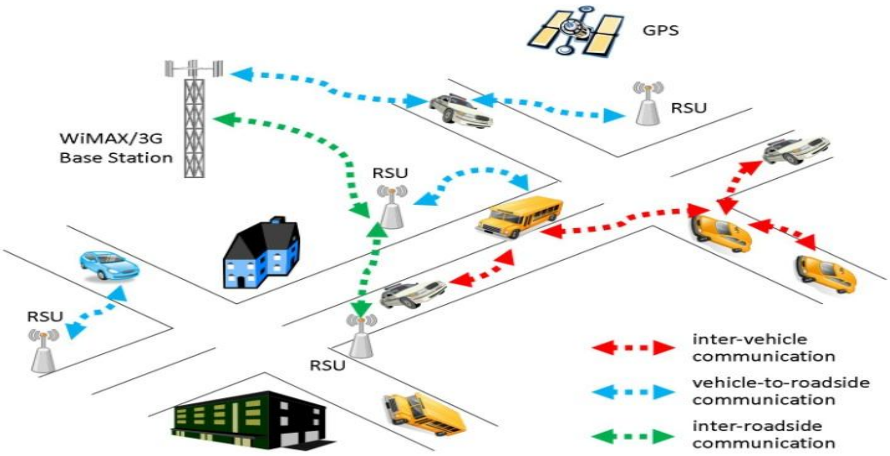

Fig 1: Vehicular ad hoc network

II. RELATED WORK

In [2] authors have proposed that, the vehicular communication network is ad-hoc network. In this work design several random access protocols for medium access control and protocols fit in the DSRC multi-channel architecture. The protocol performance is evaluated under various offered traffic and vehicular traffic flows. All message ranges may not be feasible at all vehicular traffic densities, and this indicates the need for power adaptation. This adaptation should be with respect to the flows of the vehicles. When there are many non-safety applications in the control channel such as service announcements, the CBT due to the safety traffic may be too high. In these settings, it may be best to use roadside radios to coordinate vehicle transmissions for more efficient use of the control channel. Vehicles would then follow the ad-hoc protocol till they detect a controlling roadside radio.

In [3] authors have proposed DRCV monitors and estimates channel load and controls the packet rate of outgoing periodic packets. A new approach called Fast Drop is adopted to rapidly drop the rate of periodic packets when event-driven safety packets are detected. Simulations show the effectiveness of DRCV in increasing packet reception probabilities and achieving efficient channel usage. DRCV is characterized by low complexity and overhead. An approach called Fast Drop is adopted to promptly drop the rate of periodic messages when Event Driven safety messages are detected.

In [4], author has proposed that, The Wireless Access in Vehicular Environments (WAVE) system is developed for enhancing the driving safety and comfort of automotive users. However, owing to the nature of contention based channel access scheme, the WAVE system suffers from Quality of Service (QoS) degradation for safety applications caused by the channel congestion in scenarios with high vehicle. The Wireless Access in Vehicular Environments (WAVE) system is developed to support such applications on the 5.9GHz ITS frequency band. The event-driven detection method monitors the safety applications and decides to start the congestion control whenever a high priority safety message is detected.

In [5] author has proposed that, Safety applications are a driving force behind VANET deployment. Automobile manufacturers, government organizations, and consortia of the two have been investigating using VANETs for safety applications. Though VANETs are in large part designed for safety applications, researchers do not yet know the communication requirements of VANET safety messages. As a result, protocol designers have relied on generic network success metrics, such as packet delivery ratio, to evaluate their protocols. However, a more useful metric is the ability of currently proposed VANET schemes (e.g., for authentication, power control, etc.) to allow vehicles to receive safety messages and warn their drivers sufficiently in advance of an accident so that the driver can avoid the accident. Additionally, even in collisions that were detected by our ICW application but were not avoided, the resulting damage

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was significantly mitigated as the involved vehicles speeds were significantly reduced by their drivers reacting to our simulated warnings before the actual collision occurred.

III. PERIODIC BEACON MESSAGE AND EVENT-DRIVEN MESSAGE:

In vehicular ad hoc network, vehicle to vehicle crash intersection is common problem. To avoid crash intersection problem, there are two safety messages provided, first periodic beacon message and another is event-driven message.

Vehicles and road side units equipped with short range Wireless communication devices based on IEEE 802.11p communicate with each other in self organized networks called VANETs. In principle, V2R communications combined with vehicular on board and road-side sensors may support road safety by two means: broadcasting periodic safety messages and event-driven safety messages. These safety messages typically need to be delivered within a geographical area with certain reliability and delay limit. Beacon message is nothing but periodic messages, also called Hello message, it gives the idea about vehicles status information such as positions, speeds, and location ID as shown in Fig 2.

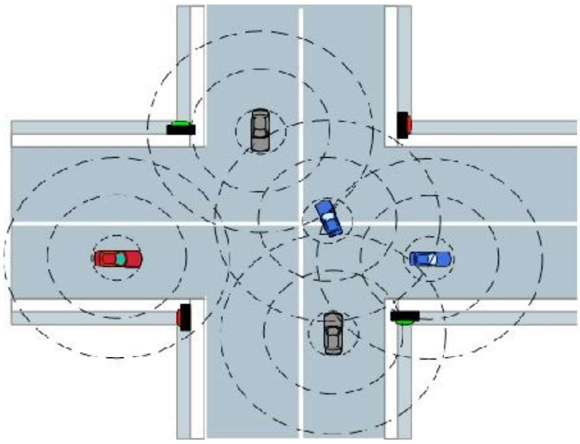

Fig 2: Periodic beacons sent at certain frequency

Beacons can be generated at the application layer or at the network layer, and are used by neighbouring Vehicles to become aware of their surrounding and to avoid potential dangers. Event-driven safety messages are generated when an abnormal condition or an imminent danger is detected, as shown in fig 3.

Beacon messages send periodically by vehicles to inform their condition such as position, direction and Speed to their neighbour vehicles. The beacon messages are used by the neighbouring vehicles (nodes) to be aware of their environment as well as preventing potential dangers. The event-driven safety messages are generated when an abnormal condition or an imminent danger is detected and are disseminated within a certain range with higher priority. The event-driven safety messages should be delivered to neighbouring node by high reliability and limited time. A single delayed or lost message could result in loss of life.

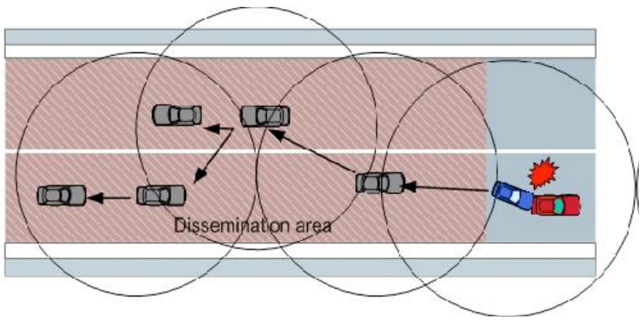

Fig 3: Event-driven message in VANET

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Dedicated short rang communication (DSRC) is specially design for vehicular ad hoc network for the application of vehicle to vehicle communication (V2V) , Vehicle to road Side (V2R), vehicle to infrastructure (V2I). MAC protocol IEEE 802..11p/WAVE is specially developed for vehicular ad hoc network. WAVE is a layered architecture for devices complying IEEE 802.11p to operate on Dedicated Short Range Communication (DSRC) band.

IV. CONCEPTS OF CONGESTION DETECTION AND ADAPTIVE CONGESTION CONTROL:

In congestion mitigate channel congestion by reducing beacon transmission duration, which is achieved by using higher 802.11p data rates. When large number of vehicles transmits beacons at a higher frequency then bandwidth can be exhausted very easily. As a result significant number of packet collision occurs. And in a scenario of emergency message, if the channel is already congested then highly life-critical even-driven message which will be deprived of channel access will either get lost or delivered to its intended recipients with a much higher delay. Thus loss of beacons and emergency message will severely affect the safety of a vehicle. The vehicle density is very high then channel will get congested easily. So, congestion in the communication channel should be detected. After congestion detection, if there is any emergency message then we will provide dynamic time slot reservation to the vehicle which generates emergency message. This can be done by pulse based reservation system in the communication channel. If the vehicles in segment do not find any time slot then they can use unoccupied time slots from adjacent segments. This is done by intersegment slot transfer. The time slots can be slotted by time division multiple access scheme. Each segment will have number of transmission periods and vehicles can transmit their beacon in that transmission period. The proposed approach can adaptively control congestion in the communication channel.

V. CONCEPT OF ADAPTIVE BEACON BROADCAST:

In each segments every vehicle broadcast a beacon message to its neighbors. Beacons are the normal periodic status messages about vehicle speed, velocity, id location. Adaptive Beacon Broadcast dynamically partitions the beacon interval to enhance the efficiency and fairness of using multiple data rates for beacons. The adaptive beacon broadcast follows the mechanism of sending the beacon only when a vehicle is moving from one segment to another segment. No beacon is sent if the vehicle resides in same segment. The adaptive beacon broadcast reduces the congestion in the network and emergency messages are easily transmitted without any delay.

VI. PROPOSED WORK

A. *Design Considerations:*

In proposed design, first we design a vehicular communication network. These vehicles having the transmission range of 100 m. These vehicles are authenticated so that they can communicate securely with other vehicle in their range. The aim of this proposed work is avoid collision in vehicular ad hoc network , for that provide two safety critical messages periodic beacon message and event-driven safety message to avoid collision between two vehicle at intersection cross road. Beacon message is status message giving the idea about location ID. Speed, velocity of vehicles and event-driven messages are generated when emergency will be occurred. According to DSRC, every vehicle will generated beacon message after 300ms, if vehicle density will very high at that time bandwidth will congested easily So, congestion in the communication channel should be detected. After congestion detection, if there is any emergency message then we will provide dynamic time slot reservation to the vehicle which generates emergency message.

B. *Description of the Flow chart:*

In each segments every vehicle broadcast a beacon message to its neighbours. Adaptive Beacon Broadcast dynamically partitions the beacon interval to enhance the efficiency and fairness of using multiple data rates for beacons. The adaptive beacon broadcast follows the mechanism of sending the beacon only when a vehicle is moving from one segment to another segment. No beacon is sent if the vehicle resides in same segment. The adaptive beacon broadcast reduces the congestion in the network and emergency messages are easily transmitted without any delay.

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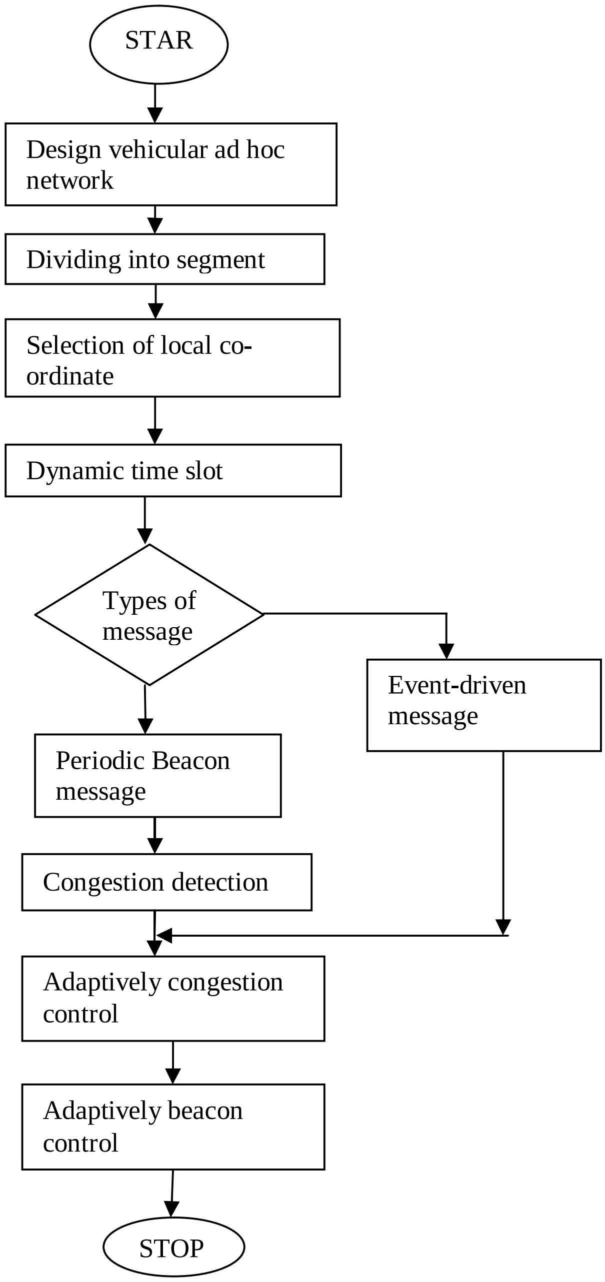

VII. SIMULATION RESULTS

In this section the performance of our proposed adaptive congestion detection of vehicle to vehicle through Simulation experiments using Network Simulator 2 (NS2). All the considered simulation parameters are summarized in Table. The following are the configuration parameters assumed for simulation:

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Table no. 1: Simulation Setup

Simulator	Network Simulator 2
Number of nodes	37
Topology	452m x 452m
Fixed setup	RSU, VANET Authority
Interface type	Phy/WirelessPhy
Mac type	802.11p
Queue type	Drop tail/Priority Queue
Queue length	50 Packets
Antenna type	Omni Antenna
Propagation type	Two Ray Ground
Routing protocol	AODV
Transport agent	UDP
Application agent	CBR
Simulation time	100 seconds

In below figures shows that comparative graphical representation of throughput and delay and of congestion, adaptive congestion detection and adaptive beacon broadcast respectively.

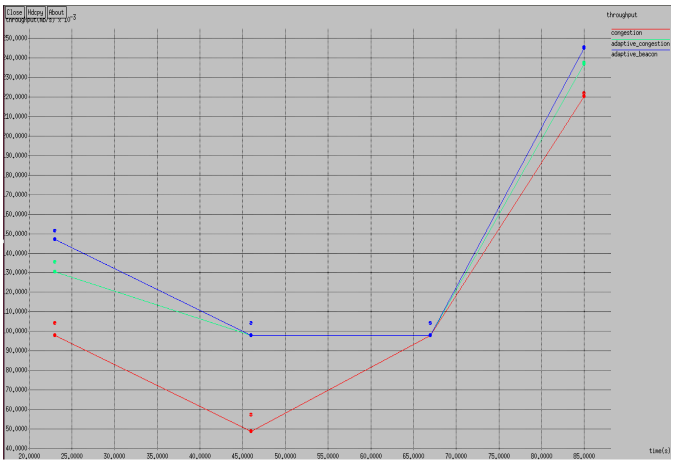

Fig 5: Throughput

In fig 5 shows that when time increases throughput in adaptive beacon broadcast is higher than adaptive congestion control and congestion control.

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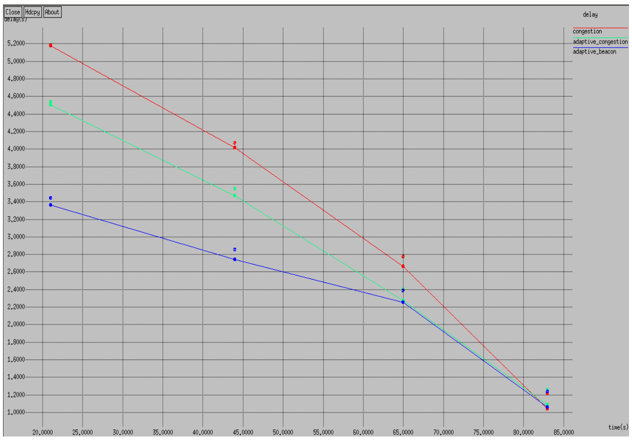

Fig 6: Delay

In fig 6 shows that, when time increases delay is decreased. Delay in adaptive beacon broadcast is lower than adaptive congestion control and congestion control. In adaptive beacon broadcast the packets are received without more delay. The beacon message and emergency message are sent at the different time in adaptive congestion control. In congestion control the packets are received with more delay because beacon message and emergency message are sent at the same time.

VIII. CONCLUSION

Vehicular ad hoc networks (VANETs), which are a class of Mobile ad hoc networks, have recently been developed as a standard means of communication among moving vehicles. To congestion avoidance provided two messages, periodic beacon broadcasting message and event-drive message. There is a problem of congestion and emergency message are lost or delivered to its intended recipients with a much higher delay. The adaptive congestion control can reserve time slots by dynamically partitioning the beacon interval without the expense of beacons. The fast and reliable propagation of emergency messages over multiple hops by incorporating a pulse based slot reservation mechanism. To enhance the efficiency and fairness of using multiple data rates for beacons. The adaptive beacon broadcast has to reduce the congestion in the network and emergency messages are easily transmitted. .

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BIOGRAPHY

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