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Partitioned Multihop Broadcast Protocol for Time Critical Emergency Message Dissemination in VANET

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Abstract **-**Here we propose a Partitioned multi-hop broadcast protocol for dissemination of time critical emergency message in Vehicular ad hoc networks (VANETs). Here we use a partitioned multihop protocol which consists ofthree primary mechanisms. First, a mini distributed interframe space (DIFS) in a medium access control (MAC) sub layer is introduced to assign the time critical warningmessages a higher access priority to the communication channel compared with other messages. Second is multiple sectoring, dividing the total region into distinct sectors (multiple sectors depending upon the density of vehicle in particular region). Third, communicate this warning message toneighborhood sectors and Road Side Unit (RSU).It enables quicker and more reliable warning message dissemination by shortening the channel access time and minimizing the contention period jitter. VANET is not limited up to Vehicle-to-Vehicle (V2V)communication; it also considers advantages of road side units. Using directional antennas as road side units it influences the system performance.

Keywords*: Road side units (RSU), On Board Unit (OBU), Dedicated Short Range Communication (DSRC)*

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I. INTRODUCTION

In today's world the density of vehicles rapidly increased in several countries, the growth rate of new road is much lower than number of new vehicles. Due to this concern there is high probability of increase in number of accidents and traffic congestion.Occurrence of accident is more severe as compare to traffic congestion.Now days, due to great advancements in wireless communication inter vehicle communication become more realistic solution.

Vehicular Ad-hoc Networks (VANET) is acritical element of the Intelligent Transportation Systems (ITS) [2].The vehicular ad hoc network is a wireless ad hoc network which implements the concept of continuous varying vehicular motion. Here, the moving vehicle is defined as nodes. Vehicular networks are composed of mobile nodesand stationary nodes, Mobile Nodes consist of vehicles equipped with On Board Units (OBU) and Stationary Node consists of Road Side Units (RSU) attached to infrastructure that will be deployed on the roads. Both OBU and RSU devices have either wireless or wired communications capabilities. OBUs communicate with other OBU and with the RSUs in ad hoc manner. Vehicular Ad-hoc Networks can implement a variety of wireless technologies such as Dedicated Short Range Communications (DSRC), Cellular, Satellite and Wi-MAX[1]. The prime objective of VANET is to help a number of vehicles in a particular group to set up and maintain a communication network among them without using any central base station or any controller. The most important feature of VANETs is the high mobility of the Vehicles.

Communication can be Vehicle to Vehicle (V2V) or Vehicle to Road Side Unit (V2R) or Road Side Unit to Vehicle (R2V). In V2V communication a vehicle can communicate directly with other vehicle and in V2R communication a vehicle can communicate to an infrastructure such as a Road Side Unit and in R2V communication, Road Side Unit can communicate to Vehicles. If the network has very weak among vehicles then it becomes more difficult to send a packet from source to destination. There is a need for quicker, wide range and practical solution for emergency message broadcasting. Here we propose apartitioned multi-hop broadcast protocol for dissemination of time critical emergency message in VANETs. Theprimary mechanism of VANET is to broadcast messagein its communication range of vehicles and recognize emergency situation and to give priority to emergency messages. The miniDIFS assigns higher priority to the critical emergency messages[2].The Secondary mechanism ispartitioningused in a forwarding process to divide the communication range in smaller sectors for the convenience of message transmission[3]. To increase the average dissemination speed, forwarding is performed by sender vehicle to the farthest possible vehicle in the farthest sector. Last step is to send these messages through RSU in a wide range to cover at least one sector in a particular region. Vehicleacts as a sender, receiver, and router to broadcast messages to the vehicular network. Vehiclesthose are participating in the VANET turns into wireless communication. If any vehicle goes out of the particular signal range thenthe connection will drop out and a new connection will be established. The vehicles in this model are equipped with On Board Communication devices (OBU) for V2V communication and a data base unit to

stored control information such as the higher priority of emergency messages and sensors such as Global Positioning System (GPS)[2]. A broadcast service send emergency message to inform the driver about critical situation. The data rate is least important as each vehicle wants to receive only warning alert messages. As a cooperative approach of vehicular communication systems will be more effective in avoiding accident and traffic congestions than individual approach to solve these problems. Vehicles and Roadside are the two types of nodes in vehicular networks; both are from Dedicated Short Range Communications (DSRC). DSRC works in 5.9 GHz band with bandwidth of 75 MHz and approximate range of 900m.The primary objective of VANET is to provide road safety measures where information about emergency situation, vehicle's current speed and location coordinatesare passed to vehicles and to road side unit.

II. RELATED WORKS

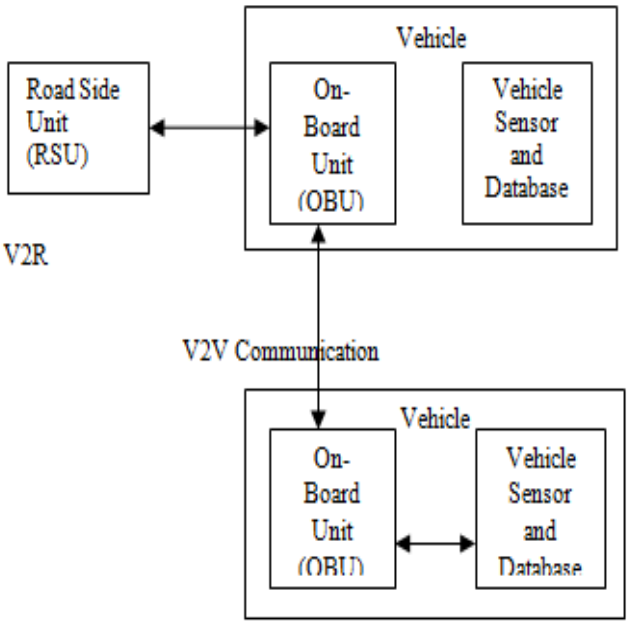
A. Trinary Partitioned Black-Burst Based Broadcast Protocol: Existing work comprises of trinary divided dark burst-based show convention (3P3B); it comprises of two essential components. Initial, a smaller than expected dispersed between edge space (DIFS) in a medium access control (MAC) sub layer is acquainted with give the time-basic EMs a higher access need to the correspondence channel contrasted and different messages. Second, a trinary dividing is intended to iteratively parcel the correspondence range into little areas. The trinary dividing system permits the most remote conceivable vehicle in the most remote part from the sender hub to perform sending to build the spread velocity by lessening the quantity of sending hops[2].

B. Parallel Partition-Assisted Broadcast Protocol: Binary segment helped show convention (BPAB) plans to lessen and balance out the telecast delay. BPAB accomplishes a decent message progress speed by selecting the most remote forwarder [3]. This convention conveys a blend of a twofold dividing and a novel conflict instrument. The twofold parceling plot continually isolates the correspondence territory into numerous segments. The twofold parcel of this plan comes from a comparative idea contrasted and that of OB-VAN, yet it presents less time openings than OB-VAN amid the choice of the following bounce forwarder. Just vehicles in the most distant allotment battle with each other amid the sending stage in this plan. In this manner, the impact rate is decreased, and the conflict term is balanced out. It is likewise demonstrated that BPAB shows a decent execution regarding the normal dispersal speed contrasted and alternate conventions, for example, UMB and SB[3].

C. Partitioned Multihop Broadcast Protocol

D. A Communication Standards for VANET: Dedicated Short Range Communication (DSRC). It is created by United States of America and is utilized as a part of short to medium extent correspondences benefit that is utilized for V2V and V2R correspondence. The Federal Communications Commission (FCC) had dispensed 75 MHz of range i.e. from 8.5 GHz to 9.25 GHz to be utilized by Dedicated Short Range Communication (DSRC)[1]. DSRC range has seven channels with every channel 10 MHz wide. Out of seven channels, six channels are utilized for administration reason and staying one for control reason. DSRC is intended to spare lives and enhance movement stream, furthermore to give esteem through private applications, for example, V2V and V2R correspondence. This give better remote channel propogation as for multipath delay spread and Doppler impact brought about by high portability and roadway environment Wireless Access in Vehicular Environment (WAVE) (IEEE 1609.11p). In 2003, American Society for Testing and Materials (ASTM) sets ASTM-DSRC which was completely in light of 802.11 MAC layer and IEEE 802.11a physical layer. The fundamental issue with IEEE 802.11a with Data Rate of 54 Mbps is it experiences different overheads. Vehicular situations requests rapid information exchange and quick correspondence in light of its high topological and portability change . For this the DSRC is renamed to IEEE 802.11p Wireless Access in vehicular Environments (WAVE) by the ASTM 2313 working gathering. This takes a shot at MAC layer and physical layers. WAVE comprises of Road Side Unit (RSU) and On-Board Unit (OBU).[1]

E. **System model**



The System Model shown in Fig: 1, the Vehicular Architecture supports two types of devices: - Roadside unit (RSU) and On-Board Unit (OBU).An RSU is a wireless access device in vehicular environments that operates only when stationary and supports information trade with OBUs. Generally, it is mounted along the road convey network. An OBU is a mobile or portable wireless device that supports information exchange with RSU and other OBU and can operate when in motion. The OBU is mounted in a smart vehicle. Vehicle move on a road and directly communicate among themselves and RSU via

IEEE 802.11P network communication interface. A vehicle is in this model is equipped with an OBU for V2V and RSU communication and sensor such as a Global Positioning System (GPS) data base unit to store control information such as the sequence no. of emergency messages. GPS is assumed to assist time synchronization among the vehicles.Vehicular Communications: Vehicle to Vehicle (V2V communication: It consists of data exchange and communication between different OBUs.Vehicle to Roadside (V2R) communications: Vehicle can communicate to Infrastructure such as RSu known as V2R. The RSU can have higher range of communication of about 1000m. Using this property of the RSU the communication becomes faster which reduces the redundant retransmissions. The combination of the V2V and V2R uses the advantages of both modes of communication which leads to enhanced performance with respect to the reduction in number of transmissions and faster communication.

F. Broadcast Procedure

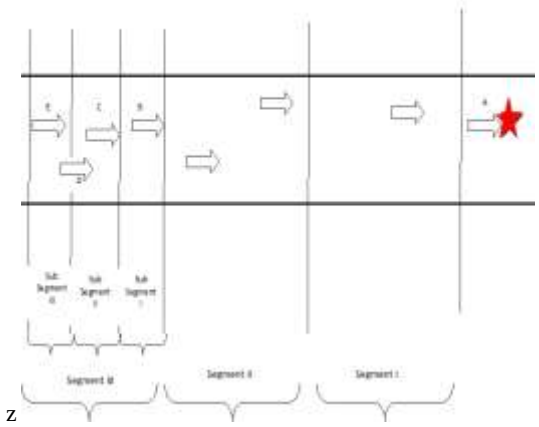


Fig: 2 Example for total Broadcast Procedure

As shown in fig: 2 consider the vehicle A. We assume that vehicle a got accident. We will detect the event and assign the priority. Here, the situation is accident, so it is very urgent message. This is the highest message priority.The vehicle a broadcast a RTB packet to candidate relay node. We will select the relay node within the cluster. The candidate relay node is selected using the Binary partition phase. The selected relay node sends a CTB packet to the source node. The vehicle A sends the RTB packet to the vehicles like B, C, D and E. Those vehicles are relay nodes and we have to select the best candidate relay node among the inside the coverage area. We will select the best candidate relay node among inside the coverage area of the source using the partition. The vehicle A will calculate the coverage area and divide the coverage area into sub segments. In the above diagram, first sub segment contain vehicles B . The second sub segment contains vehicles C and D. The source will check for candidate node in each sub segment for one time line. When the time line over, it will goes for another segment. It will select the E is best candidate relay node because it is more nearer and it is in the same way of the source [8].

G. Data Dissemination

The emergency message has been received by the transceiver working in V2R (R2V) and V2V communication mode

If the receiving node is the broadcast node (checking the broadcast node ID in the emergency message), it stops rebroadcasting the emergency message to the RSU in order to reduce overhead in networks.

If the receiving node is not the broadcast node and is in front of the broadcast node, it will ignore the emergency message.

If the receiving node is behind the broadcast node, but has already received emergency messages with the same event ID from other nodes or RSU it will ignore the emergency message.

If the receiving node is behind the broadcast node and emergency messages with the same event ID have not yet been received it will carry out appropriate maneuvers to avoid collision. Meanwhile, the receiving node waits for a random duration for emergency messages with the same event ID from node behind or RSU. If the emergency message is received for first time, it will carry out appropriate maneuvers to avoid collision. At the same time it checks whether an emergency message with the same event ID has also been received from its roadside unit. If not, it will periodically transmit this emergency message to the roadside unit until it receives an emergency message with the same event ID from the roadside unit.

If it receives such a message, it will stop rebroadcasting it for same event. Similarly, this behavior helps to minimize overhead.

Otherwise, it will periodically broadcast this emergency message until it receives an emergency message with the same event ID from node behind and RSU.

III. VALIDATION OF ANALYTICAL MODEL

OMNET++ is a discrete event simulator used for modeling communication networks, multiprocessors and other distributed or parallel system. It is communicate with each other using message passing. These modules are written in C++.OMNET++ in itself is not a simulator it provide mechanism to write simulator. So simulation is done by different simulation model and framework like MIXIM, INET/INETMANET or VEINS.Two different open-source simulator have been used first is Simulation of urban mobility (SUMO) for road traffic simulation. It can handle very large network. Second is OMNET++ for network simulation. Vehicular environment in network (Veins) module is available in MIXIM frame network. MIXIM provides communication module and protocol. It made up of two distinct simulators, OMNET++ and SUMO. Both these simulator are run in parallel connected via a TCP socket. The movement of vehicles in the road traffic simulator i.e. SUMO is reflected in movement in an OMNT++ simulation.

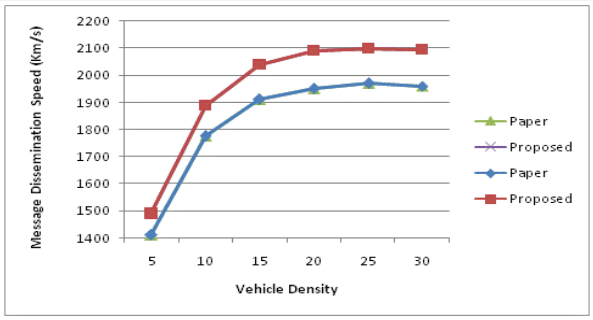


Fig: 3 Performance of Average Dissemination Speed

Fig: 3 shows that lower degradation of dissemination speed compared with 3P3B hence the emergency message arrival rate increases because of its mini DIFS mechanism and reduce delay of black burst signal.

IV. CONCLUSION

In this paper, we have proposed a Partitioned multihop broadcast protocol for dissemination of time-critical emergency message in VANET . If the network has very weak among vehicles then it becomes more difficult to send a packet from source to destination. There is a need for quicker, wide range and practical solution for emergency message broadcasting. Hence road side unit is deployed on the road the priorities are assigned to the packets using the message priority assignment. The main objective of the three partition phase is finding the candidate relay node inside the coverage area of the source. The main advantage of this method is that there is no chance of accident if the driver is not responding as well. This method provides high reliability during emergency message dissemination. Simulation results will show that the proposed technique reduces the delay and overhead involved in message dissemination while increasing the throughput. This approach does not provide solution for beacon message.

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