Collision Control of Safety Messages in Wave

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ABSTRACT
WAVE is a Wireless Access in Vehicular Environment. At National highway, when we transfer a safety messages from one vehicle to another it reduces the messaging frequency, when there is a heavy contention in the channel, there may be a chances of message collision and because of this collision of messages, Basic Safety Messages (BSM) can not be transfer in WAVE environment and due to this, Message loss is occurred, So here we proposed a Network Coded Repetition scheme to recover that message loss in WAVE system. This method combines the packets from closed-by neighbour's and repeats that packet instead of that original packet, therefore creating the possibility of an increased number of packets recovery. It is used to improve packet delivery in congested vehicular networks.

Keywords
Basic safety message (BSM), DSRC, IEEE 802.11p, VANET, WAVE

1. INTRODUCTION
VANET is a Vehicular Ad hoc Network. It is a self organized, multi purposed service oriented network. Basically it provides the infrastructure for developing new systems to improve the drivers and passenger's safety and comfort. VANETs are distributed self-organizing networks formed between moving vehicles equipped with wireless communication devices. Such networks are developed as a part of the Intelligent Transportation Systems (ITS) for significantly improving the performance of transportation systems. The main idea behind this ITS is to improve safety on the roads, and reduce traffic congestion, waiting times, and fuel consumptions. Vehicular networks consist of On Board Units (OBU), and Road Side Unit (RSU) in which vehicles equipped with OBU, and stationary nodes called RSU.Both OBU and RSU devices have wireless/wired communications capabilities. OBUs communicate with each other and with the RSUs in ad hoc manner [1]. There are mainly two types of communications scenarios in vehicular networks: Vehicle-to-Vehicle (V2V) and Vehicle-to-RSU (V2R) which enables vehicle-to-vehicle and vehicle-to-roadside infrastructure communication for the purpose of exchanging messages to ensure an efficient and comfortable traffic system on roads. The RSUs can also communicate with each other and with other networks like the internet as shown in Figure 1.

Vehicular Network contains different advanced wireless technologies such as Dedicated Short Range Communications (DSRC), which is an enhanced version of the Wi-Fi technology suitable for VANET environments. This technology is basically developed to support the data transfer in continuously changing communication environments, such as VANET, where time critical responses and high data rates are required.

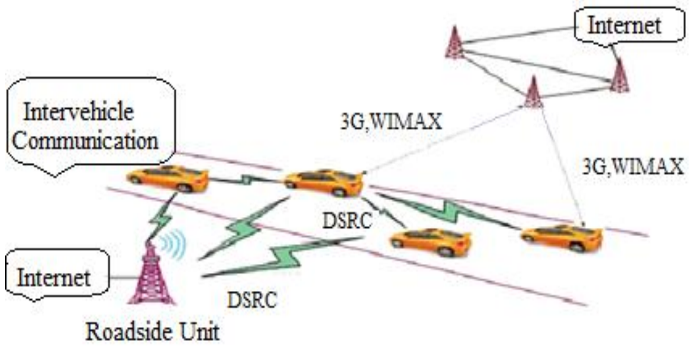

Fig 1: Vehicular Adhoc Network (VANET)

The IEEE 1609 WG was made up the standard of VANET is Wireless Access Vehicular Environment(WAVE).In constructing IEEE Wireless Access in Vehicular Environment (WAVE) system must periodically broadcast message transmission from each vehicle reporting their position, speed, and direction which plays an important role while delivering the safety messages in VANET.Then this Basic Safety Message (BSM) not only immediately enables driving safety applications such as cooperative collision warning but it provides the basis for topology construction and multihop message routing for other applications as well[5].

Many accidents occur today, when distant objects or roadway impediments are not quickly detected. To avoid these accidents, longer-range safety systems are needed with real time detection capability. Statistics have shown that over 60% of all these mishaps take place in suburban areas, while probable causes include speeding vehicles, fewer traffic signals, no or less number of speed breakers, and lack of traffic surveillance or monitoring. In all the field tests, a single unidirectional radio link is evaluated, either between two vehicles or between a roadside unit and vehicle. To avoid this road traffic collisions, in WAVE system. Vehicles will be required to periodically broadcast their position and speed to nearby vehicles. For cooperative vehicular safety applications in a WAVE environment, there must be a strict messaging frequency and delay requirement. This Provides broadband, real time, long range, and bi-directional communications.

2. LITERATURE REVIEW
There are different technologies that are used for transmitting data in VANET.

2.1. DSRC (Dedicated Short Range Communication)
Dedicated Short Range Communication is a technology (DSRC) developed based on the Wi-Fi standards. The DSRC technology proposed by Zang.et.al [3] will be used in the ITS domain to provide secure and reliable communication links

among vehicles and between vehicles and infrastructure. It has channel bands intended for safety and non-safety applications, and has spectrum allocated in the 5.9GHz band. The draft version of the DSRC lower medium access control (MAC) and (PHY) was published as part of the IEEE 802.11p amendment standard for WAVE. Dedicated short-range communications is also known as IEEE 802.11p was originally proposed by the ITS for its use in the smart vehicle initiative.

Basically, this DSRC is designed to ensure the service reliability for safety applications taking into account the time constraints for this type of applications. It can also used for supporting other non-safety applications that require a Quality of Service (QoS) guarantee. DSRC is developed for the environments where short time response (less than 50 msec.) and/or high data rates are required in high dynamic networks. The DSRC standard supports vehicles with an on-board device (OBD) to communicate with a roadside unit (RSU), or other traveling vehicles [13].

The Federal Communications Commission (FCC) has allocated the 5.9 GHz Dedicated Short Range Communications technique to support public safety and commercial applications in V2V and V2R communication environments. The 5.9 GHz (5.850-5.925) band is divided into seven non-overlapping 10 MHz channels. One channel is called the control channel, and the other six are called service channels [4].The control channel is basically used for broadcasting safety data like warning messages to alert drivers of potential dangerous conditions. The service channels are used to exchange safety and non-safety data like announcements about the sales in nearby malls, video/audio download, digital maps, etc. Vehicles, using service channels, can relay the received data to other vehicles in other regions or/and to the roadside units.

2.2 MAC Protocol

A new MAC protocol known as the IEEE 802.11p is used by the WAVE stack. The IEEE 802.11p basic MAC protocol is the same as IEEE 802.11 Distributed Coordination Function (DCF), which uses the Carrier Sense Multiple Access/Collision avoidance (CSMA/CA) method for accessing the shared medium. The authors Zang.et.al [10] proposed a congestion detection and control architecture for VANET.

802.11 was approved by IEEE as an international standard for wireless local area networks (WLAN), including the detail of medium access control (MAC) and physical layer (PHY). This IEEE 802.11 defines nine services that need to be provided by the wireless LAN to provide functionality equivalent to that which is inherent to wired LANs [11]. In the wired world, a station can detect collision signals and run a back-off algorithm to address the collision problem. In WLAN, collision is like noise, and stations cannot distinguish collisions from other noise. As a result, the 802.11 standard adopts the method of Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) and provides two access methods, Distributed Coordination Function (DCF) and Point Coordination Function (PCF) as it is a shared medium (RF channel) environment where all stations compete to access the medium, but at a time only one station can transmit data. If two or more stations try to send the data at the same time, collision would occur and data is lost. The IEEE 802.11p standard is designed to enable the deployment of VANETs in high-speed environments [7]. In the context of vehicular ad hoc networks, IEEE 802.11p is complemented with other standards to cover additional layers in the protocol suite.

2.3 Simple Repetition Method

In order to improve the reliability of transmissions, repetition schemes are employed by the safety and emergency message broadcast MAC protocol of DSRC. These schemes simply repeat the messages based on some scheduling and scrambling mechanisms, such as synchronous fixed repetition (SFR), or synchronous p-persistent repetition (SPR) [12], to improve reception probability (i.e., probability of successful reception) of the vehicle safety messages. However, there is no positive or negative feedback in the MAC protocol and the transmitting node assumes that at least one of the repeated messages is successfully received. Broadcasting frequency, which depends on vehicle density and number of repetitions, and vehicle mobility can significantly affect the reliability of the reception and reduce the probability of successful message transmission due to message collisions [2]. Collisions in such random MAC schemes are not completely avoidable, especially when a large number of vehicles in the transmission region are present and number of repetitions is large It is shown that increasing number of repetitions does not always contribute to increasing probability of success.

3. PROBLEM FORMULATION

One significant problem in delivering the BSM in Wireless Access in Vehicular Environment is collisions among BSMs from neighboring vehicles. And due to this collision of safety messages rate control and data packets loss is occurred. In VANET when there is a heavy contention in the channel then Basic Safety messages (BSM's) can not be delivered to neighbouring vehicles and because of this messaging frequency get reduced. And when there is a collision of messages in Vehicular Ad hoc Network, there may be chances of data packets loss and due to this data packet loss some Basic safety messages get loss and can not reach to the specified destination.

4. NETWORK CODED REPETITION

We meet the challenges and problems in WAVE environment at the time of transmission of basic safety messages, existing approach is used to reduce the collision among BSMs and improve the delivery probability. It works on the BSM messaging application and does not require MAC layer standard modifications or MAC layer contention parameter changes. The BSM application creates its own notion of timing slots and dynamically changes the BSM transmission timing slot based on the observed use of the slots by other vehicles.

But there may be chances of data packets loss, so here we proposed A Network Coded Repetition method which combines packets from closed-by neighbours and repeat that packet instead of original packets, therefore creating the possibility of an increased number of packet recovery, it recovers lost packet during the collision of message in a heavy contention of channel.

Basically in this paper being proposed a Network Coded Repetition with Shortcut Tree Routing Algorithm. The main idea of the shortcut tree routing is to calculate remaining hops from an arbitrary source to the destination using the hierarchical addressing scheme and each source or intermediate node forwards a packet to the neighbor node with the smallest remaining hops in its neighbor table.

The most widely discussed loss recovery scheme for vehicular safety communication is the repetition-based retransmission scheme. The basic idea behind the repetition-based loss recovery is that if the sender rapidly repeats (retransmits) a packet several times within a short duration, the nodes that failed to receive the original transmission will now have multiple chances to recover the lost packet in time. All this can be achieved without relying on any ACKs from the receivers.But the main drawback of repetition-based scheme is the repetition itself. While each repetition provides an additional opportunity for recovery, it also contributes to channel congestion, which in turn increases the probability of packet loss due to collision [9].

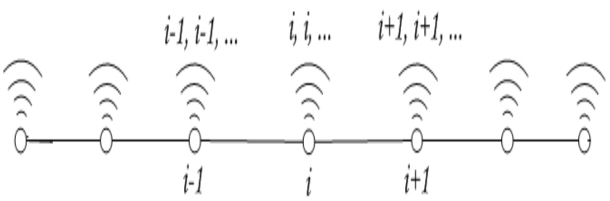

Fig 2(a):Simple Repetition (SR)

So here, we propose a simple network coded repetition (NCR) scheme, which combines (XORs) packets from close-by neighbours and repeats the XOR-ed packets instead of original packets, thereby creating the possibility of an increased number of packet recovered per repetition [6]. In our proposed network coded repetition (NCR), we extend the SR scheme as follows

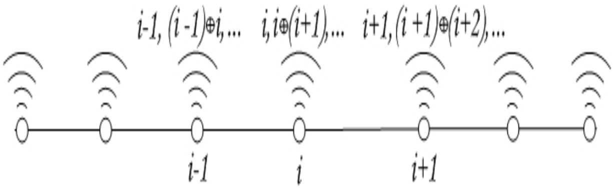

Fig 2(b): Network Coded Repetition (NCR)

In this Network Coded Repetition method, instead of repeating its own native packet, each node XORs its native packet with the native packet received from its closest neighbour in a predefined direction, and repeats the XORed packet. By selecting the closest neighbour, we can assume that the probability of not receiving a native packet from the neighbour is negligible. The main reason of selecting the closest neighbor from a predefined direction is to guarantee that each native packet is encoded in two coded retransmission [8]

5. CONCLUSION

VANET is the answer to modern problems of city traffic management. There are several techniques being proposed for a suitable communication in VANET.Critical message transmission still remains a big challenge in VANET. This paper has considered how to reduce the collision losses of these messages in the IEEE WAVE communication. We have proposed a simple NCR protocol and studied its performance analytically. The analytical model will validated by simulation. In this work we have proposed a unique technique and Shortcut Tree Routing algorithm for quick and successful packet transmission of critical messages with minimum loss and maximum reach ability.

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