International Journal of Research in Advent Technology, Vol.3, No.11, November 2015
E-ISSN: 2321-9637
Available online at www.ijrat.org

Reliable Broadcast of Safety Messages in WAVE

[1]P. B. Kalpande , [2]Prof.J.S.Karnewar
ME(CSE), Assistant Professor
Jagadmbha College Of Engg & Technology, Yavatmal
priyakalpande99@gmail.com jay.skumar9@gmail.com

Abstract- WAVE is a Wireless Access in Vehicular Environment. In vehicle-to-vehicle safety messaging, periodic safety messages can be used for safety applications. These applications require low latency and high probability of reception, however there can be a problem with unsuccessful reception due to collision of these safety messages when there are sufficiently large amount of vehicles and/or repetitions. Because of this collision, Basic Safety Messages (BSM) can not be transfer from one vehicle to another and message loss is occurred. So here we proposed a Network Coded algorithm and used along with Network Coded Repetition scheme to minimize the collision of safety messages in WAVE system. It will used to improve packet delivery in congested vehicular ad-hoc network.

Keywords: Basic safety message (BSM), WAVE, VANET, vehicle-to-vehicle communication

1. INTRODUCTION

A Vehicular Ad-Hoc Network or VANET is a technology that uses moving vehicles as nodes in a network to create a mobile network. Vehicular Ad Hoc Network (VANET) is an innovative wireless network that is rapidly developing by the advances of wireless and automotive technologies. VANETs are automatically formed between moving vehicles equipped with either same or different wireless interfaces. VANETs are a good example of a real-life application of the ad-hoc network that connects the vehicles with other close vehicles or other infrastructures on the road.

VANET has two entities roadside infrastructure and vehicles. In VANETs, vehicles act as the mobile nodes. The roadside infrastructure is fixed, hence act as distribution points for the vehicles [1].In the VANETs there are two type of communication mechanism one is vehicle to vehicle (V2V) communication in which vehicle communicate with other vehicles in the network. For example, road side accidents, traffic jams, speed control free passage of emergency vehicles and unseen obstacles etc. Second is vehicle to RSU (V2R) communication in which vehicle will communicate with access points i.e. Road Side Units to get required information. For example, information of petrol pumps, information of nearby hospital, hotel, weather forecasting information, internet access and multimedia applications, postcrash warning, road condition warning, notification of approaching emergency vehicles, and vehicle diagnosis [11]**.** The RSUs can also communicate with each other and with other networks like the internet as shown in Figure1.

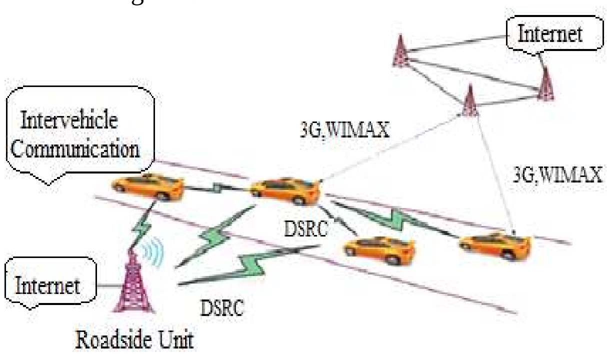

Figure1.1: Vehicular Ad-hoc Network (VANET)

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. 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 this paper, we propose a novel approach to reducing collisions among BSMs and improve the delivery probability. To avoid road traffic collisions, vehicles will be required to periodically broadcast their position and speed to nearby vehicles, and it is possible with the help of transforming Basic Safety Messages (BSM) from one vehicle to another, it not only immediately enables the driving safety applications such as cooperative collision warning, but provide the basis for topology construction and multihop message routing for other applications as well. So this Basic Safety Messages are very important in VANET for transferring safety messages, but one significant problem is there while delivering the BSMs in the WAVE environment is collisions among BSMs from neighboring vehicles, and because of that collision there may be a chances of data packet loss, so it's a need to have one method for minimizing these data packet loss, that basically minimize the collision of Basic Safety Messages.

We meet the challenges and problems in WAVE environment at the time of transmission of basic safety messages, existing approach is used to reduced 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 a chances of data packets loss, so here we proposed a Network Coded algorithm and used this algorithm along with Network Coded Repetition method which creates the possibility of an increased number of packet recovery. It will basically used to improve packet delivery in congested vehicular networks.

2. LITERATURE REVIEW

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 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 [4].

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 as shown in Figure 2. One channel is called the control channel, and the other six are called service channels [8].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.

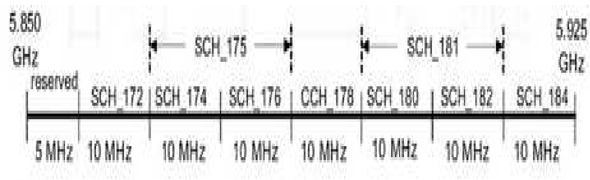

Figure 2: DSRC channel

The channels at the edges are reserved for future use. The control channel is used to broadcast safety data like warning messages to alert drivers of potential dangerous conditions. It can also be used to send advertisements about the available services, which can be transferred over the service channels. 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. The DSRC supports different data transfer rates: 6, 9, 12, 18, 24, and 27 Mbps with 10 MHz channels. The data rate can be increased to 54 Mbps with 20 MHz channels. Switching between the different data transfer rates can be achieved by changing the modulation schemes and channel code rate.

2.2 IEEE 1609—standards for wireless access in vehicular environments (WAVE) (IEEE 802.11p)

Existing 802.11a provides the Wireless connectivity between moving vehicles with data rates of up to 54 Mbps [6]. Now a day, vehicular traffic scenarios have greater challenges than fixed wireless networks, caused by varying driving speeds, traffic patterns, and driving environments. So the traditional IEEE 802.11 Media Access Control (MAC) operations suffer from significant overheads when used in vehicular scenarios. At that time, fast data exchanges are required, to ensure timely vehicular safety communications, in these circumstances the scanning of channels for safety messages from an Access Point along with multiple handshakes required to establish communication are associated with too much complexity and high overheads. Such as, in the case of a vehicle encountering another vehicle coming in the opposite direction, the duration for possible communication between them is extremely short [5] making it difficult to establish communications. To address these challenging requirements of IEEE MAC operations, the DSRC effort of the ASTM (American Society for Testing and Materials) 2313 working group migrated to the IEEE 802.11 standard group which renamed the DSRC to IEEE 802.11p Wireless Access in Vehicular Environments (WAVE) [7].

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) [9], 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. 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 STATEMENT

One significant problem in delivering the BSM in Vehicular Ad hoc Network 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 congestion in the channel, then messaging frequency get reduced, and Basic Safety messages (BSM’s) can not be delivered to neighboring vehicles. Because of this, unsuccessful reception of BSM’s, 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. Existing Simple repetition methods have different problems 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.

4. PROPOSED SCHEME

4.1 Network Coded algorithm

Here we are using Network Coded algorithm along with AMODV protocol for improving the BSM delivery probability. In this algorithm, first of all we initialize the node location then finding the optimized path from source to destination with shortest routing delay and energy. For every active node find the Euclidean distance between the nodes and minimum cost for transmission. Then we check how to transmit data with minimum re-transmission and find the distance from source node to the destination, as the minimum path has been found, then sends the packet from source node to destination node and stop routing. After this we check the number of packets being received at each node, and find the number of packets received per unit time at the nodes then compare this value packet per unit time with the threshold of the node’s capacity, and if the value is more than the nodes capacity, then re-route the packet, so that it can come later to the node for reception. In this way this process ensures there is no congestion in the network. Steps for the algorithm is as follows

- Find an optimized path from source to destination with shortest routing delay and energy.
- This will ensure lower latency and higher throughput.
- Check the number of packets being received at each node, and find the number of packets received per unit time at the nodes.
- Compare this value (packets per unit time) with the threshold of the node's capacity, and if the value is more than the node's capacity, then re-route the packet, so that it can come later to the node for reception.
- This process will ensure there is no congestion in the network.

4.2 Network Coded Repetition Method

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].

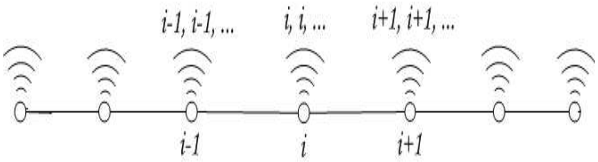

Figure 4.1: Simple Repetition (SR)

So here, we used 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. An analytical study is conducted to evaluate the performance of this NCR method, which is validated by simulation experiments. We find that, for packet error rate (PER) smaller than a given threshold, NCR is an improvement over the simple repetition (SR), the basic repetition proposed in [10]. In this network coded repetition (NCR), the SR scheme is extended as follows

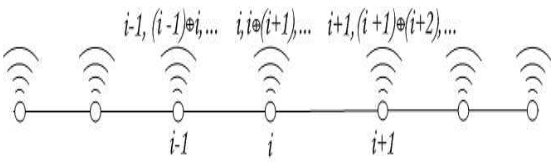

Figure 4.2: Network Coded Repetition (NCR)

With NCR, 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 reason of selecting the closest neighbor from a predefined direction is to guarantee that each native packet is encoded in two coded retransmissions. For example, in Fig.3.3, the predefined direction is rightwards so that each native packet (i)1 will be encoded in its own coded retransmission ($i \oplus (i + 1)$) and the coded retransmission of its left side neighbor ($(i - 1) \oplus i$).

In Network Coded Repetition method a native packet is not only retransmitted by its original sender but also by the sender's closest neighbour. The retransmission packets are sent in the coded (XOR-ed) form so that the number of retransmissions is the same as the SR scheme. In vehicular communication, each node is a sender that periodically transmits broadcast packets and also a receiver that receives the packets from all the nodes within its communication range. Some of the data packets are lost due to various reasons, e.g., packet collision.
To recover the lost packets, after transmitting a packet, each node transmits extra k packets i.e. retransmission packets. As shown in Fig. 3.2, for the simple repetition (SR) scheme proposed in [10], the retransmission packets are exactly the same as the native packets. The coded retransmission packets are repeated for k times. For a given node i, there are $2k$ retransmission packets containing the content of its native packet: node $i-1$ transmitting k retransmission packets ($(i-1) \oplus i$) and node i transmitting k retransmission packets ($i \oplus (i + 1)$).

5. SIMULATION RESULTS

In this section, we present the simulation results. One might think that the RES will add to the BSM delivery delay because there can be time difference between the BSM generation and the BSM transmission on the application layer. But in our experimental result, delay gets reduced as shown in figure 5.1.

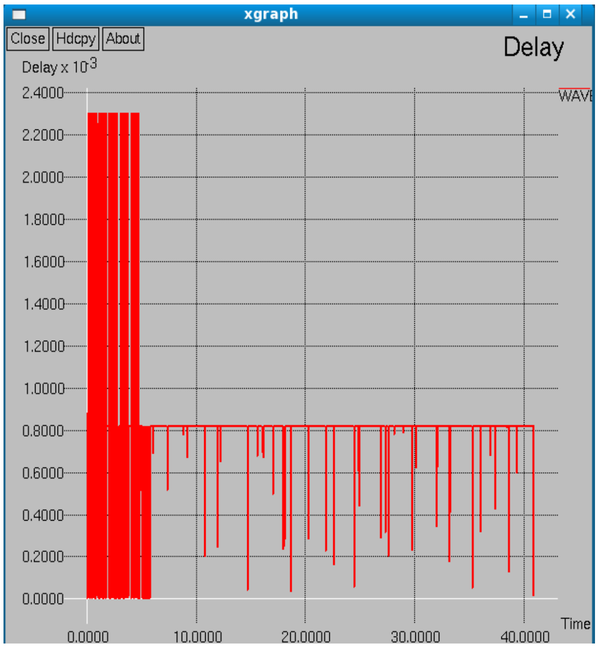

Figure 5.1: Graph for simulation time v/s delay

Figure 5.2 and 5.3 shows the PDRs on the application layer used with WAVE almost perfect PDR Therefore, the number of dropped BSMs in the T1 duration ends up being exaggerated compared to the simulation.

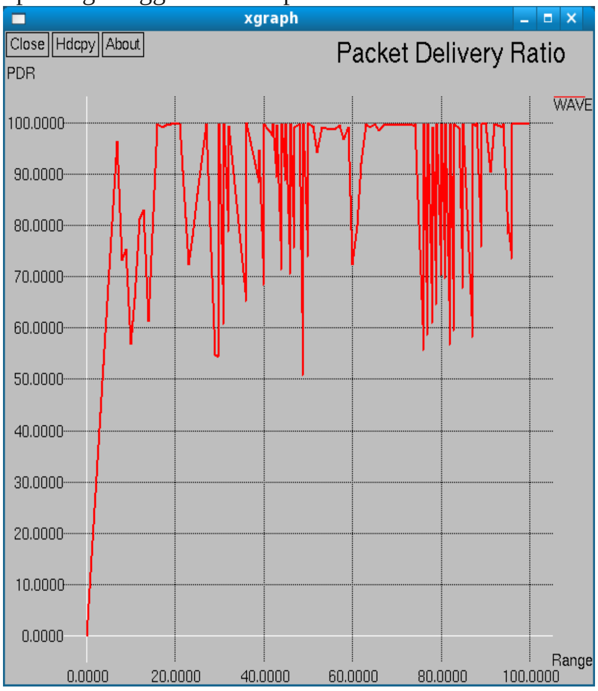

Figure 5.2: Graph for Communication range v/s PDR

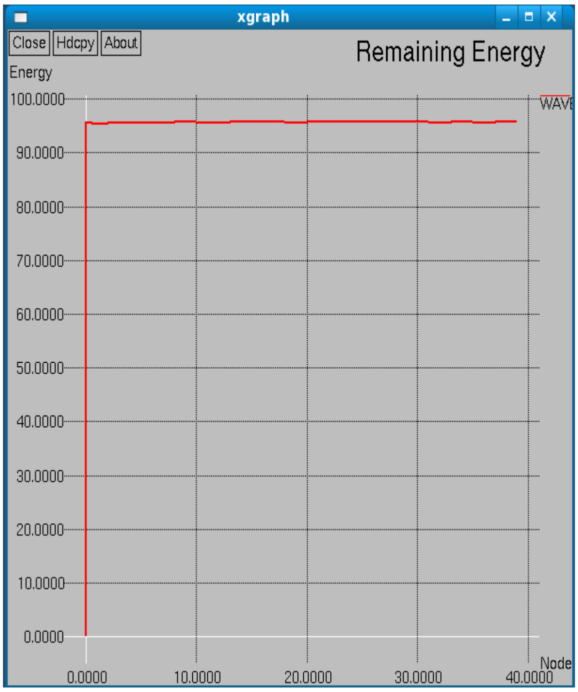

Figure 5.4: Graph for number of node v/s energy

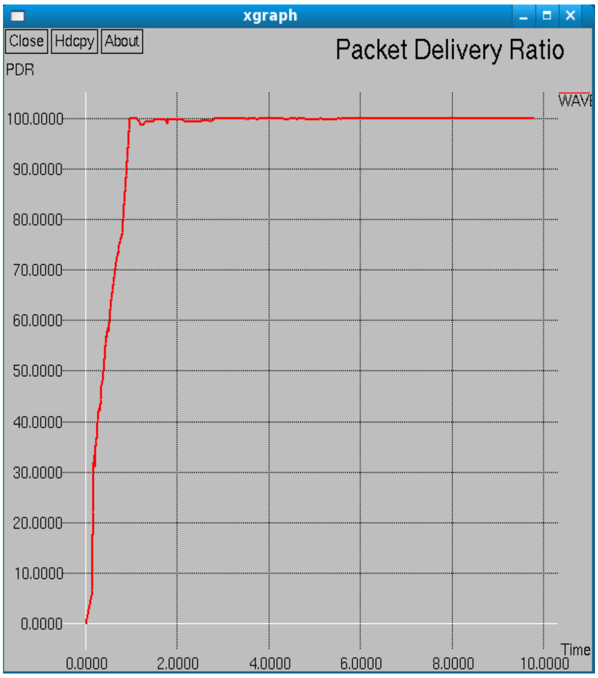

Figure 5.3: Graph for time v/s PDR

Figure 5.4 shows energy remained after complete simulation of nodes in the network, it shows lifetime of nodes increased in our experimental results.

6. CONCLUSION

VANET is the answer to modern problems of city traffic management. This paper has considered how to reduce the collision losses of these messages in the IEEE WAVE communication. It is being successfully experimented in real time in several places in the world. There are several techniques being proposed for a suitable communication in VANET. Critical message transmission still remains a big challenge in VANET. In this work we have proposed a unique technique for minimizing the collision of basic safety messages and quick and successful packet transmission of critical messages with minimum loss and maximum reach ability. As the proposed scheme works on the application layer, it can be easily implemented and deployed to improve the driving safety through more reliable delivery of BSMs in the IEEE WAVE vehicular communication environments.

REFERENCES

[1] Altayeb, M., and Mahgoub, I., "A Survey of Vehicular Ad-hoc Networks Routing Protocols", International Journal of Innovation and Applied Studies, Vol.3, pp.829-846, 2013.

[2] Harsch, C., Festag, A., & Papadimitratos, P. (2007)." Secure position-based routing for VANETs." In Proceedings of IEEE 66th vehicular

technology conference (VTC-2007), Fall 2007 (pp. 26–30), September 2007.
[3]K.KEERTHI, K.SEKHAR,“Safety Communication in Integrated VANETs for Emergency Situations - 3G wireless Networks”, International Journal of Advanced Research in Computer Engineering & Technology, Vol. 1, Issue 3, May2012.
[4] T. K. Mak, et al., "Multichannel medium access control for dedicated short-range communications," Vehicular Technology, IEEE Transactions on, vol. 58, pp. 349-366, 2009.
[5] Jiang, D., & Delgrossi, L. (2008). IEEE 802.11p: towards an international standard for wireless access in vehicular environments.In Proceedings of 67th IEEE vehicular technology conference on vehicular technology (pp. 2036–2040), May 2008.
[6] IEEE Standard 802.11 (2007). IEEE Std. 802.11-2007, Part 11: wireless LAN medium access control (MAC) and physical layer (PHY) specifications.
[7] IEEE P802.11p/D3.0, draft amendment for wireless access in vehicular environments (WAVE), July 2007.
[8] IEEE Standard for Wireless Access in Vehicular Environments (WAVE)—Multi-channel Operation, IEEE Std. 1609.4-2010, 2010.
[9] Saurabh Kumar Gaur, S.K.Tyagi, Pushpender Singh,”“VANET” System for Vehicular Security Applications”, International Journal of Soft Computing and Engineering (IJSCE), Volume-2, Issue-6, pp 279-282, January 2013
[10] Q. Xu, T. Mak, J. Ko, and R. Sengupta, “Vehicle-to-vehicle safety messaging in DSRC,” in Proceedings of the 1st ACM international workshop on Vehicular ad hoc networks, VANET04,
pp. 19–28,2004.
[11] J Sahoo, EH-K Wu, PK Sahu, M Gerla,“Binary-partition-assisted MAC-layer broadcast for emergency message dissemination in VANETs”. IEEE Trans. Intell. Transportation Syst.Vol. 12, No.3, pp. 757–770 (2011)