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. 4, Issue 5, May 2016

Inter-Vehicular Communication Study for Safety Applications

Nusrat Mulla, Dr. D. M. Bhalerao

Department of Electronics & Telecommunication, Sinhgad College of Engineering, Pune, India

Department of Electronics & Telecommunication, Sinhgad College of Engineering, Pune, India

ABSTRACT: Many recent advances in wireless communication technology lead to its application in Inter Vehicular Communication (IVC). IVC is a rapidly growing research area due to the increasing capabilities and services provided by communicating vehicles on road. Most of these services are classified as safety services and non safety services i.e. comfort services Using communication technology for safety services is the present significant research topic that includes,traffic monitoring, traffic flow control, achieving auto-drive, and minimizing car accidents by autonomous control. Non safety or comfort services include internet connectivity, emails, online transactions, online gaming, etc.Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) communication forms the basis of communication amongst the vehicle nodes and between On Board Unit (OBU) of vehicle and Road Side Unit (RSU) in Intelligent Transport System (ITS). ITS utilizes Global Positioning System (GPS) and Dedicated Short Range Communication (DSRC). Although ITS applications range from safety, crash avoidance to internet access and multimedia. This paper includes studies that basically focus on safety of vehicles travelling on road/highways and a survey on application of IVC for highway safety.

KEYWORDS: IVC, V2V, V2I, ITS, DSRC, Safety Applications

I. INTRODUCTION

Nowadays safety of vehicles has increased due to the application of Intelligent Transport System (ITS) in automobiles. Despite of some of the safety services the number of accidents, crashes, and injuries have not been reduced to a considerable amount. To reduce such unfavorable causalities, the Federal communications commission (FCC) has allocated 5.9GHz band of 75 MHz spectrum for Dedicated Short Range Communication (DSRC) for ITS and its applications.VANET is a promising application of Mobile ad hoc network (MANET). For operation of MANET no centralized control is required, it is a self-formation network. In Ad hoc network every node act as a data terminal and router. VANET are self-organizing, distributed high speed communication networkwith some degree of freedom in node movement pattern.There are many applications in Vehicular ad hoc network (VANET) that use advanced wireless communication technology to manage traffic, improve highway efficiency and safety. Application of these technologies helps in reducing the overall percentage of mishaps occurring on highways. The accidents on highways basically occur due to unknown diversions, obstacles, emergency arising situation, poor road condition, etc. If the driver is unaware of these situations, it is not possible to react in time and mishap occurs. Thus it is the need to send periodic alert messages to the ongoing vehicles. So that every driver is made aware of the situation ahead within time and thus can respond accordingly. Even though accident occurs all other vehicles in the vicinity are informed about the mishaps, so that they can take decision accordingly. In short all the vehicles are self-aware and can communicate with other vehicles about their condition. Vehicular communication is one such domain in which communication is broadly classified into communication between vehicles (V2V) and communication between vehicle OBU and RSU infrastructure (V2I) within a VANET helps to improve the performance of vehicle on road. Vehicles communicate with each other i.e. V2V communication takes place when they are in range of 250m approximately.While V2I communication takes place between a vehicle (i.e. closest to the RSU) and the RSU infrastructure. There is single hop communication or multihop broadcast communication for routing of information among vehicles. VANETs have wide range of useful application such as navigation safety, emergency healthcare, infotainment services, etc. VANETs support all the significant application that readily serves safety travelling on highways because of its ability to handle dynamic condition of road traffic.

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. 4, Issue 5, May 2016

II. LITERATURE SURVEY

Vehicular Ad hoc Network (VANET) is conceived by the car business as one of the key future innovation to upgrade the wellbeing and solace of travelling vehicles. VANETs could bolster an expansive number of utilizations including wellbeing, activity administration, and infotainment. The solid working of these applications relies on upon effective transmission of different sorts of messages with required technology. Specifically, safety applications are empowered by the transmission of two primary sorts of messages. Intermittent single-hop safety messages are utilized to bolster helpful awareness applications empowering vehicles to keep up safe driving environment while warning messages engender event driven warnings to all the vehicles within a specific geological range. Authors [1] have proposed a a vehicle-to-vehicle communication protocol for cooperative collision warning. This protocol helps in to achieve low-latency in delivering emergency warnings in various road situations.Emerging wireless technologies for vehicle-to-vehicle (V2V) and vehicle-to- roadside (V2R) communications such as DSRC are promising to dramatically reduce the number of fatal roadway accidents by providing early warnings. Another study in paper [2] focuses on accident avoidance in non line of sight (NLOS) by the inter-vehicular communication (IVC). To communicate with other vehicles in NLOS, VHF radio frequency is assumed since the VHF signal can reach behind obstacles.In this paperit reveals the effect of the proposed transmission control scheme by computer simulations. Cooperative collisionavoidance (CCA) scheme for ITS is proposed by authors [6] where a clusterbased organization of the target vehicles is presented. The cluster is based upon several criteria, which define the movement of the vehicles, namely, the directional bearing and relative velocity of eachvehicle, as well as the inter vehicular distance. According to the order of each vehicle in its corresponding cluster, an emergency levelis associated with the vehicle that signifies the risk of encountering a potential emergency scenario. In the paper [3] it has been presented the model of wireless base station good put evaluation. The wireless access point model as a queuing system with variable requests and the auto traffic model. The performance of the wireless networks can be impacted from a variety of parameters, such as radio communication range, available bandwidth and bit rate, the number of clients in wireless network range and vehicle speed. The basic parameters were analyzed and presented. Authors [4] have proposed a work on optimizing the control channel interval of the DSRC for vehicular safety applications. This gives non-safety applications the opportunity to function without jeopardizing the critical safety applications.Different techniques mentioned above are used by the authors so as to improvise the ITS for increased safety and reliable communication in VANET. Routing Protocols for VANETs are of different types[12]: 1) Ad hoc/topology based 2) Position-based/geographic 3) Cluster-based 4) Broadcast 5)Infrastructure based 6) Geocast routing.

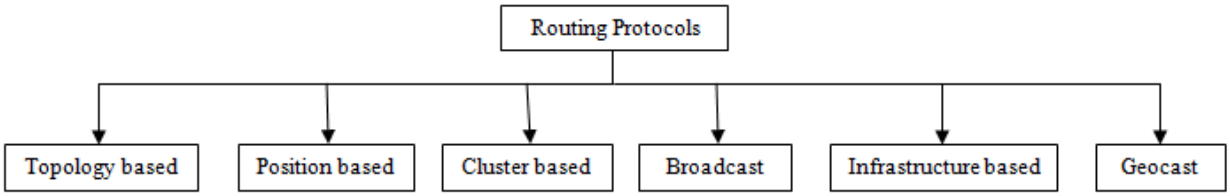

Figure 1. Classification of Routing Protocols

1) Topology/Ad hoc based routing: In this routing, selection of route is on the basis of link information from source to destination which is previously collected by the vehicle (Proactive) or which is sought as required (Reactive).Proactive and reactive routing are table driven and on-demand respectively. So here it is necessary to search and maintain route before packet sending. Examples of proactive routing protocols are Destination-Sequenced Distance Vector(DSDV), Fisheye State Routing(FSR), Optimized Link State Routing(OLSR), Examples of reactive protocols are Ad hoc On-demand Distance Vector Routing(AODV), Dynamic Source Routing(DSR).
2) Position-based routing: This class of routing protocols uses geographical information of vehicle for selecting the node and route through it. It assumesthat each vehicle has the provision to know its geographical position (as GNSS – GlobalNavigation Satellite System). The knowledge of the entire route is not necessary to deliver the data packets. Some examples of these protocols are Geographic Source Routing(GSR), Anchor based Street and Traffic Aware Routing (A –STAR), Greedy Traffic Aware Routing(GyTAR).

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. 4, Issue 5, May 2016

3) Cluster-based routing:In this routing,the vehicles in a cluster sharesimilar characteristics. These characteristics may be moving in the same directionwith more or less the same velocity. Elected cluster-head manages the cluster and is incharge of inter-clusters communications. Communications within the cluster are cluster-head free and performusing direct route. Cluster Based Location Routing (CLBR), Clustering for Open IVC Network (COIN) and cluster based routing (CBR) are examples of few cluster based routing algorithm.
4) Geocast-based routing- It is the routing from single source to many destinations belonging to an area called zone of relevance (ZOR). Zone of Forwarding (ZOF)is used to forward the message until reaches ZOR. Inter-Vehicle Geocast (IVG), Distributed Robust Geocast(DRG), Robust Vehicular Routing (ROVER) are some of the examples in this category.
5) Broadcast-based routing: It is sending of message from one to many, it is simple flooding on network so that messages reach all the vehicles with less overhead. This category is further classified into many types but the location based broadcast (LBB) protocol type meets the requirement of VANET for highway safety.
6) Infrastructure-based routing: This routing makes use of vehicles as nodes and installed Road-Side Units (RSU) as infrastructure for communicating the information to all vehicles in its range.

Protocols	Topology based Protocols	Position-based protocols	Cluster-based Protocols	Broadcast Protocols	Geocast Protocols
Forwarding method	Wireless multi-hop	Heuristic method	Wireless multi-hop	Wireless multi-hop	Wireless multi-hop
Digital Map Requirement	No	No	Yes	No	No
Infrastructure requirement	No	No	Yes	No	No
Realistic Traffic Flow	Yes	Yes	No	Yes	Yes
Scenario	Urban	Urban	Urban	Highway	Highway

Table1. Comparison of Routing Protocols

Among all these, position-based and geocast routing protocols are best [11] for VANETs. Broadcast and geocast routing protocols are common approaches for VANET routing in highway scenarios. The basic difference between two is position-based routing is for unicast routing i.e. routing from a single source to single destination and depends on position of destination, while geocast routing is multicast routing and is used for sending packets from source to different destinationswith specific geographic location. Many communication protocols and techniques for efficient transmission of warning messages in VANET exists but a comparative study between V2V / V2I technique with other existing techniques in VANET shows numerous advantages of V2V/V2I communication for safety application in ITS.

Features	V2V/V2I communication technology	Other existing collision warning technology
Aim	Improved message delivery ratio and obtain low latency	Achieves low latency in delivering messages
Routing	Multipath routing (V2V/V2I)	One way routing (V2V)
Routing type	Broadcast	Unicast,Multicast,Broadcast
Cause for loss in warning message	No loss because of multichannel technique	Loss of warning message due to packet collisions in MAC layer
Cause for network overhead	No network overhead	Periodic transmission of messages
Packet Collision	Low packet collisions because of separate transmissions on V2V/V2I	Occurs due to periodic retransmissions of messages
Reliability	More reliable as wireless channel has multi-route diversity,thus co-channel interference is reduced	Channel fading and multipath fading causes unreliability
Wireless services	Services are comparatively more reliable	Services depends on technology

Table 2. Comparative study of V2V/V2I communication technology with existing technology

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. 4, Issue 5, May 2016

III. VANET ARCHITECTURE

Vehicular ad hoc network can have numerous applications, ranging from comfort to entertainment application to onboard safety applications. The safety applications are the most important and challenging ones. It is therefore critical to test the viability and usefulness of IVCto avoid chain collisions with real world data. The basic VANET architecture (Figure 1) consists of DSRC technology, wireless sensors, vehicle node, On Board Unit(OBU), Road Side Unit (RSU) and internet.

- DSRC technology: DSRC is a technology that allows inter-vehicular communication. The vehicle to vehicle (V2V) communications is used to transmit information between vehicles in emergency conditions in which vehicles must stop as soon as possible. DSRC supports many safety applications in vehicular ad-hoc networks (VANETs) such as collision avoidance warning, lane-changing assistant,intersection collision warning, etc. In most of the cases, types of accidents are because of sudden decrease in vehicle speed of the front vehicle and insufficient time for the rear vehicles to decrease their speed. This generally happens due to limited view span of the driver and failure to react in proper time. The issue becomes critical when several vehicles are moving consecutively in one line on highway. Sudden decrease in the speed of one vehicle in such situations will lead to chain collisions. Figure2 shows DSRC protocol stack which consists of significant Physical layer and Medium Access Control (MAC) layer. The physical layer transmits raw bits on wireless channel after assignment of channel. There are 6 service channel and 1 control channel in 75 MHz spectrum in 5.9 GHz DSRC band. Critical and emergency safety communication uses control channel while non safety communication uses service channels. Thus multichannel communication mechanism is required to ensure reliable safety broadcast messages to maintain adequate and timely safety awareness along with the support of non safety communication in DSRC. The MAC layer is to arbitrate the access to shared wireless channel medium, to coordinate the data, to prevent nodes from simultaneous transmission thus preventing collisions. MAC layer achieves synchronization which is difficult in a network where the nodes have high degree of mobility. The rest of the layers of DSRC protocol stack are for message formats, location tracing and various internet applications requirements.

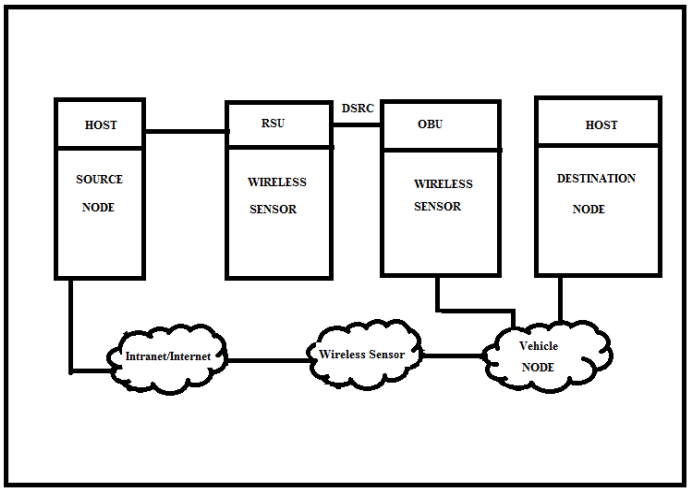

Figure 2. System Architecture

- Wireless Sensors: It acquires information regarding the road condition like obstacles, accidental vehicles, weather, etc. By alerting the approaching vehicles with this sensed information the driver can overcome the danger that may be caused due to some emergency arising situations.
- Vehicle node, OBU, RSU: Each vehicle is represented by a node in our simulation. The communication between vehicles (V2V) takes place with the help of on board unit (OBU) processor and V2I communication is between vehicle OBU and road-side unit (RSU).

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. 4, Issue 5, May 2016

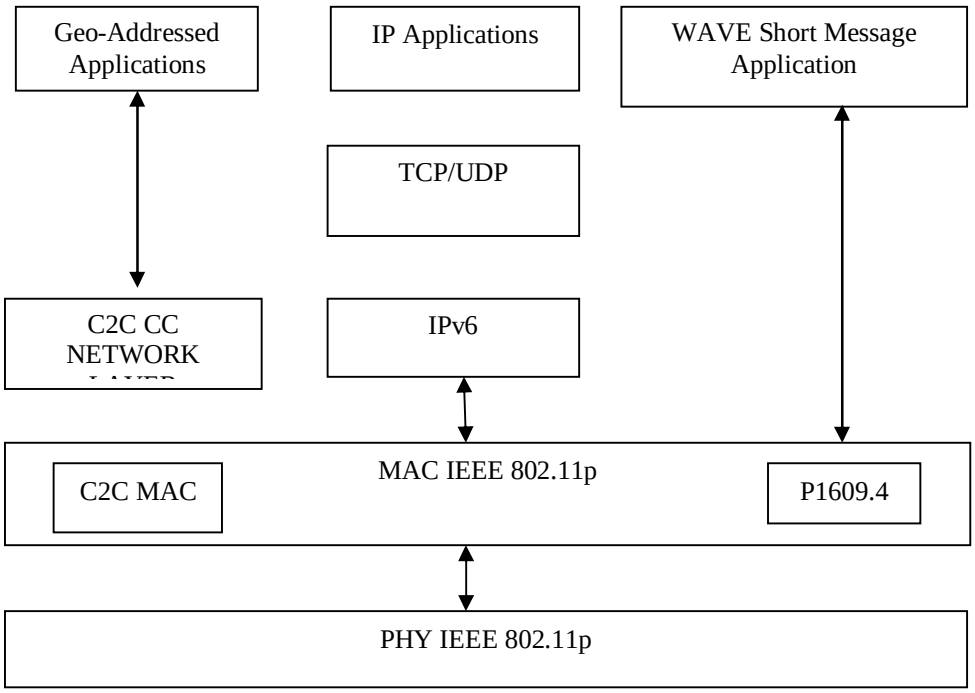

Figure 3. DSRC protocol stack

IV. FUTURE WORK

The travelling on road with highly dense OBU equipped vehicles can suffice the need of safety travelling. But presently not allthe vehicles on road are equipped with the OBU; this may be achieved few years later. But most of the simulation work is obtained by considering all equipped vehicles. The problem arises when vehicles on highways are sparsely dense and are beyond the communication range of other travelling vehicles and RSU. This condition of vehicle, will not be able to provide its location or any emergency condition information to the RSU or other vehicles. Moreover studies have helped to provide information of all vehicles through IVC and autonomous control is taken by the driver itself. This can be taken to a much better ITS in future which will help to automate the control of vehicle by considering the arising situation. More and more automation in automobiles will lead to the development of driverless car in future. The present Google self-driving car project and its testing is an example of how technology is taking its shape in ITS domain.

V. CONCLUSIONS

The purpose of this paper work is to study technology involved in collision avoidance and detection in VANETs that helps in smooth flow of traffic on highways. In this paper we explore the VANET architecture, DSRC protocol stack, routing protocols and its survey that will help in analysis of performance over different techniques. Applications in VANET range from safety/crash avoidance to internet access and multimedia. Although many challenges and issues are not yet solved, the vehicles could highly benefit from high speed wireless communication technologies in near future.

REFERENCES

[1] Xue Yang, Jie Liu,Feng Zhao,"A Vehicle-to-Vehicle Communication Protocol for Cooperative Collision Warning" Proceedings of the First Annual International Conference on Mobile and Ubiquitous Systems: Networking and Services
0-7695-2208-4/04 $20.00 © 2004 IEEE

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. 4, Issue 5, May 2016

[2] Hidenori Suzuki ,Hidekazu Murata, Kiyomichi Araki," Performance of Inter-vehicle Communication Technique for Intersection Collision Warning" 0-7803-9282-5/05/$20.00 ©2005 IEEE

[3] Janis Jansons, Ernests Petersons, Nikolajs Bogdanovs,"WiFi for Vehicular Communication Systems" 978-0-7695-4952-1/13 $26.00 © 2013 IEEE
DOI 10.1109/WAINA.2013.17

[4] Khalid Abdel Hafeez, Alagan Anpalagan, Lian Zhao," Optimizing the Control Channel Interval of the DSRC for Vehicular Safety Applications" 0018-9545 (c) 2015 IEEE

[5] Biswas, S.; Tatchikou, R.; Dion, F.; , "Vehicle-to-vehicle wireless communication protocols for enhancing highway traffic safety," Communications Magazine, IEEE , vol.44, no.1, pp. 74- 82, Jan. 2006

[6] Taleb, T.; Benslimane, A.; Ben Letaief, K.; , "Toward an Effective Risk- Conscious and Collaborative Vehicular Collision Avoidance System," Vehicular Technology, IEEE Transactions on , vol.59, no.3, pp.1474-1486, March 2010

[7] Garcia-Costa, C.; Egea-Lopez, E.; Tomas-Gabarron, J. B.; Garcia-Haro, J.; Haas, Z. J.; , "A Stochastic Model for Chain Collisions of Vehicles Equipped With Vehicular Communications," Intelligent Transportation Systems, IEEE Transactions on , vol.PP, no.99, pp.1-16

[8] http://www.cvt-project.ir/ (CVT-Project official website)

[9] Tang, A.,Yip, A., "Collision Avoidance Timing Analysis of DSRC Based Vehicles". Accident Analysis and Prevention, pp, 182-195, 2010.

[10] Lambert, A.; Gruyer, D.; Busson, A.; Mansoor Ali, H.; , "Usefulness of Collision Warning Inter-Vehicular System," Int. J. Vehicle Safety, Vol. 5, No. 1,2010.

[11] F. Li and Y. Wang, Routing in vehicular ad hoc network: a survey," IEEE Vehicular Technology Magazine, vol. 2, no. 2, pp. 1910-1922, 2008.

[12] J. Kakarla, S. S. Sathya, B. G. Laxmi, and al., *A Survey onRouting Protocols and its Issues in VANET* InternationalJournal, vol. 28, no. 4, pp. 38-44, 2011.