Fast Broadcast Technique for Real Time Applications with WAVE 1609.4 Protocol

Sujata Agrawal, Prema Daigavane, M.B Daigavane, Sandeep Agrawal

Abstract: As the technology improves, the attention on vehicular communication is increasing with a wide range of applications accessible to the passengers and also the increasing number of cars on the roads leads to delay in accessing the various applications. The safety and entertainment applications need fast transmissions of messages and due to the specific characteristics of vehicular mobility (such as short connection times of oncoming vehicles, high relative velocities and possibly unstable connections) the inter-vehicular communication is affected. Considering this, we propose a system with faster broadcast technique and with the use of IEEE WAVE 1609.4 protocol and DSRC with an aim to reduce number of hops, transmission time. The simulation has been carried out in NS 2.34.

Keywords: DSRC, WAVE 1609.4, Broadcast, Inter-vehicular communication

I. INTRODUCTION

As the use of cars is increasing on the roads, with that, the need for vehicle-to-vehicle and vehicle-to-infrastructure communication increases. Decline in road accidents rate and progress in development of entertainment applications is the demand of inter-vehicular communication. As extensive study has been done on safety, messages transmission we have studied the service message transmission by which the user can access various services. It is, indeed, not possible to provide all the roads with communication infrastructure to enable the cars to communicate among them, a lot of research is being carried out to improve the inter-vehicular communication by increasing the speed of message delivery to the particular car or to all the cars in a particular area. We have proposed one such method which will improve the inter-vehicular communication through a fast multi hop broadcast scheme which will reduce the number of hops, a particular message takes to reach the destination, and also have implemented IEEE WAVE 1609.4 protocol, an extension to the IEEE 802.11 standard adjusted to V2C, published as IEEE 802.11p. The MAC and physical layer specifications are part of a whole protocol stack designed to meet the requirements of vehicular communication, envisioned to establish the basis for an IVC system: the IEEE 1609 WAVE family of standards. Among these, IEEE 1609.4 defines the multi-channel and Quality of Service (QoS) operation of radios, vehicles with a single radio will periodically switch between multiple channels to access multiple applications [4].

The further paper is organised as follows. Section II is the proposed system. The System model is discussed in section III. In section IV the analysis and simulation is provided of the results obtained. Finally, in section V we conclude the work.

II. PROPOSED SYSTEM

In paper [1], the broadcast technique used transmission range to be static, i.e. the maximum range was fixed, and this scheme tries to assign different forwarding priorities through random back off delays that depends upon the node distance from the source irrelevant of the transmission capacity; if the transmission range set is high it will increase the average waiting by setting contention window high or, if the transmission range set less will decrease the contention window for all the vehicles and cause collisions.

Inspired by [2], to compute the transmission range dynamically and assign the random back off strategy according to the distance between the source and the vehicle, with minimum back off assigned to the farthest vehicle in reach of its computed transmission range; to minimize hops by individuating the farthest car from the source, which will have high priority to forward the message. As given in [3], the advertisement scheme can be implemented with the different applications that run on the various channels, just as the advertisement on the internet.

In paper [6], the experts have shown that, the delay caused by the real time applications is due to the number of hops to reach all the vehicles involved. In paper [2], the channel used is only one which increases the load on the channel and does not give the option for different application to be run on different channel, thus affects the QoS by increasing the waiting time for the applications; we propose to use IEEE WAVE 1609.4 protocol which supports the multichannel transmission of packets and also supports safety message and service message transmission on different channels. The Broadcasting technique along with WAVE 1609.4 will help to reduce the hops which will reduce the delay to transmit the packets and give an advantage of transmitting safety as well as service packets simultaneously on different channels. The WAVE 1609.4 will help to have different applications on different channels so the vehicle user can access applications. As we are concentrating on sending safety as well as application messages simultaneously and as specified in paper [1] the drawback that the switching on safety channel will increase the delay of the various applications by 50 ms we have kept the Control channel time to 20 ms, and as the real time application will need more major portion, so the service channel has been given more preference so that the real time applications run properly.
III. III System Model

Inter-vehicular communications generally happen through multiple hops. We are considering each car has an antenna for DSRC/802.11p, with a guarantee of maximum range of 1000m under optimal conditions, or a smaller range for very high speeds[2]. The WAVE 1609.4 has been implemented at Interface priority Queue with CCH as 20ms, Guard Interval as 4ms and SCH as 80ms. The changes made in NS 2.34 & system working flow is given figure 2.1 & Figure 2.2 respectively.

```
A. Flow of the scenario

Vehicle
  Prepare Message
  Type of MAC
    Service(0-5)
    Safety
      Check for Slot(CCH or SCH)
      Send Message

B. Algorithm : Setting channels for different applications and using the fast broadcast technique

channel_ = channel
app_type=application
if (app_type= service app && SCH slot )
  switch to channel from 0 to 5
  fast_broadcast()
else if(app_type=service && CCH slot)
  switch to channel -99
  fast_broadcast()
else if (app_type=safety)
  channel=-99
  fast_broadcast()
```

IV. Simulation Analysis and Assessment

To analyse the above scheme we have considered 400 vehicles in an 8 km road and noise nodes ranging from 0 to 20, from the real IEEE 802.11 protocol, we have set CWMin and CWMax equal to 32 and 1024, We measure in slots all the time variables in the system such as MAC layer contention windows, time intervals, and other random waiting times. These time slots can be very small the IEEE 802.11g’s slot amounts to 9μs.

Simulation Parameters:

| Parameter               | Value         |
|-------------------------|---------------|
| Highway length          | 8 km          |
| Number of Channels      | 7             |
| Control Channel         | 20 ms         |
| Service Channel         | 80 ms         |
| Guard Slot              | 4 ms          |
| Simulation Time         | 22 sec        |
| Number of vehicles      | 400           |

As the cars will be on different channels so for different applications the slots will be reduced for a particular application with different noise nodes shown in Figure (a)

![Figure (a) : Noise Node Vs number of Slots](image)

The hops required to transmit from source to destination with different noise nodes, as observed shown in Figure (b).
The delay was observed to reduce as the nodes on the channel increased shown in Figure (c). because the dynamically transmission range gives the farthest vehicle to transmit first as the contention window will be set appropriately, thus proving that dynamic transmission is an optimal solution.

V. CONCLUSION

In this paper we have studied and simulated the WAVE 1609.4 along with the multi hop broadcast techniques with preference to service application in which the transmission range is calculated dynamically, thus exploiting the actual transmission range to reduce the number of hops and the delay along with vehicles given access with different applications on different channels. The Proposed scheme is simulated for real time application. Simulation result shows that the system performance increases in terms of Number of hop count & therefore transmission delay.

REFERENCES

1. Ali J. Ghandour, Marco Di Felice, Hassan Artail “Modeling and Simulation of WAVE 1609.4-based Multi-channel Vehicular Ad Hoc Networks” vii.path.berkeley.edu/ feb 2012
2. Claudio E. Palazzi, Stefano Ferretti, Marco Roccuti, Giovanni Pau, Mario Gerla
3. “How Do You Quickly Choreograph Inter-Vehicular Communications? A Fast Vehicle-to-Vehicle Multi-Hop Broadcast Algorithm, Explained”. in Proc. of IEEE CCNC 2007, Las Vegas, NV, USA, IEEE Communications Society, Jan 2007
4. A. Nandan, S. Das, B. Zhou, G. Pau, M. Gerla, “AdTorrent: Digital Billboards for Vehicular Networks”, submitted for publication IEEE/ACM International Workshop on Vehicle-to-Vehicle Communications (V2VCOM), San Diego, USA, Jul 2005.
5. David Eckhoff, Christoph Sommer “A Multi-Channel IEEE 1609.4 and 802.11p EDCA
6. Model for the Veins Framework”
7. Jianhua He, Hsiao-Hwa Chen, Thomas M. Chen, and Wenqing Cheng
8. “Adaptive Congestion Control for DSRC Vehicle Networks”. IEEE COMMUNICATIONS LETTERS, VOL. 14, NO. 2, FEBRUARY 2010
9. L. Pantel, L. C. Wolf, “On the Impact of Delay on Real-Time Multiplayer Games”, in Proc of NOSSDAV ’02, Miami, FL, USA, 2002, pp. 23-29
10. C. E. Palazzi, M. Roccuti, S. Ferretti, L. Pantel, L. C. Wolf, “On the Impact of Delay on Real-Time Multiplayer Games”, in Proc of NOSSDAV’02, Miami, FL, USA, 2002, pp. 23-29
11. “An Inter-Vehicular Communication Architecture for Safety and Entertainment”, 12. IEEE Transactions on Intelligent Transportation Systems, vol. 11, no. 1, Mar 2010, 90-99.

AUTHORS PROFILE

Dr. Mrs. Sujata S Agrawal completed her bachelor degree in electronics and Telecommunication from Nagpur University. She has done her Post graduation (M.E,Electronics) from Government college of Engineering ,Aurangabad,India in 2005.She received Ph.D degree from RTM Nagpur University,India in 2015.She has joined Smt.Kashibai Navale college of Engineering, Pune on August 2002.Presently she is serving as professor. She is engaged in teaching and research. Her main areas of interest are Communication Networks, Digital signal processing and Electronics Devices and circuits. She is the life member of the Indian Society for technical education.

Dr. Mrs. Prema. M Daigavane obtained the B.E Degree in Electrical Engineering from Amravati University, India in 1988. She received the M.S.Degree in Electronics and Control Engineering from Birla Institute of Technology and Science, Pilani (Raj) India in 1996.She received Ph. D Degree in Engineering & Technology from RTM Nagpur University, India in 2013. Since August 1988- June 2007, she had been with the Department of Electronics and Power Electronics Engineering, B. D. College of Engineering, Sewagram (Wardha), affiliated to the Nagpur University, India. Since July 1, 2007 to Apr 30, 2009, she was Professor of Electrical and Electronics Engineering, Disha Institute of Mgmt. and Tech., Raipur (C.G.) affiliated to the Chhattisgarh Swami Vivekananda Technical University, Bilai India.Where she is engaged in teaching & research. she was Professor & Head of Electronics/Electronics &Communication Engineering at Suresh Deshmukh College of Engineering, Wardha – Maharashtra (India), since May 2009 to June 2013. Presently, she is Professor & Head Electrical Engineering at G.H.Raisoni College of Engineering (Autonomous Institute) Nagpur – Maharashtra (India), since June2013, Her main areas of interest are microprocessors & microcontrollers based system design, image processing & intelligent transportation. She is a Member IEEE, Member of the Institution of Engineers (India), and a Life Member of the Indian Society for technical Education.

Dr. Manoj B. Daigavane obtained the B.E. Degree in Power Electronics Engineering from Nagpur University, India in 1988. He received the M.S. Degree in Electronics and Control Engineering from Birla Institute of Technology and Science, Pilani (Raj) India in 1994.He also obtained the M.E. Degree in Power Electronics Engineering from Rajeev Gandhi University of Technology, Bhopal (M.P), India in 2001. He received Ph.D Degree in Electrical Engineering from RTM Nagpur University, India in 2009. Since Sept.1988- June 2007, he had been with the Department of Electronics and Power Electronics Engineering, B. D. College of Engineering, Sewagram (Wardha), affiliated to the Nagpur University, India. Since July 1, 2007 to Apr 30, 2009, he was Professor & Head of Electrical and Electronics Engineering, Disha Institute of Mgmt. and Tech., Raipur (C.G.) where he is engaged in teaching & research. He had been Principal of S.D College of Engineering, Selukate,Wardha, Maharashtra (India), since May 01,2009 to July 15, 2013. He had been Principal of Vidarbha Institute of Technology, Nagpur ,Maharashtra (India), since Feb.1,2015 toJuly20,2018. Presently, he is Principal of Government Polytechnic, Brahmapuri (Chandrapur), Maharashtra (India), since July21, 2018. His main areas of interest are resonant converters, Power quality issues, DSP applications and Power electronics for motor drives. He is a Member of the Institution of Engineers (India),Member IEEE and a Life Member of the Indian Society for technical Education.
Fast Broadcast Technique for Real Time Applications with WAVE 1609.4 Protocol

Sandeep Agrawal obtained BE degree from Nagpur University in Electronics and Power Engineering from Nagpur University Nagpur India in 1986. He has worked with various organizations such as Depart of Atomic Energy Govt. of India since he passed out from college. He got an opportunity to work with other organization such as Garware Chemicals Aurangabad, IBM and Neilsoft Limited. Presently he is working as Vice President at Neilsoft Limited Pune driving digital transformation initiatives. He has global certifications in IT security such as CISSP, CISP and he is also PMP and ITIL V3 certified professional. Sandeep Agrawal is Executive Vice President at Neilsoft Limited Pune. (Email: Sandeepa1@rediffmail.com)