Shruthi R, Prof. Harshavardhan H / International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com
Vol. 3, Issue 4, Jul-Aug 2013, pp.781-784

Fuzzy Scheduling For Ensuring Qos in VMAC for VANETs

Shruthi R (M.Tech)[1], Assoc.Prof. Harshavardhan H[2]
[1, 2] (Department Of Computer Science , Srinivas Institute Of Technology,Mangalore,India,

ABSTRACT

The need of a medium access control (MAC) protocol for an efficient broadcast service is of great importance to support the high priority safety applications in vehicular ad hoc networks (VANETs). Hassan omar proposed VeMAC, a novel multichannel TDMA MAC protocol proposed specifically for a VANET scenario. The VeMAC supports efficient one-hop and multi-hop broadcast services on the control channel by using implicit acknowledgments and eliminating the hidden terminal problem. The protocol reduces transmission collisions due to node mobility on the control channel by assigning disjoint sets of time slots to vehicles moving in opposite directions and to road side units. But the protocol has high packet loss & does not support different class of broadcast services. Taking this as motivation we propose a fuzzy scheduler based mechanism to ensure QOS for different class of broadcast messages along with VeMAC. Through simulation we measure the packet delivery ratio & prove that our mechanism is able to increment the delivery ratio by 20% over VeMAC.

Keywords-fuzzy scheduler, medium access control, reliable broadcast, TDMA, vehicular ad hoc networks.

I. INTRODUCTION

An ad hoc network is defined as a collection of nodes dynamically forming a network without any existing infrastructure or centralized administration. One special type of mobile ad hoc networks is the network among moving vehicles, which is known as vehicular ad hoc network (VANET). A VANET consists of a set of vehicles equipped with a communication device, called on-board unit (OBU), and a set of stationary units along the roads, called road side units (RSUs), which can be connected together and/or to the Internet via wireless or wireline links. Each OBU has a radio interface to connect to other OBUs and RSUs, as well as a wireless or wired interface to which an application unit can be attached. The main objectives of VANETs are to provide efficient vehicle-to-vehicle (V2V) and vehicle-to-RSU (V2R) communications. Based on these two kinds of communications, VANETs can support many applications in safety, entertainment, and vehicle traffic optimization [2], [3]. Motivated by the importance of vehicular communications, the United States Federal Communication Commission (FCC) has allocated 75MHz radio spectrum in the 5.9GHz band for Dedicated Short Range Communications (DSRC) to be exclusively used by V2V and V2R communications. The DSRC spectrum is divided into seven 10MHz channels: six service channels for safety and non-safety related applications, and one control channel for transmission of control information and high priority short safety messages.

Most (if not all) of the high priority safety applications proposed for VANETs are based on one-hop broadcast of information. For instance, for V2V communication based applications such as the pre-crash sensing, blind spot warning, emergency electronic brake light, and cooperative forward collision avoidance, each vehicle periodically broadcasts information about its position, speed, heading, acceleration, turn signal status, etc, to all the vehicles within its one-hop neighborhood [2].

Similarly, for V2R communication-based applications, such as the curve speed warning and traffic signal violation warning, an RSU periodically broadcasts to all the approaching vehicles information related to the traffic signal status and timing, road surface type, weather conditions etc [2]. As the precision of the safety applications is directly related to the safety of people on road, the need of a medium access control (MAC) protocol which provides an efficient broadcast1 service is crucial for VANETs.

VMAC gives better throughput than its rival ADHOC MAC. But VMAC does not support different class of services. All the broadcast messages are treated equally. Some message may need real time delivery, but they would be queued for processing behind low priority messages. In this paper work, we propose a solution to this problem. For processing of packets of different class of service, we design a fuzzy schedules which assigns priority to the messages and always schedules higher priority messages ahead of other messages.

II. RELATED WORK

Various MAC protocols have been proposed for VANETs, based either on IEEE 802.11 or on channelization such as time division multiple access (TDMA), space division multiple access (SDMA), and code division multiple access (CDMA). In SDMA schemes, each vehicle decides whether or not it is allowed to access the channel based on its location on the road [4], [5]. An SDMA scheme consists of three main parts: a discretization procedure which divides the road into small areas called cells, a mapping function which assigns to each of the cells a unique time slot, and an assignment rule which specifies which time slots a vehicle is allowed to access based on the cell where it is currently located. Similarly, CDMA is proposed for MAC in VANETs due to its robustness against interference and noise [6], [7]. The main problem which arises with CDMA in VANETs is how to allocate the pseudo noise (PN) codes to different vehicles. Due to a large number of vehicles, if every vehicle is assigned a unique PN code, the length of these codes will become extremely long, and the required bit rates for VANET applications may not be attained. Consequently, it is mandatory that the PN codes be shared among different vehicles in a dynamic and fully distributed way [7]. On the other hand, the IEEE 802.11p is a recently proposed MAC standard for VANETs [8]. The protocol is based on the legacy IEEE 802.11 standard [9] which is widely implemented, but does not provide an efficient broadcast service. The reason is that, for broadcast frames, no RTS/CTS exchange is used and no acknowledgement is transmitted from any of the recipient of the frame [9]. This lack of RTS/CTS exchange results in a hidden terminal problem which reduces the frame delivery ratio of the broadcast service, especially with the absence of acknowledgement frames [10]. Another limitation is that, in a VANET scenario, by employing the enhanced distributed channel access (EDCA) scheme defined in the IEEE 802.11 standard, the high priority safety messages will be assigned to the high priority access categories (ACs) which contend for the wireless channel using a small contention window size [9]. Although this small contention window size allows the high priority safety frames to be transmitted with small delays, it increases the probability of transmission collisions when multiple nodes within the same communication range are simultaneously trying to broadcast their safety messages [11]. Moreover, unlike the unicast case, the size of the contention window is not doubled when a collision happens among the broadcasted safety messages since there is no collision detection for the broadcast service without CTS and acknowledgment frames [9]. Different from the contention-based IEEE 802.11p standard, the ADHOC MAC protocol is based on TDMA and is proposed for inter-vehicle communication networks [12].

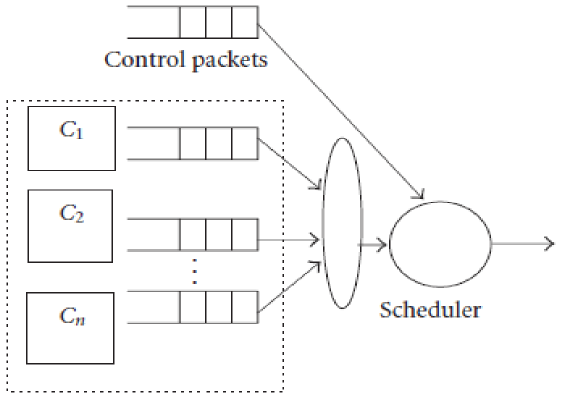
The ADHOC MAC protocol operates in a time slotted structure, where time slots are grouped into virtual frames, i.e. no frame alignment is needed. By letting each node report the status of all the time slots in the previous (sliding) virtual frame, the ADHOC MAC can support a reliable2 broadcast service without the hidden terminal problem [12]. As well, the ADHOC MAC provides a multi-hop broadcast service which can cover the whole network using a significantly smaller number of relaying nodes than that using a flooding procedure. Moreover, in ADHOC MAC, each node is guaranteed to access the channel at least once in each virtual frame, which is suitable for non delay-tolerant applications. However, simulation results show that, due to node mobility, the throughput reduction can reach 30% for an average vehicle speed of 50km/h [13]. Another major limitation of ADHOC MAC is that it is a single channel protocol, not suitable for the seven DSRC channels.

Hassan omar proposed VeMAC, a novel multichannel TDMA protocol developed based on ADHOC MAC [12] and designed specifically for VANETs. On the control channel, the protocol provides a reliable2 one-hop broadcast service without the hidden terminal problem as well as an efficient multi-hop broadcast service to disseminate information all over the network. The VeMAC assigns disjoint sets of time slots to vehicles moving in opposite directions and to RSUs, and hence can decrease the rate of transmission collision on the control channel caused by node mobility. As well, the VeMAC employs new techniques for the nodes to access the available time slots and to detect transmission collisions. It is shown that the proposed VeMAC protocol provides significantly higher throughput on the control channel than that of ADHOC MAC and ADHOC-enhanced.

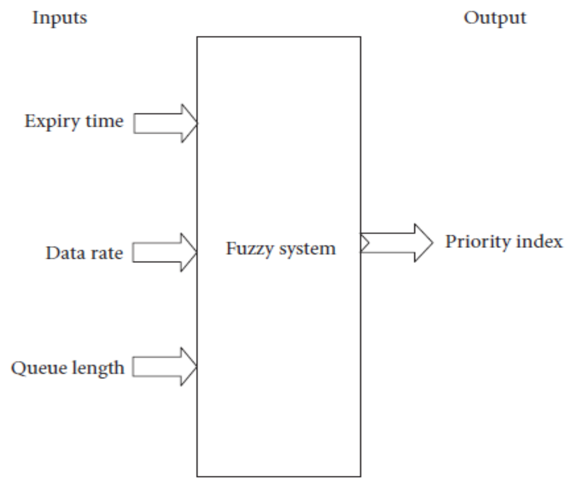
III. PROPOSED METHOD

Fuzzy logic implements human experiences and preferences via membership functions and fuzzy rules. The application of fuzzy logic to problems of traffic control in networks is more attractive. Since it is difficult for a network to acquire complete statistics of the input traffic, it has to make a decision based on in complete information. Hence the decision process is full of uncertainty. It is advantageous to use the fuzzy logic in the target system because it is flexible and capable of operating with imprecise data. Basically the fuzzy system consists of four blocks, namely, fuzzifier, defuzzifier, inference engine, and fuzzy knowledge base. The following section explains the working of the general fuzzy system.

At each RSU fuzzy scheduling is applied to the messages. The broadcast packets coming from different sources are first queued. The schedules decides the priority of messages to be processed & the high priority messages is processed first.



The priority of message is calculated based on following parameters
1. Expiry Time
2. Data rate
3. Queue Length.



The membership functions for the expiry time, data rate, queue length & the output parameters priority index is given below.

Q / D	L	M	H
	Expiry time (low)		
L	L	L	VL
M	VL	VL	VL
H	L	VL	VL
	Expiry time (medium)		
L	M	M	L
M	M	M	L
H	M	M	M
	Expiry time (high)		
L	VH	VH	H
M	H	M	M
H	H	H	M

Fuzzy scheduling is implemented at each RSU node. Among the broadcast message received at RSU, the higher priority messages is first taken for processing.

IV. PERFORMANCE ANALYSIS

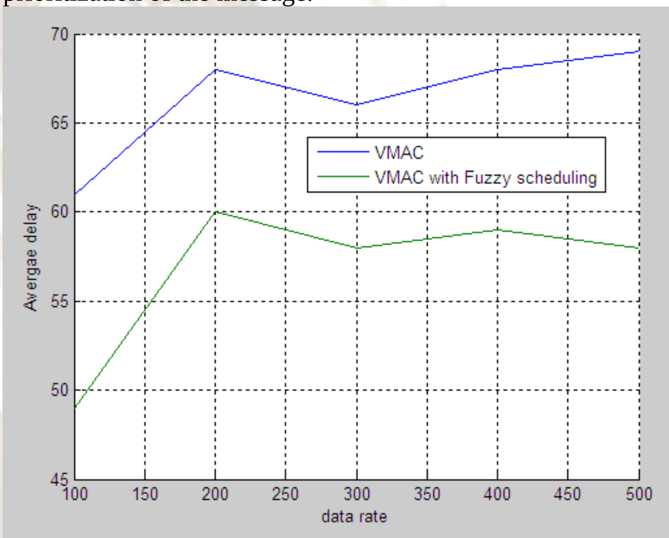
We implemented the proposed solution in MATLAB and analyzed the performance of the system in terms of

(i) *Packet delivery ratio*. Packet delivery ratio is the ratio of the number of data packets actually delivered to the destinations to the number of data packets supposed to be received. This number presents the effectiveness of the protocol.

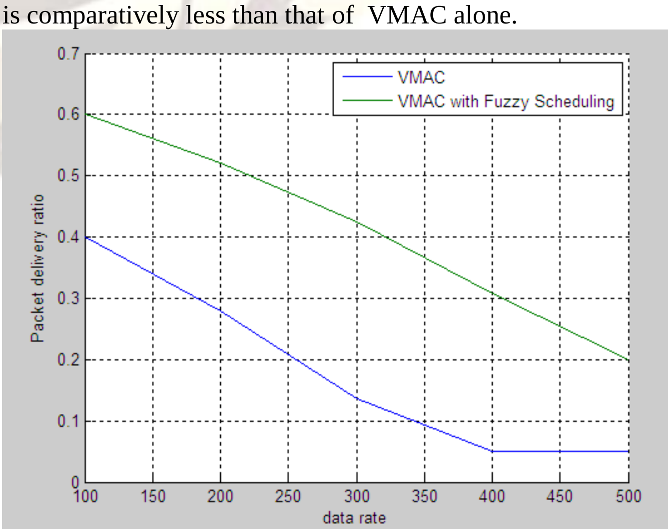
(ii) *Average end-to-end delay*. This indicates the end-to-end delay experienced by packets from source to destination. This includes the route discovery time, the queuing delay at node, there transmission delay at the MAC layer, and the propagation and transfer time in the wireless channel.

We compared the performance with Fuzzy scheduler & without fuzzy scheduler at the RSU for different traffic generation rate.

The average delay is less in fuzzy scheduling is less than that of VMAC because of prioritization of the message.



The packet delivery ratio reduces as we increase the data rate. But the rate of decrease in fuzzy schedules is comparatively less than that of VMAC alone.



V. CONCLUSION

In this paper, we introduced a fuzzy scheduler in addition to VMAC. We proved that use of fuzzy scheduler is able to reduce the packet end to end delay & increase the packet delivery ratio.

In future we plan to add more parameters to increase the efficiency of the fuzzy scheduler.

REFERENCES

a. H. A.Omar, W.Zhuang, and L.Li, "VeMAC: a novel multichannel MAC protocol for vehicular ad hoc networks," in *Proc. IEEE INFOCOM Workshop on Mobility Management in the Networks of the Future World (MobiWorld 2011)*, Apr. 2011, pp. 413–418.

[2] "Vehicle safety communications project task 3 final report," The CAMP Vehicle Safety Communications Consortium, Tech. Rep. DOT HS 809 859, Mar. 2005.

[3] R.Baldessari *et al.*, "Car-2-car communication consortium manifesto," Tech. Rep. Version 1.1, Aug. 2007.

[4] J. J.Blum and A.Eskandarian, "A reliable link-layer protocol for robust and scalable intervehicle communications," *IEEE Trans. Intell. Transp. Syst.*, vol. 8, no. 1, pp. 4–13, Mar. 2007.

[5] R.Mangharam, R.Rajkumar, M.Hamilton, P.Mudalige, and F.Bai, "Bounded-latency alerts in vehicular networks," in *Proc. Mobile Networking for Vehicular Environments (MOVE 2007)*, May 2007, pp. 55–60.

[6] F.Watanabe, M.Fujii, M.Itami, and K.Itoh, "An analysis of incident information transmission performance using MCS/CDMA scheme," in *Proc. IEEE Intelligent Vehicles Symposium (IV'05)*, Jun. 2005, pp. 249–254.

[7] H.Nakata, T.Inoue, M.Itami, and K.Itoh, "A study of inter vehicle communication scheme allocating PN codes to the location on the road," in *Proc. IEEE Intelligent Transportation Systems Conference (ITSC 2003)*, vol. 2, Oct. 2003, pp. 1527–1532.

[8] "IEEE standard for information technology–telecommunications and information exchange between systems–local and metropolitan area networks–specific requirements Part 11: Wireless lan medium access control (MAC) and physical layer (PHY) specifications Amendment 6: Wireless access in vehicular environments," *IEEE Std 802.11p-2010*, pp. 1–51, Jul. 15, 2010.

[9] "IEEE standard for information technology –telecommunications and information exchange between systems-local and metropolitan area networks-specific requirements - Part 11: Wireless lan medium access control (MAC) and physical layer (PHY) specifications," *IEEE Std 802.11-2007 (Revision of IEEE Std 802.11-1999)*, pp. 1–1184, Jun. 2007.

[10] M.Hassan, H.Vu, and T.Sakurai, "Performance analysis of the IEEE 802.11 MAC protocol for DSRC safety applications," *IEEE Trans. Veh. Technol.*, vol. 60, no. 8, pp. 3882 –3896, Oct. 2011.

[11] S.Eichler, "Performance evaluation of the IEEE 802.11p WAVE communication standard," in *Proc. IEEE 66th Vehicular Technology Conference (VTC 2007-Fall)*, Oct. 2007, pp. 2199–2203.

[12] F.Borgonovo, A.Capone, M.Cesana, and L.Fratta, "ADHOC MAC: New MAC architecture for ad hoc networks providing efficient and reliable point-to-point and broadcast services," *Wireless Networks*, vol. 10, pp. 359–366, Jul. 2004.

[13] F.Borgonovo, L.Campelli, M.Cesana, and L.Fratta, "Impact of user mobility on the broadcast service efficiency of the ADHOC MAC protocol," in *Proc. IEEE 61st Vehicular Technology Conference (VTC 2005-Spring)*, vol. 4, Jun. 2005, pp. 2310–2314.

[14] W.Franz, H.Hartenstein, and M.Mauve, *Inter-vehicle communications based on ad hoc networking principles: the FleetNet project*. Universit¨atsverlag Karlsruhe, 2005.

[15] F.Borgonovo, L.Campelli, M.Cesana, and L.Coletti, "MAC for adhoc inter-vehicle network: services and performance," in *Proc. IEEE 58th Vehicular Technology Conference (VTC 2003-Fall)*, vol. 5, Oct. 2003, pp. 2789–2793.

[16] "A recursive solution to an occupancy problem resulting from TDM radio communication application," *Applied Mathematics and Computation*, vol. 101, no. 1, pp. 1–3, Jun. 1999.

[17] "IEEE standard for wireless access in vehicular environments (WAVE) - multi-channel operation," *IEEE Std 1609.4-2010 (Revision of IEEE Std 1609.4-2006)*, pp. 1–89, Feb. 2011