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A New Intelligent Transmission Protocol for VANETs

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ABSTRACT: VANETS are upcoming and promising applications of Mobile Ad-Hoc Networks. They promise vehicle to vehicle interactions for safer transportation, emergency update services during unexpected calamities, efficient traffic routing in urban areas and on freeways for faster transport, routing of packets for infotainment services and much more. Traffic maintenance in highway using Intelligent Transmission protocol in India is a new theme. It is important to find a reliable transmitting protocol that is especially designed for an optimum performance of public-safety and data travelling related applications. There are few novel ideas presented in this research work, namely choosing the nearest following node as the network probe node, headway-based segmentation, non-uniform segmentation and application adaptive. Through these ideas a protocol has been developed on MATLAB platform that possesses minimum latency, minimum probability of collision in the acknowledgment messages and unique robustness at different speeds and traffic volumes. As the majority of tools available at present do not have the ease and widespread reach, using MATLAB offers unique advantage over other systems.

KEYWORDS: Vehicular Ad-Hoc Network (VANET), Transmitting Protocol, Ad-Hoc Networking, Road Side Unit (RSU), On Board Unit (OBU), Latency, MATLAB

I. INTRODUCTION

VANETs are unique subset of Mobile Ad-Hoc Networks in the sense that the nodes in VANETs strictly follow fixed and regular patterns. The speed and direction of nodes involved is bound by the traffic laws, geometrical and geographicalconstraints. VANETs also are unique in that the nodes are significantly larger compared to their cellular counterparts. They do not have harsh limitations of the battery size and battery life as vehicular nodes need and consume significant amount of energy for their locomotive operation itself. Hence the energy required for the nodal communication aspect is comparatively very negligible.

A VANET is a technology that uses moving cars as nodes in a network to create a mobile network. VANET turns every participating car into a wireless router or node, allowing cars approximately 100 to 300 meters of each other to connect and in turn create a network with a wide range. As cars fall out of the signal range and drop out of the network, other cars can join in connecting vehicles to one another so that a mobile Internet is created which can be operated without the need for a fixed infrastructure. Such a topology is suitable for rapid deployment of a wireless network i.e. VANET.

Transmission refers to a method of transferring a message to all recipients simultaneously. It is a method where a single node transfers message and all other nodes receive it within range. Wireless ad hoc networks have special characteristics related to node mobility, node self-configuration and the lack of centralized access points (APs) [3]. Each car can behave as OBU that is as node and we can also have RSU. Thus the number of vehicles is never zero on highway in India. This topology will fasten the rate of deployment as the industry will not wait for the infrastructure to be built. Besides, it will offer the service at no charge.

II. LITERATURE SURVEY

Sabih ur Rehman, M. Arif Khan, Tanveer A. Zia, Lihong Zheng: 2013 Vehicular ad-hoc networks (VANETs) technology has emerged as an important research area over the last few years. Being ad-hoc in nature, VANET is a type of networks that is created from the concept of *establishing a network of cars for a specific need or situation*. VANETs

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have now been established as reliable networks that vehicles use for communication purpose on highways or urban environments. Along with the benefits, there arise a large number of challenges in VANET such as provisioning of QoS, h igh connectivity and bandwidth and security to vehicle and individual privacy. This article presents state-of-the-art of VANET and discusses the related issues. Network architecture, signal modeling and propagation mechanism, mobility modeling, routing protocols and network security are discussed in detail. Main findings of this paper are that an efficient and robust VANET is one wh ich satisfies all design parameters such as QoS, minimum latency, low BER and high PDR. Some key research areas and challenges in VANET are presented at the end of the paper.

Manpreet Kaur, Amit Kumar;2014: The performance of VANET remains optimum within thousand meters and after that due to high packet loss rate communication among vehicles is not feasible. Finding optimal path is a typical task for dynamic protocols. The research objective is to study some of the important QOS metrics in VANET & vehicular traffic management solutions to improve overall safety of traffic.

Md. Humayun Kabir; 2013: Vehicular Ad Hoc Network (VANET) is a kind of special wireless ad hoc network, which has the characteristics of high node mobility and fast topology changes. VANET has become an active area of research, standardization, and development because it has tremendous potential to improve vehicle and road safety, traffic efficiency and convenience as well as comfort to both drivers and passengers. Vehicular networks will not only provide safety and lifesaving applications, but they will become a powerful communication tool for their users. This paper presents the aspects related to this field to help researchers and developers to understand and distinguish the main features surrounding VANET.

III. METHODOLOGY

A. The Algorithm

The Intelligent Transmitting Protocol seeks the best performance as a dissemination protocol. It elects the furthest node to relay the broadcast to its followers. The election methodology is by logically dividing the transmission range into a number of adjacent and non-overlapping equal segments. The node located in the furthest non-empty segment should reply with a CTB (Clear to Broadcast) message containing its identity and prepare itself to be the relay node for the incoming broadcast. On receiving of an RTB (Ready to Broadcast) message, every node in the message propagation direction should perform these steps:

- Find the segment number (based on its distance from the transmitting node).
- Choose a random back off period within the contention window assigned to its segment (assuming a contention window size of (4)).
- On receiving of a valid CTB, exit the contention phase.
- On receiving of a colliding CTB messages, hold its countdown timer until the end of collision.
- On the end of its countdown timer, send a CTB message.

In this algorithm, decisions of the receiving node depend solely on information from the RTB message and GPS (Global Positioning System) device without using any prior information. The Intelligent Transmitting Protocol assumes dividing the transmission area into ten segments.

B. **Headway Based Segmentation**

Time headway or headway for short (Figure 1) is the time interval between two vehicles passing a point as measured from the front bumper to the front bumper. The headway is the in-between distance divided by the following vehicle's speed. It may be of different meter lengths corresponding to different speeds, with a minimum length of 4m, which is the average length of a car.

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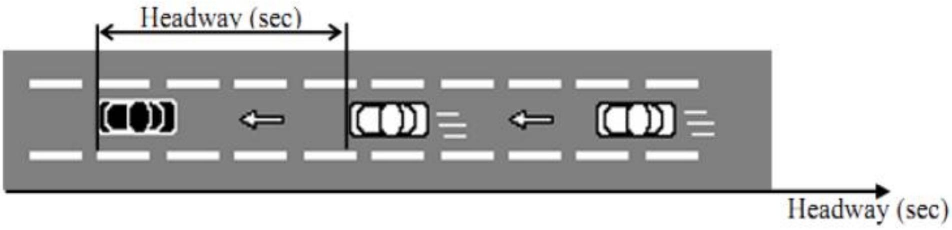


Figure 1: Headway

The only change introduced in this step is how the following vehicles will calculate the segment number; assuming that the communication range is divided into (10) segments, each is only of one second.

1. Get the source vehicle location (ls) from the RTB message
2. With the receiving vehicle current location (lr) and speed (*s*), calculate the Headway (*H*) with this very simple equation

$$H = \frac{l_s - l_r}{s} \tag{1}$$

3. The segment number is the headway rounded to +∞.

The probability density function (pdf) of the Semi-Poisson distribution () is recalled here;

$$f(t \mid p,\beta,\alpha,\theta) = p\frac{(\beta * t)^{\alpha-1}}{\Gamma(\alpha)}\beta * e^{-\beta * t} + (1-p)\frac{\gamma(\beta,\alpha * t)}{\Gamma(\beta)}(1+\frac{\theta}{\alpha})^{\beta} * \theta * e^{-\theta * t} \tag{2}$$

However, the parameters β and α do not correlated with the traffic volume. Parameters chosen are considered at the traffic volume of 300 vehicles/h and 1300 vehicles/h approximately [3]. Using MATLAB commercial program, a simple program was developed to compute the Semi-Poisson equation and to perform the minimization process as indicated above for different number of segments ranging from (4) to (10) segments. The best points of segmentation are listed in Table 1 and Table 2.

10-seg	[1.02	1.75	2.52	3.35	4.26	5.27	6.36	7.52	8.75	10.00]
9-seg	[1.13	1.94	2.80	3.74	4.80	5.97	7.23	8.57	10.00]	
8-seg	[1.27	2.18	3.16	4.26	5.52	6.91	8.41	10.00]		
7-seg	[1.43	2.46	3.59	4.91	6.43	8.12	10.00]			
6-seg	[1.63	2.82	4.18	5.84	7.77	10.00]				
5-seg	[1.88	3.29	5.04	7.28	10.00]					
4-seg	[2.18	3.92	6.43	10.00]						

Table 1: Best Segmentation Points for 330 vehicles/h (in headway sec)

10-seg	[1.18	1.95	2.74	3.57	4.45	5.42	6.47	7.58	8.74	10.00]
9-seg	[1.30	2.15	3.03	3.96	4.97	6.10	7.32	8.61	10.00]	
8-seg	[1.45	2.40	3.40	4.47	5.68	7.03	8.48	10.00]		
7-seg	[1.62	2.70	3.84	5.11	6.60	8.25	10.00]			
6-seg	[1.82	3.05	4.38	5.97	7.86	10.00]				
5-seg	[2.07	3.51	5.16	7.33	10.00]					
4-seg	[2.38	4.11	6.43	10.00]						

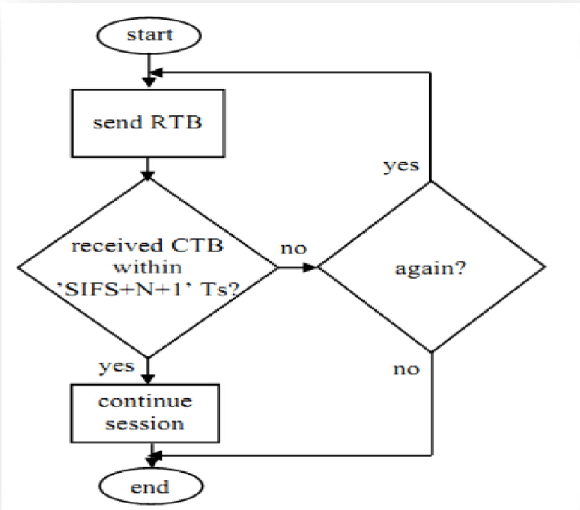
Table 2: Best Segmentation Points for 1300 vehicles/h (in headway sec)

It is to be noted that the width of each segment is monotonically increasing as indicated earlier with an upper bound to 10 sec. In Table 1, the width of each segment is {1.19-1.36-1.66-1.93-2.23} for (6) segments. Using the above results, the probability of collision is computed using equation (2). In Table 2, for a traffic volume of 1300 vehicles/h, we have implemented the same simulation program using in the similar segmentation Table 1. We have compared the performances of Table 1 with Table 2. We have seen in our research work that the protocol that we are using is very suitable to implement and safe.

C. Proposed Algorithm of the Transmitting Node

In case of an OBU has a message to broadcast, the MAC layer of the system has to proceed with the following (Figure 2)

1. It sends an RTB message including its MAC address, current location, current speed, message propagation direction and the mode of operation.



2. It waits for a valid CTB message within SIFS (Short Inter-frame Space)+N+1time-slots (assuming N segments). If it received a valid CTB, then it should send the unencrypted broadcast to with intended receiver as that indicated in the CTB message. Otherwise (if not), repeat the procedure from the beginning (as long as the application requires).

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D. Proposed algorithm of other Vehicles

Upon receiving of an RTB message, other nodes proceed with the following algorithm (Figure 3):

1. Set the NAV (Network Allocation Vector) to be SIFS+N+2 time-slots so that nodes will not start a new session until the end of the current transmission.
2. Check the transmitting mode field.
3. Compare the geographical coordinates of the transmitting vehicle with their own, and obtain its relative position. If the receiving vehicle is in the opposite driving direction or not in the message propagation direction, ignore the message and go to end. Otherwise, if the receiving vehicle is in the message propagation direction, continue to Step 4.
4. Compute the headway in seconds (or distance in meter) then determines its segment number with reference to the operating mode. Widths of each segment are implemented according to tables.
5. Assuming that the segment number equals Si where (i<= N) and (i) is the segment number. Set the back-off counter to be equal to (i-1). So that, nodes wait for the SIFS then decrement the back-off counter by one in each time slot while listening to the channel for any valid CTB message, if locked with a valid CTB message then the node should exit the contention phase and listen for the incoming broadcast. The node that reaches zero initiates a CTB message including its MAC address and continues the session with the transmitting node. Simulation was done using MATLAB.

IV. SIMULATION RESULTS

These parameters are quoted from the 802.11p [4] standard. It is assumed that the length of ACK message is the same as the original broadcast. The ACK message is a mere repeat of the original broadcast setting the ACK field, which is considered as compensation to the expected collisions at far range nodes. The headway distribution is considered at a traffic volume of 330 vehicles/h and 1300 vehicles/h.

Parameters	Value
Data rate	3 Mbps
CTB	14B(B=bytes)
RTB	20 B
Slot Time	16µs
SIFS	32 µs
DIFS	64µs
Message	512 B
ACK	512 B

Table 3: MATLAB Parameters

Using these random variables, a simulation program was conducted for estimating the probability of collisions and the average latency within each segment of the communication range (10 sec). The width of each segment is taken according to Table 1. The probability of collision is shown in Figure 4, while the average latency is shown in Figure 5.

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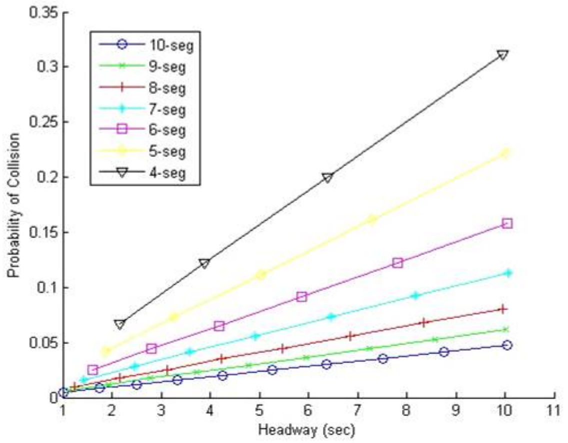

Figure 4: Simulated calculation for PC for best segmentation for 330 veh/h.

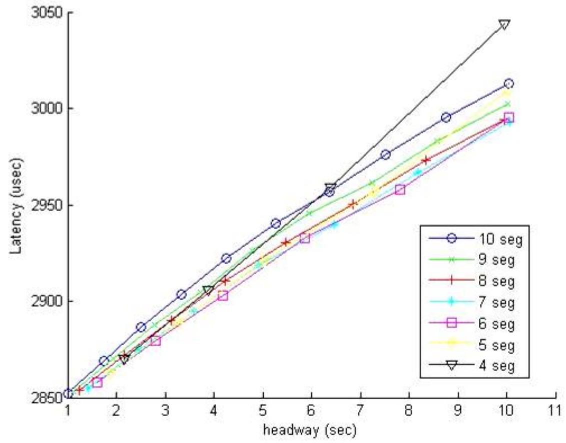

Figure 5: Simulated calculation of latency at best segmentation for 330 veh/h.

In Figure 6, we have seen that for 1300 vehicles/h, the probability of collision is higher than the 500 vehicles/h. The latency of the segmentation for 1300 vehicles/h has given in Figure 7.

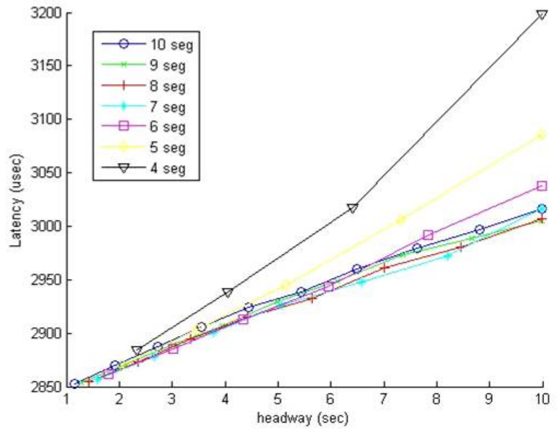

Figure 6: Probability of collision for 1300 veh/h

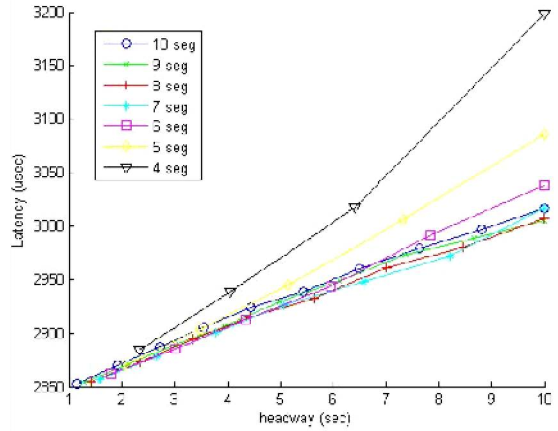

Figure 7: Latency for 1300 veh/h.

The headway distribution at traffic volume of 330 vehicles/h and 1300 vehicles/h (very low vs. very high) are shown in Figure 8 and 9.

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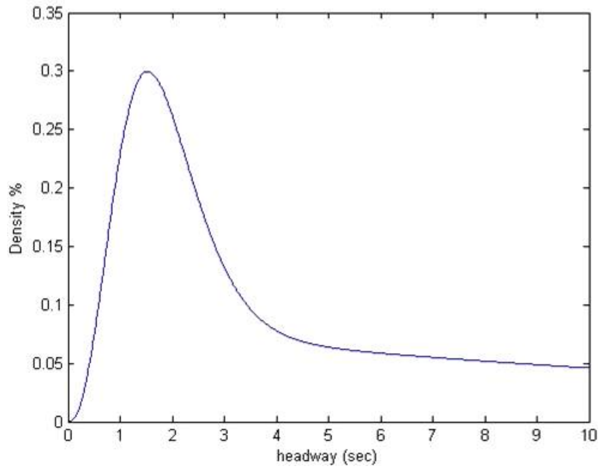

Figure 8: Headway Distribution at 330 veh/h.

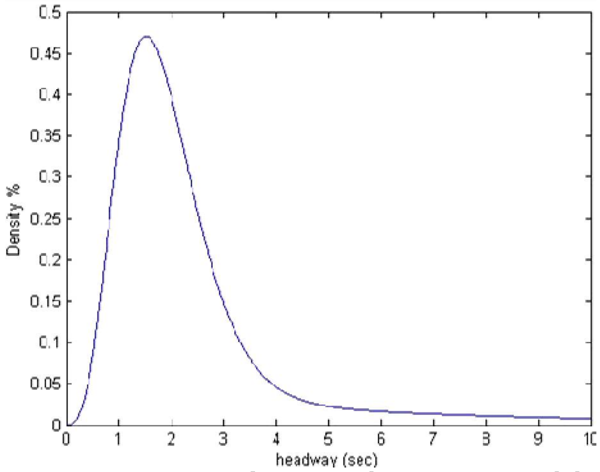

Figure 8: Headway Distribution at 1300 veh/h.

V. DISCUSSION AND CONCLUSION

In this research, an Intelligent Transmitting protocol in VANET is developed for the highway environments of INDIA with these new features: To use the concept of headway-based segmentation and to include effects of human behaviours in its design with the headway model.; Non-uniform segmentation achieving a unique minimum slope linearly increases latency distribution; Unique robustness at different speeds and traffic volumes rooted to the headway robustness at different traffic volume variations. For example the latency difference between the traffic volume of 330vehicles/h and 1300vehicles/h is in a range of 10µsec; Superior minimum latency for public safety applications; Application adaptability with special multi-mode operations; Considered offering a solution to applications like "Approaching Emergency Vehicle".

In this paper the integration of ideas have been implemented on MATLAB which results in a protocol that possesses minimum latency, minimum probability of collision in the acknowledgment messages and unique robustness at different speeds and traffic volumes. The majority of tools available at present do not have the ease and widespread reach, using MATLAB offers unique advantage over other systems.

REFERENCES

[1] Maen M. Artimy, William Robertson, and William J.Phillips, "Vehicular Ad Hoc Networks: An EmergingTechnology Toward Safe and Efficient Transportation"
[2] Grzybek,gata; Seredynski, Marcin ;Danoy, Grégoire ;Bouvry, Pascal , "Aspects and trends in realistic VANETsimulations", World of Wireless, Mobile and Multimedia Networks (WoWMoM), 2012 IEEE International Symposium 2012
[3] Sandeep Tayal, Malay Ranjan Tripathy, "VANET-Challenges in selection of Vehicular Mobility Model", 2012Second International Conference on Advanced Computing& Communication Technologies
[4] Marco Fiore, "VehicularMobility Simulation for VANETs", Simulation Symposium,2007. ANSS '07. 40th Annual
[5] K. Pahlavan and P. Krishnamurthy, "Principles of Wireless Networks", Prentice Hall PTR Upper Saddle River, NJ, USA, 2001.
[6] Mostafa M. I. Taha, "Broadcasting Protocols in Vehicular Ad-Hoc Networks (VANETs)", Thesis of Master of Science under the department of Electrical Engineering of Assiut University, Egypt, 2008.
[7] IEEE P802.11p, "Amendment 3: wireless access in vehicular environments (WAVE)," Draft D0.26, January 2006.