AVOIDING COLLISION USING PROTOCOL SEQUENCES IN VEHICULAR Ad HOC NETWORKS

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***Abstract*-In collision avoidance system, safety messages are given to the mobile users in a periodical manner to all of their neighbors. Within the hearing range, these messages are time constraints and have rigorous delay requirements. For this kind of application in CSMA, channel access is not suitable. In our system, we have proposed that using protocol sequences, so as to broadcast the safety messages. The protocol sequences are deterministic 0-1 sequences. The user can read 0's and 1's in the given protocol sequences in a regular manner and transmits a packet in a time slot. It doesn't require any time synchronization among users. On employing protocol sequences delay can be reduced by comparing delay performance with an ALOHA-type random access scheme. The delay experienced is random and limitless. As the user has to wait for the long time until they gains the opportunity to send data. Alternatively on scheduling the packet data's or regards to certain deterministic patterns (protocol sequences); the delay can be reduced.**

***Keywords*-ALOHA, collision channel, IEEE 802.11p, Protocol Sequences, Safety Message, VANET.**

1. INTRODUCTION

In this paper, we consider the application of safety-message broadcast in a VANET. The goal is to allow all user nodes to simultaneously broadcast safety messages to all their neighbours within transmit range. Safety messages can be divided into two types. The first type is periodic information (also called heartbeat messages) such as the speed and location of an automobile. The second type of messages relates to emergency events such as lane-change warning or pre-crash warning. These basic safety messages are the essential data on which one can build a variety of traffic safety applications.

We focus on safety message broadcast. It is pointed out in that the newly introduced IEEE802.11p Wireless Access in Vehicular Environment (WAVE) over the dedicated short range communications (DSRC) band for a VANET is not desirable for the transmission of time critical safety messages because the delay may be unbounded when the channel is very busy. In American systems, safety messages are generated approximately every 0.1 s, encapsulated using the WAVE short message protocol and sent according to the carrier-sense multiple access with collision avoidance (CSMA/CA)-based enhanced distributed channel access mechanism over the control channel, which is one of the seven channels in the DSRC spectrum. There are several other suggested multiple-access schemes in the

literature. A packet is retransmitted several times within its useful lifetime, with the pattern of retransmissions randomly chosen. The packet loss rate is reduced by adaptively adjusting the rate of transmitting the safety beacon. Here, the delay experienced by a user in random or Contention-based MAC scheme is unbounded; where the user may need to wait for a long time until he/she has the opportunity to send some data. The scheduling of packet transmissions in a protocol-sequence-based scheme follows a binary and periodic sequence. A user simply reads out the sequence values once per time slot duration and sends a packet if and only if the sequence value is equal to 1. One key property of protocol sequences is that they are designed to accommodate asynchronous users, which is an indispensable feature in the VANET application. There are three different levels of synchronization, namely, asynchronous, slot-synchronous, and frame-synchronous.

The asynchronous model is the minimal framework in which slot boundaries of the users are not necessarily aligned, although the slot duration of all users is identical. Hence, packets sent from different users may partially overlap with each other. The relative delay offsets between two protocol sequences in this model may be any real number. In the slot-synchronous model, the slot boundaries of the users are aligned. Two packets from two different users either overlap completely or do not overlap at all. However, the protocol sequences need not start at the same slot. The relative delay offsets of two users are integral multiples of the duration of a time slot. In the frame-synchronous model, all users start their protocol sequences at the same time instance. The relative delay offsets are integral multiples of the sequence period. The dynamics of code-based scheduling in MANETs is much slower than in VANETs. Achieving frame synchronization in VANETs is more costly.

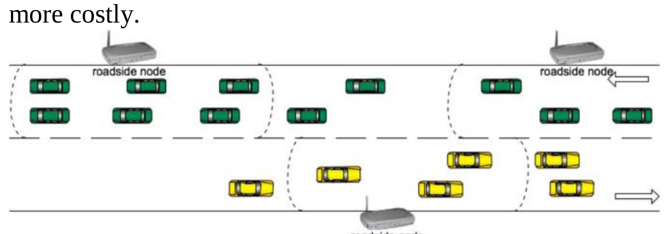


Fig. 1. VANET on a highway.

Any results on the slot-synchronous system can be also extended to practical systems that are asynchronous. For example, we can require that each user only transmits in the first half of an active time slot and leaves the second half idle. Then, the analysis of the slot-asynchronous system is the same as that of the asynchronous system. We distribute the protocol sequences to the users via roadside nodes or roadside units near highway entrances or toll booths (see Fig. 1). These roadside units are expected to be sparsely located as they do not serve as base stations. When a user enters the highway or when a user passes through a toll booth, he/she is assigned a protocol sequence from a roadside node via a downlink control channel. The user will use the assigned sequence for message broadcast until entering the range of the next roadside node. At that point, the user will trigger the roadside node to issue a new protocol sequence to be used. If the number of active users increases, for example, in peak hours, the roadside node can switch to a larger pool of protocol sequences, such that every mobile user in a segment of the highway can be assigned a unique protocol sequence.

In this paper, we consider slot-synchronous single-hop broadcast and analyze the delay performance of a class of protocol sequences, which are called the generalized prime (GP) sequences. In the majority of the existing works on the protocol sequences, the design objective is to maximize the throughput and support as many users as possible. However, in the application of safety-message broadcast, throughput is of secondary importance. The primary concern is the minimization of the time within which a user has to wait until he can receive a packet from his neighbour. The period of a protocol sequence set has a fundamental impact on delay performance.

The period of protocol sequences is nonetheless not the sole consideration factor. Suppose that there are two users and they schedule their packets according to the following protocol sequences of period 9:

s_1 (t): 111 000 000

s_2 (t): 100 100 100

For $i = 1, 2$, the sequence s_i (t) is assigned to user i. The first user sends packets in three consecutive time slots in each period of nine slot durations. The second user sends one packet in a period of three slot durations.

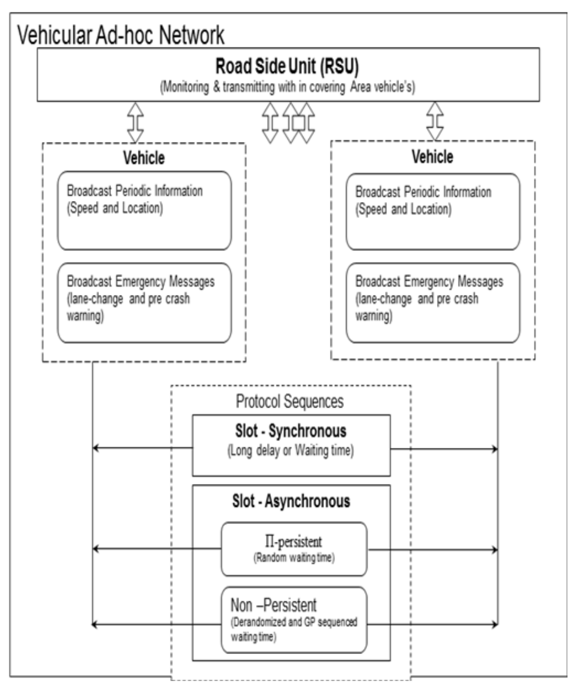
2.EXISTING SYSTEM:

In Vehicular Ad Hoc Network (VANET), it is very difficult to maintain time synchronization among user nodes due to their mobility. In Conventional carrier-sense multiple access, users must be contented with channel access and this can not be used in adhoc networks. In existing system, there is no base station to facilitate time synchronization. There is no dedicated control agent to monitor users. It is difficult and undesirable to designate any subset of nodes as central access nodes with control authority, even temporarily. This makes the design of a Medium-Access Control (MAC) for low latency application, a very challenging task. The frequency division in MAC layer is used, and the carrier frequency is assigned according to the locations of the users. The delay may be unbounded, when the channel is very busy in dedicated short range communications (DSRC) band. So, it is not desirable for transmission of time critical safety message in VANET. So, we newly introduced IEEE802.11p Wireless Access in Vehicular Environment (WAVE) over the dedicated short range communications (DSRC) band.

3.PROPOSED SYSTEM:

In our proposed system, we used protocol sequences to broadcast the safety messages. Here, there is no time synchronization among the users. The main goal is to allow all the user nodes to simultaneously to broadcast safety messages to all their neighbors within the transmit range. Safety messages can be divided into two types. The first type is periodic information (also called heartbeat messages) such as the speed and location of an automobile. The second type of messages relates to emergency events such as lane-change warning or pre-crash warning. We consider slot-synchronous single-hop broadcast and analyze the delay performance of a class of protocol sequences, which are called the generalized prime (GP) sequences. The communication channel is modelled as a time-slotted collision channel. That the system is slot-synchronous. The results can be extended to the slot-asynchronous case. If two or more users transmit packets in a time slot, then there is a collision, and the collided packets cannot be recovered. On the other hand, if only one user among the K users transmits at a time slot, then the packet can be received by user 0 without any error. In the system all packet erasures are due the packet collisions. For instance, if there are errors due to thermal noise, be employing a forward error-correcting code. We assume that successfully received packets are error-free and also assume that the transmission is half-duplex.

3.1 ARCHITECTURE DESIGN



In VANET, we are using a road side unit, which monitors and transmits the messages within the hearing range. It has certain coverage area. Within the covering range, the messages are transferred to all their neighbors. In this architecture diagram, vehicles broadcast both the periodic and emergency messages. The vehicles broadcast their safety messages to all their neighbors using protocol sequences. The protocol sequences are of two kinds .They are slot-synchronous and slot-asynchronous. In slot-synchronous, while broadcasting the messages long waiting time will be allocated. In slot-asynchronous, we have two techniques. First one is pi-persistent; here random waiting time will be allocated for the packets. Another one is non-persistent; here we use derandomized and GP sequenced waiting time.

3.2. INITIALIZE VEHICULAR AD HOC NETWORK AND BROADCAST

In this module, we create a road side unit and user's vehicles as nodes. We consider a particular user as user 0 and surrounding users as k users. Now the user 0 will broadcast the message to the surrounding users who are in the transmission range include road side unit. Then, user 0 wants to receive messages from the surrounding k users. In this system, the communication is modeled as a time-slotted collision channel. The messages broadcast are speed, location of the vehicle, lane-change warning and pre-crash warning.

3.3. SLOT-SYNCHRONOUS BROADCASTING

When the communication is modeled as a time-slotted collision channel, then the system is slot-synchronous. In slot-synchronous system, the slot boundaries for users are allocated. If two or more users transmit packets in same time slot, then the collision will occur and the collided packets cannot be recovered. In slot-synchronous, the two packets are transmitted by two different users either overlap completely or do not overlap at all. The packet transmission need not start at the same time slot. The relative delay offsets of two users are integral multiples of the duration of a time slot. In this module, we have code assignment problem or the sequence assignment problem because of the number of users on the highways are virtually unlimited. It is very difficult to assign identical protocol sequences to all users. The protocol sequences must be spatially reused. We have to assure that no protocol sequence is assigned to two users within the hearing range.

3.4. SLOT-ASYNCHRONOUS BROADCASTING

In this module the slot boundaries of the users are not necessary aligned, even though the slot duration of all users are same. Hence the packets sent from different users may partially overlap with each others. The relative delay offset of two user in this module may be any real number. Hence the slot- synchronous can be extended to the slot-asynchronous. At a time, if only one user among the K users transmit the messages then the user 0 receive the messages without any error. We describe a general protocol for the time-slotted collision channel without feedback. This includes the deterministic channel access scheme using protocol sequences and several random channel access schemes. In the general protocol, each user decides whether he/she transmits or not by a finite Markov chain. We implement and compare with two random access schemes. The first one is called π-persistent random access. In this scheme, a user simply sends independently in a time slot with probability π. The second random scheme is called non-persistent random access. The GP sequences can be considered as a class of protocol sequences obtained by derandomizing the non-persistent random scheme.

4.PROTOCOL SEQUENCE TECHNIQUE

By scheduling the data packets according to a certain deterministic pattern , which is called ***protocol sequences.*** Each user decides whether he/she transmits or not by a finite Markov chain. The Markov chain of user i is represented by a directed graph. The vertices are also known as the states. Each directed edge has two labels. The first label is a probability between 0 and 1. The second label is either 0 or 1. It is required that for each state, the sum of the probabilities of the outgoing edges is equal to 1.

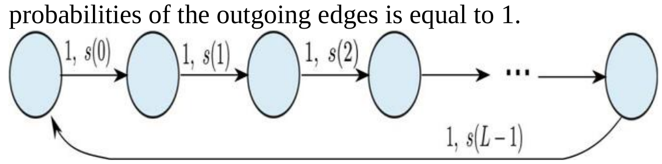


Fig. 2. Markov chain of the deterministic channel access scheme based on protocol sequence s (t).

The second labels of the edges are the bits in the protocol sequence.The users may not start their transmissions of packets at the same time. Suppose that for k = 0, 1, 2. . . K, user k starts transmitting at τk, which is called *relative delay offset*.

User k transmits a packet at time slot $t + \tau k$ *if* and only if sk (t) = 1. The relative delay offsets τk is a parameter that cannot be controlled. When the common period of the binary sequences is L, we model the relative delay offsets as discrete random variables uniformly and independently distributed between 0 and $L - 1$.

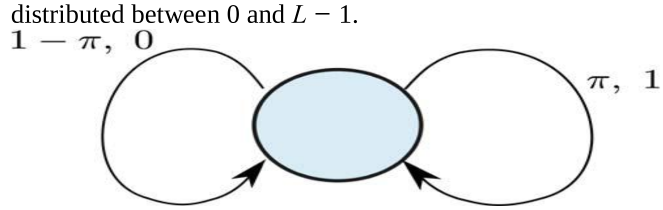


Fig. 3. Markov chain of the π-persistent random access scheme.

We will compare with two random access schemes. The first one is called *π-persistent random access*. In this scheme, a user simply sends independently in a time slot with probability π. This is a special case of the general Markov chain framework with only one state. There are two self loops, i.e., one with labels π and 1 and one with labels 1 – π and 0. The π-persistent random access is called *synchronous p-persistent*. The second random scheme is called *non-persistent random access*. User k transmits packets in slots ,

$$\tau k + qm + Uk,m(W)$$

for $m \geq 0$, where τk is the relative delay offsets of mobile user k, q is a positive integer, $Uk,m(W)$'s are independent random variables uniformly drawn from $\{0, 1, \ldots, W-1\}$, and W is an integer that represents the window size.

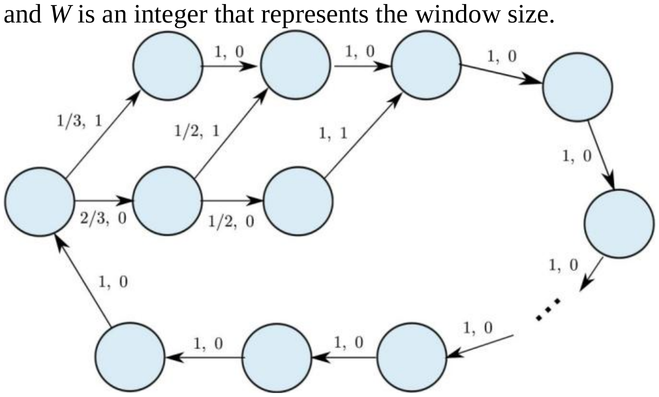


Fig. 4. Markov chain of the nonpersistent random access scheme.

A. GENERALIZED PRIME SEQUENCES

The GP sequences can be considered as a class of protocol sequences obtained by derandomizing the nonpersistent random scheme. Let p be a prime number and $rem(x, p)$ denote the remainder of x after division by p, which is an integer between 0 and $p-1$. For a given prime number p and an integer q, which is greater than or equal to p, we derandomize the nonpersistent random scheme by replacing the random numbers $U_{k,m}(W)$ in (1) by $rem(km, p)$. User k, for $k = 0, 1, \ldots, p-1$, transmits packets at time indexes

$$\tau_k + qm + rem\ (km, p)$$

for $m = 0, 1, 2...$ We note that in (2), only the relative delay offset τ_k is a random variable; the other terms are a deterministic function. The value of τ_k is fixed at the beginning of a communication session. Then, the sequence is a deterministic and periodic sequence with period $L = pq$.

5. CONCLUSION

In this paper, we proposed protocol sequences for broadcasting the safety messages in vehicular adhoc networks. The protocol sequences have certain structure that reduces the individuals and group delays. The potential advantages of the protocol sequence in VANET are to broadcast the safety message safely. The protocol sequence is effective as long as the neighbouring users are assigned identical protocol sequence. Although the system performance analysis is little difficult, the construction and regeneration of protocol sequences are simple. It uses only modular arithmetic and do not require random numbers generator.

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