Congestion Control in VANET with Time Synchronization Approach and by Controlling Number of Messages

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Abstract – The main objective of congestion control in VANET is to best exploit the available network resources and to minimize the congestion in the network. In this context, we present a congestion control approach, based on time synchronization approach reducing number of messages, to ensure reliable and safe communication within VANET. It supports discarding of similar types of messages and time synchronization.

Keywords –SCH, CCH, RSU, CA, V2V, V2I.

1. INTRODUCTION

Congestion control is an important research issue to ensure safe and reliable vehicle to vehicle (V2V) communication by using the limited resource available in vehicular ad-hoc network (VANET). Each vehicle in VANET is a node which is able to transmit its own message and can receive messages from other vehicles. VANETs are composed of vehicles equipped with advanced wireless communication devices without any base stations. Each vehicle equipped with VANETs device will be a node in the ad-hoc network and can receive and relay other's messages through the wireless network.

A congestion control approach as proposed in [1] considers dynamic priority based scheduling. The service messages are scheduled in control channel if it is free. But the authors have not suggested the message format. Moreover the performance analysis is not presented graphically in [1].

A Cooperative Scheme for service channel (SCH) reservation is proposed in [2]. According to Wireless Access Vehicular Environment (WAVE) standard, the safety messages are carried over a dedicated control channel (CCH) while non-safety messages are delivered over one of a set of available service channel (SCH) [2]. But in [2] there is a possibility of bandwidth wastage when the SCH is overloaded and CCH is idle.

Unlike [1] the performance of the proposed scheme is evaluated and presented graphically. Unlike [2] the proposed scheme considers the transfer of messages from service queue (SQ) to control queue (CQ) when SCH is overloaded and CCH is free to avoid misuse of bandwidth and transmission delay.

The objective of the proposed scheme is to minimize the channel congestion and to revoke misbehaving vehicles from VANET. The scheme in [3] aims for the reduction of channel congestion. The VANET in that proposed scheme is a hierarchy having certifying authority (CA) at the root level, road side units (RSUs) at the intermediate level and vehicles at the leaf level. Each vehicle has an electronic license plate (ELP) in which the encrypted vehicle identification number (VIN) of the vehicle is embedded by the vehicle manufacturer. Each vehicle is equipped with global positioning system to know its current location.

This scheme supports V2V communication of safe and unsafe messages among authentic vehicles. It also supports vehicle to infrastructure (V2I) communication of unsafe message among authentic vehicles and RSU. The priority of safe messages is assumed as higher than the priority of unsafe messages to disseminate the safe messages among vehicles without delay. The ELP of a vehicle broadcasts (as per IEEE P1609 and IEEE 802.11p) the encrypted VIN after entering into the coverage area of a new RSU. The new RSU verifies the authentication of the vehicle. It assigns a digital signature to the vehicle as a valid key if the vehicle is authentic. Each authentic vehicle includes its digital signature in the message format which helps to prevent the unauthentic vehicle from participating in V2V and V2I communication. Each RSU revokes the misbehaving vehicles from its coverage area without which antisocial and criminal behavior jeopardizes the benefit of the system deployment.

A control queue (CQ) is maintained for keeping safe messages and a service queue (SQ) is maintained for keeping unsafe messages at each vehicle. The length of CQ and SQ at each vehicle is assumed as variable and it depends upon the number of safe and unsafe messages. The duplicate messages are discarded from CQ to minimize channel congestion.

The current research problem should be summarized in this section. Times New Roman font with size 10 must be used in this section. Sub topic should be written as given below:

2. PORPOSED MODELLING

As outlined in the introduction, safety applications can be enabled by two types of messages: periodic and event-driven. Periodic status messages are intended to exchange state information from the sending vehicle, i.e., position, direction, speed, etc., in this scheme we consider three message format.

Message Format:

1. B*eacon Messages:-*

Beacon messages (Type_I) are issued periodically by vehicles to other vehicles falling under its network coverage area as shown in fig. 1.1. It describes their situations (speed, positioning and direction) that help the other vehicles to understand about their surroundings. The message format for Beacon messages is shown in fig 1.

TYPE	IDENTITY	CURRENT LOCATION	DIRECTION	SPEED	HOP COUNT

Fig1: Beacon message

2. Emergency Messages:-

Emergency messages (Type_II) are generated when an abnormal condition or an imminent danger is detected, and disseminated within a certain area with high priority as shown in fig. 2.1. Critical emergency messages usually have strong reliability and delay requirements. Emergency messages will travel till hop two. The message format for Emergency messages is shown in fig 2.

TYPE	IDENTITY	CURRENT LOCATION	TIME OUT	HOP COUNT	MESSAGE

Fig2: Emergency message

3. Query Message:-

Query messages (Type_III) are generated when a vehicle has a query regarding any route or place. Query messages are generated when a there is a query. Query will be related to the local area information and result in a reply from infrastructure. Query messages will travel till hop one. The message format for Query messages is shown in fig 3.

TYPE	IDENTITY	DIRECTION	CURRENT LOCATION	SPEED	TIME OUT	MESSAGE	HOP COUNT

Fig 3: Query message

4. Warning Messages:-

Such messages can be both vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) communication which are generated by a node (Source node) during traffic signal breakdown, jamming information etc. The Source node broadcasts this message to the nodes which are moving towards the jam location.

TYPE	IDENTITY	CURRENT LOCATION	TIME OUT	HOP COUNT

Fig4: Warning message

Congestion control mechanism:

We are assuming that message m_i is send to node n_i.

The information from the message is extracted and the values are compared with the values of neighbor table.If a match is found then the corresponding message field in the table is updated else a new entry is added in the table and the message is transferred to CQ or SQ. After being processed the entry is deleted from the queue as well as table.

Here Type_i, Type_ii, Type_iii are Beacon, Emergency and Query messages.

ID_{mi} is the ID of the incoming message, ID_{db} id the ID recorded in the database for received messages. MSG_{mi} is the message field of incoming message m_i and MSG_{db} is the message attribute of the database. CL_{mi} is the current location of the incoming message m_i and CL_{db} is current location recorded in the database for received messages.

```
If (hop count==0)
        Discard mi
Else
    {
        If (mi==Type_i)
         {
                Extract information from mi
                Search the IDi in the table
                If (IDmi == IDdb)    // this will be checked using a database query
                  {
                    update the current location & speed
                  }
                Else
```

Add new record

Decrease hop count by 1

}

Delete the records after processing

Elseif (mi==Type_ii)

{

Extract information from mi

Compare message and current location fields

If $(MSG_{mi}==MSG_{db}\ \&\&\ CL_{mi}==CL_{db})$

// this will be checked using a database query

{

Discard message

}

Else

{

Add new record

Decrease hop count by 1

}

}

Delete the records after processing

Else

{ Extract information from mi

Compare ID and message fields

If $(ID_{mi}==ID_{db}\ \&\&\ MSG_{mi}==MSG_{db})$

// this will be checked using a database query

{

Discard message

}

Else

{

Add new record

Decrease hop count by 1

}

}

Delete the records after processing

}

Time synchronization:

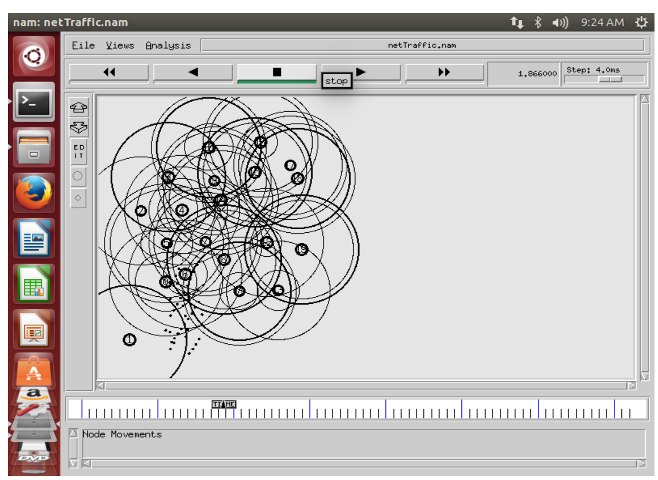
Input: nodes

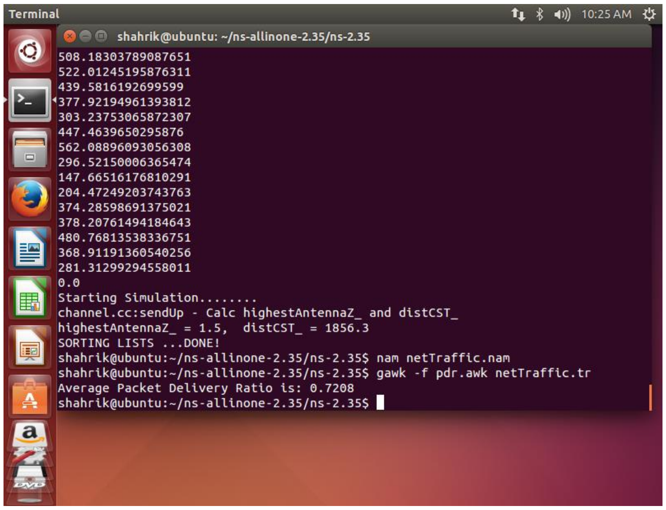
Output: Time value for broadcasting of a packet

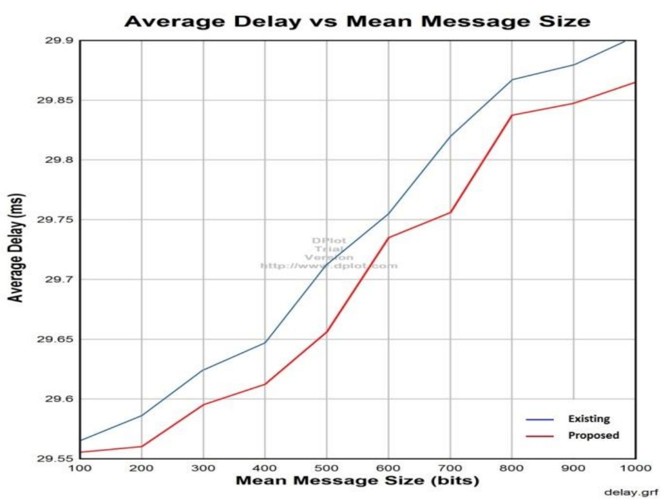
Process:

1. Initialize the network.
2. Call Comparison.
3. Now transferring packet:
4. Start time from node i to node j = time
5. End time from node i to node j=time
6. End

3. RESULTS







4. CONCLUSION

The proposed work is a congestion control mechanism in VANET. It considers both V2V and V2I communication of safe and unsafe messages among nodes. The proposed algorithm considers congestion control in VANET by discarding similar type of messages with time synchronization approach. The present work can be extended by evaluating the dynamic priority of a message as a function of network condition in terms of vehicle density, congestion level of the network etc.

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