Priority Based Scheduling and Reliable Content Delivery in VANET
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Abstract— Vehicular Ad-Hoc Network (VANET) is a subclass of Mobile Ad-Hoc Network (MANET). It communicates in two approaches Vehicle-To-Vehicle (V2V) and Vehicle-To-Infrastructure (V2I). By communicating with other vehicles and with Road Side Units (RSUs) VANET provides many lifesaving and commercial services. There are no fix infrastructures in VANET. Both Vehicle-To-Vehicle (V2V) and Vehicle-To-Infrastructure (V2I) take place with the help of On Board Unit (OBU) which is residing on the vehicle. Scheduling is a very important issue in VANET as messages are to be delivered to the recipient vehicle properly and accurately. It is important to send emergency, lifesaving and messages with critical information before general entertainment and commercial messages. It is also critical that any message which is sent to the vehicle is received by it in the time period for which the vehicle will be in range of the RSU. The objective of our work is to enhance the delivery of a message from RSU to vehicle. To achieve this we will develop a priority based scheduling protocol which will send the message from the RSU to the vehicle in the required time bound by broadcasting periodic messages which results into reduction in network traffic and without affecting the service ratio and without compromising reliability.

Key words: VANET, Scheduling, RSU, Priority Scheduling, Protocol

I. INTRODUCTION
Vehicular Ad hoc Networks (VANETs) belong to a subclass of traditional Mobile Ad hoc Networks (MANETs). The main feature of VANETs is that mobile nodes are vehicles endowed with sophisticated “on-board” equipments, traveling on constrained paths (i.e., roads and lanes), and communicating each other for message exchange via Vehicle-to-Vehicle (V2V) communication protocols, as well as between vehicles and fixed road-side Access Points (i.e., wireless and cellular network infrastructure), in case of Vehicle-to-Infrastructure (V2I) communications.(10) For Intelligent Transport System (ITS) VANETs are emerging as preferred network design.(3)

A Dedicated Short Range Communication (DSRC) IEEE 802.11 is used by VANET between vehicles for communication. Vehicles on the road can communicate with each other through vehicle-to-vehicle (V2V) communication and/or vehicle-to-infrastructure (V2I) communication. Vehicular Ad-hoc networks provide communication between nearby vehicles and nearby fixed equipment (9).

VANETs enable a new class of applications that require time critical response or very high data transfer rates. VANETs have unique characteristics as: very high mobility, theoretically infinite extension, absence of a centralized control and intermittent connectivity through the sparse infrastructure (9).

The core concern in vehicular ad-hoc networks (VANETs) is the reliable transfer of safety related messages to all vehicles which are in danger on the road. A severe challenge in the reliable safety message dissemination has occurred due to the presence of transmission holes in the VANET communication (7).

VANET is a part of Intelligent Transport System (ITS) which provides many applications like global positioning system, traffic observation, management of traffic and many more.(4) Various protocols are used to establish communication between Vehicle-To-Vehicle (V2V) and Vehicle-To-Infrastructure (V2I) communication. These protocols are defined as follow:

- Position Based Routing Protocol
- Topology Based Routing Protocol
- Broadcast Based Routing Protocol
- Cluster Based Routing Protocol
- Geo Cast Based Routing Protocol

A new class of application that requires time-critical responses (less than 50 ms) or very high data transfer rates (6-54 Mbps) is enabled by VANET (8).

VANET routing is classified into Unicast: Vehicle to Vehicle communication, Multicast: Vehicle to multicast members through multi hop communication, Geocast: A subset of Multicast with communication targeted in a specific geographical location and Broadcast: Vehicle to all the vehicles in the coverage area.

II. ARCHITECTURE OF VANET

Fig. 2.1: Architecture of VANET (7)
From the vehicular communication perspective, it can be categorized into:
- Road-vehicle communication (RVC, also called C2I)
- Inter-vehicle communication (IVC, also called C2C) (9)
V2V communications and transferring of safety data can be reliably carried out using IEEE 802.11p VANET. Vehicular wireless broadband can be accessed over IEEE 802.16 metropolitan networks (11).

Generally, vehicular communication in VANET can be of two types:
- Inter-vehicle communication, [V2V]
- Intra-vehicle communication, [V2I]

The intra-vehicle communications is used to describe communications within a vehicle, whereas the term inter-vehicle communications represents communications between vehicles or vehicles and sensors placed in or on various locations, such as roadways, signs, parking areas, and even the home garage. Inter-vehicle communications can be considered to be more technically challenging because in this case the vehicle communications need to be supported both when vehicles are stationary and when they are moving (12).

III. ANALYSIS OF SCHEDULING AND PROTOCOLS
There are various protocols in which different scheduling techniques are described. In the protocol DOVE: Data Dissemination To A Fixed Number of Receivers in VANET it is emphasized on accurately control the number of receivers, achieve low dissemination delay and incur only small communication overhead. So, by implementing this protocol we can focus on sending the fixed number of desired message from the RSU to the targeted vehicles in the interested area. The high accuracy of sending the message can be achieved by a small overhead and low delay.

Many applications of VANET require disseminating data to a fixed number of recipients. This is achieved by implementing the technique of this paper with a small overhead and little inaccuracy, e.g., 0.2% of inaccuracy, i.e., 1002 receivers actually gets the data though the desired number is 1000. (1)

![Data Structure In Dissemination](image1)

Fig. 3.1: Data Structure In Dissemination

In the given diagram data structure of dissemination is given in which the data dissemination area, abstract directed graph, shortest path tree and tree with timeline are shown. In figure (a) an abstract road map is shown, fig. (b) represents a road, c and d are showing shortest path tree and work time line accordingly.

The distributed scheme is divided into 3 parts:
- The workload delegation
- Relay the disseminator role forward and share it backward
- Dynamic work reassignment

A new scheduling technique is implemented in the SCORE: Data Scheduling at Roadside Units in Vehicle Ad hoc Networks (2) which focuses on the RSU that provides a scheduling technique which builds a schedule that is divided in time-slots in which all users are expected to connected to VANET.

In this paper the user’s data will be cached and stored during the free time slot of the RSU and by doing this RSU will estimate the time on which user connects to the VANET. RSU’s cache can store any kind of data which is ready to be delivered to users and from the data and service provider it can also obtain on-demand data as well.

To acquire this facility of the RSU the user has to register with RSUs online website and he specified his personal detail for authentication purpose. The user can also choose a default RSU by which he will connect regularly. Default database will save his account in the database.

The RSU, by building their own schedule which contains the time at which the user will connect, RSU prepares the data which is cached during the free time slot of the RSU will be allowed to balance its load and enable to user to obtain data much faster after they connect.

The RSU will start a training period to update the user’s profile. The default RSU will of the user will be assigned with a probability value which will be initialized to 1. The RSU then starts a training period for the user, during which the RSU increases or decreases the probability (i.e., priority) of each period according to whether the user connects during this period or not.

To build the RSU’s schedule data can be classified into three parts:
- Data that change frequently and are fetched every session.
- Data that doesn’t change frequently and are fetched only when they change.
- Data that are sent to the user only once.

By using all the techniques the load on the Road Side Unit will be reduced and the complexity will be hidden for getting the data in a secure way.

A stable routing protocol for highway scenarios using a segment-by-segment method is designed to send packets in highway scenario. When the source and destination nodes are in the same vicinity this protocol adopts the proactive routing protocol. When a node is in near by surrounding it maintains a k-hop count.

A full use of topology based routing and location based routing is done by stable routing protocol. Information is maintained and updated periodically with short end-to-end delay in proactive routing (5).

In case of route discovery proactive routing is used when the destination is within the k-hop vicinity. Source phase, source to anchor phase and anchor to destination phase, these are the three phase type if the routing is not proactive.
The protocol IDVR-PFM: Intersection dispatch-based VANET protocol with parked vehicles forwarding mechanism have proposed a protocol system which delivers a message with a higher efficiency and lower latency of packets using parked vehicles (4).

There are various scheduling algorithms are available in VANET like First Come First Serve (FCFS), Longest Wait Time (LWT), Most Requests First (MRF), Longest Total Stretch First (LTSF), First Deadline First (FDF), Smallest Data Size First (SDF), MQIF-Maximum Quality Increment First, LSF-Least Selected First, D*S Scheduling Algorithm(7)

IV. PROPOSED MODEL FOR PRIORITY SCHEDULING WITH RELIABILITY

As per the literature review done the proposed model will send the the messages from the RSU to the vehicle according to their priority which is set according to their type with reliability. The priority queue is implemented in the RSU buffer and the messages are stored with a count number. The messages with higher count number will have the higher priority and it will be sent ahead of the other messages to the vehicle to achieve better service ratio. The vehicles with higher service ratio will receive duplicate messages to maintain reliability.

A. Pseudo Code:

```plaintext
RSU ()
{
    For i=1 to N // Vehicles in RSU range
        Queue < id_i, vel_i> ← Reg_req (v_id)
        Queue < id_i, vel_i> ← Velocity (v_id)
    ...
}
```

Fig. 4.2: Running Mode

- As from figure 4.1 The parameter for the training mode are set and the RSU will keep track of the vehicle and it will cacche the ntvera time and speed of the vehicle to send the packets to the vehicle.
- The mobility movements of the vehicle will be tracked and RSU buffer will cache the data accordingly. If it is not regular the the data will not be cached
- The RSU will be sending hello packets to the OBU on the vehicle to perform the registration process.
- If the training time is expired the RSU will be switched to running mode.
- In figure 4.2 running mode is explained in which RSU will be broadcasting the messages to the vehicles.
- The OBU will intimate the RSU if it receives a duplicate messages. After the running mode it will be switched back to training mode.

The interval time that is the number of messages received in a particular time is being scanned in the training mode. From the above flowcharts we can illustrate a stepwise process:
- Train RSU in training mode
- RSU executing in running mode
- Determine RSU range
- Determine vehicle velocity
- Set priority for the messages stored in buffer
- Calculate deadline of the vehicle
- Send prioritized message according to the type of message

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    ...
}
```
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End For
Avg_vel ← Queue < vel 1 to N > / N
Deadline ← RSU_range / Avg_vel
Call priority (Queue < >) //by type of message
Send (message <Queue>) //To achieve better service ratio

V. RESULT AND ANALYSIS

In the below given diagram the RSU is transmitting data to the vehicles in a cross-layer mobility model scenario in which traffic is coming from both the sides.

Fig. 5.1: Rsu Vehicle Transmission
Fig 5.1 shows the RSU and traffic of vehicles in a cross-layer mobility scenario.

Fig. 5.2: RSU And Vehicle Transmission

Fig. 5.2: Packets Received In Given Interval Time
In the figure 5.2 the number of packets which are received are shown in a given interval time.

Fig. 5.3: Speed Vs. Service Ratio & No. Of Duplicate Message 20-Km/h

Fig. 5.4: Speed Vs. Service Ratio & No. Of Duplicate Message 60-Km/h

The above figure describes the graph of speed vs. service ratio and number of duplicate nodes. In Fig 5.1 at the speed of 20 km/h service rate is high and number of duplicate messages are negligible but as the speed increases as shown in Fig 5.2 the service ratio decreases with speed and the number of duplicate messages increases.
The above graph is plotted of speed vs. service ratio in percentage. This describes the results of service ratio at various speeds with and without priority scheduling technique. The results generated from the above graph are shown as below.

<table>
<thead>
<tr>
<th>Speed of Nodes</th>
<th>Service Ratio Without Priority (%)</th>
<th>Service Ratio With Priority (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>89</td>
<td>99</td>
</tr>
<tr>
<td>30</td>
<td>93</td>
<td>99</td>
</tr>
<tr>
<td>40</td>
<td>96</td>
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<td>80</td>
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<td>94</td>
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</table>

VI. CONCLUSION

Proposed Model in this thesis may enhance the current vehicle-to-infrastructure (V2I) communication in VANET in terms of message delivery. This can be achieved by setting the priority of the messages according to their type. An accident related message can have a higher priority than a message containing some entertainment information. We have implemented two queues, in the RSU buffer in which the messages are stored with a count number. The messages with higher count number will be given higher priority against the messages of lower count number and are delivered in the given deadline to the recipient to achieve better service ratio. To achieve reliability duplicate messages will be sent to the vehicles which have a low deadline.

As the priority messages are being passed with duplicity to achieve reliability the network overhead increases. In the future scenario we can form a new reliability technique to reduce the overhead.

REFERENCE


