Categorization and Secure Scheduling of Data Packets for Improving the Efficiency of Data Downloading in Moving Vehicles

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Abstract— Vanets are the result of the envisioned Smart Transportation Systems. It allows various vehicles to communicate with each other and form network. Vanet is one application in which ad hoc networks are used at their full potential. In vanets vehicles can access store and route data to one another. Vehicles in vanets are connected to other networks with the help of RSUs(Road Side Units). Road side Units are like access points by which the vehicles can request new data. Vehicles can work in two different modes under vanet, relay vehicles and end vehicles. Relay vehicles are ones which actively route data through them to other vehicles and end vehicles are one which receive and use them. Therefore with the increasing amount of vehicles on the road, it is very important to regulate or provide a framework by which vehicles can transmit data between each other without any data loss or delay. Efficient methods are also required to allow access to a vehicle in a low density area. Because there may be eve situation when a particular vehicle may move to an area where there is no traffic or very low traffic. On of the most challenging issues is the changing architecture of the communicating vehicles which acts as nodes on vanet. Various scheduling schemes and data handling schemes have been proposed for effectively scheduling the resources and data through vanet. In this paper we propose a TDMA based data scheduling scheme which can categorize the data which is being transferred by the system and can work accordingly to the requirement for that data to be delivered effectively to the end vehicles. We also plan to employ mac based congestion control approach which can effectively handle heavy traffic load at places with high traffic.

Key words: Road Side Unit (RSU), transfer, VANET, algorithm

I. INTRODUCTION

A vehicular ad hoc network (VANET) uses cars as mobile nodes in a MANET to create a mobile network. A VANET makes every participating car into a wireless router or a communicating node. It allows cars which are nearly 100 to 300 metres of each other to connect and, create a network with a large range. When a single car drops out of the network, other cars can join in, thus connecting vehicles to one another so that a mobile internet is created. Car-to-roadside communication is based on a WLAN (IEEE 802.11p) platform developed particularly for the vehicles. In VANETs, the vehicles usually move pretty fast which leads to short vehicle to vehicle connectivity time. Therefore, installing RSU at the important places in a planned manner is also very important. Vehicular networks are the envision of intelligent transportation system (ITS) in which vehicles communicate with each other via inter vehicle communication (IVC) and also with roadside base station through roadside to vehicular communication (RVC). The final goal is that vehicular networks will contribute to safer and more efficient roads in the future by providing timely information to drivers and the concerned officers.

II. CHARACTERISTICS AND REQUIREMENTS

Since the vehicles directly communicate with each other and with RSU, an entirely new type for vehicle based applications can be created. The main applications such as safety and non-safety applications can greatly improve the road and vehicle efficiency. New challenges are faced by high vehicle speeds and highly changing operating environments of the vehicles. Again, a new requirement, necessitated by these newer applications, includes new expectations on high packet delivery rate along with low packet loss. This data is usually self-contained within a single vehicle. But With a VANET, the 'the necessity for creating awareness of other vehicles' for the vehicle or driver drastically increases. In VANET, the vehicular communication can be done either directly between vehicles at the next hop, or vehicles can be made to continuously retransmit messages, thereby enabling the vehicle to act as a router. With the increasing traffic conditions there is also an equal increase in the amount of traffic and accidents that occur on the road. The vanet applications mainly aims to be a solution for such hazards that may occur on the road by promptly alerting the drivers of the traffic conditions and the accidents which could have occurred on the path ahead. But the main difference in vanet from other mobile networks is its ability to work without any infrastructure. Vanet can work without any access points of base station of infostation. Therefore complexities arrive when either vehicles travel in a high traffic area or into area with very low vehiclular density where a vehicle may not have any connection with any other vehicles. Therefore proper scheduling of data that is transferred among vehicles and a methodology to regulate the flow is various traffic conditions are required for this emerging network.

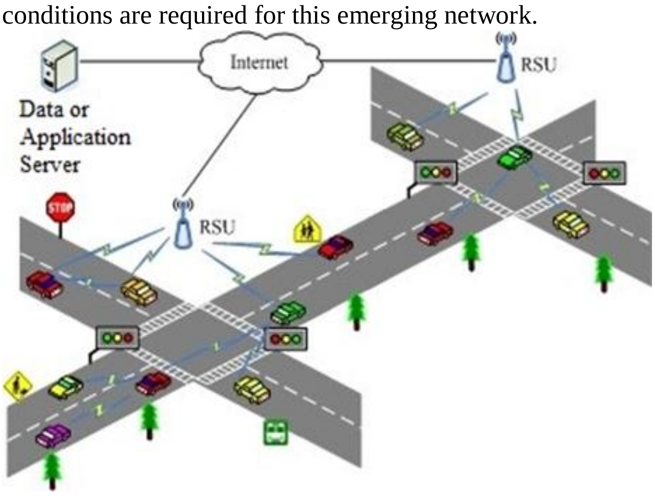

Fig. 1: VANET (Vehicular Network)

III. APPLICATIONS OF VANET

The applications of vanet can be broadly classified as follows

A. *Real time Traffic Information's:*

The network should be able to provide real time traffic alerts and information on traffic conditions on roads ahead. This can be done by actively collectng and storing location information of various vehicles on a particular area and storing it on the RSU. When other vehicles approaching the same area requests this information, it can be directly provided from the RSU to that particular vehicle requesting it.

B. *Active Prediction and Traffic Alerts:*

This application can be used to promptly broadcast the traffic information priorly to the vehicles before they reach the congested areas on the road.

C. *Cooperative Data Sharing:*

When a car on the road suddenly hard brakes, the information should be relayed and transferred to all the vehicles behind the particular vehicle and the information should be delay sensitive.

D. *Commercial Applications:*

The vehicular network can be used to provide business based or commercial data to the vehicles such as real time video streaming from the cloud, internet access, on demand entertainment services, etc.

E. *Real Time Map Generation:*

The drivers can request the real time maps of the regions which they area about to travel prior to overtaking it.

F. *Real Time Data Relay:*

This is especially for normal people travelling in the vehicles connected to the vanet. They will be able to transfer or relay real time data such as live video calls, data transfer and share files across vehicles of their choice while on the move.

G. *Advertising:*

This can be effectively used to provide live ads to the customers who are on the move. For example, when a vehicle moves across a motel, restaurant or a movie theatre, the business people can use this technology to provide ads to the vehicles about their enterprise so as to effectively attract customers.

H. *Vehicle Registration & Regulation:*

This system can be used to effectively register and save information on number of vehicles crossing a particular area without the requirement for the vehicle to be stopped and have to register automatically.

I. *Toll Collection:*

Payments in toll can be done electronically at certain collection points[4]. It is beneficial to both the traverllers and the toll operators.

IV. PROPOSED SCHEME

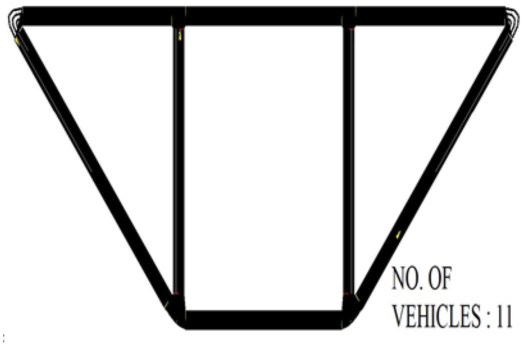

Fig. 2: Road Structure & Number Of vehicles

A. *System Model:*

Consider a one-dimensional road and choose one segment of the road, which is a straight line as,

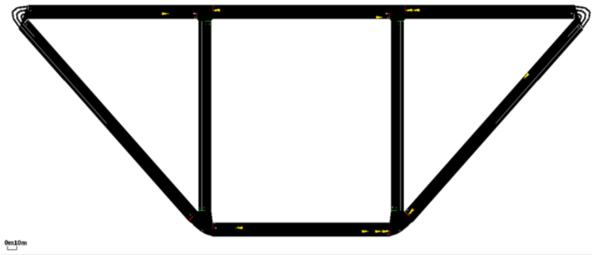

Fig. 3: VANET Network design

shown in Figure 3. The Vehicles are distributed as poisson points over the road segment. That is, given that there are k vehicles, they are independent and uniformly distributed over a initially. We are interested in a network scenario on highways or rural areas, where the vehicle density (defined as the average number of vehicles per unit road length) is low enough to have disrupted vehicle-to-vehicle and vehicle-to-RSU connectivity. With a high vehicle density, a multihop end-to-end path can be found between a vehicle and an RSU with a high probability. Also, we do not consider the case where no packet relaying is possible (i.e, data packets will be carried by their originator vehicle till it meets the RSU) since wireless communication has no significant role in the packet delivery delay in such a case. This may happen either when the vehicle density is extremely low and/or the number of RSUs covering the road is fairly large. Although an RSU can receive packets from the vehicles heading toward the RSU or moving away from it, we consider only one direction in packet transmission, as considering both directions (i) does not constitute a significant difference in the analysis, and (ii) is difficult to implement as a vehicle needs to know the location of the RSU and its own location (otherwise it may not be able to know when to switch its transmission to the RSU ahead of it).

Here, we do not consider packet relaying via vehicles moving in the opposite direction. The reason is that it makes packet transmission subject to severe physical channel impairments, which are very significant due to the high relative speed between two vehicles moving in the opposite directions. In addition, the meeting time between two vehicles moving in the opposite directions may not be enough for transmitting a significant number of packets unless the available bandwidth is very large. The vehicles can upload data from RSU when they are in range of RSU. Usually the RSU maintains non-preemptive scheduling in which one service cannot be interrupted until it gets completed. The communication takes place with the help of the wireless channel and the vehicle which wants to access data from RSU sends a request which consists of the vehicle number, identifier of the requested data and the operation that vehicle can do. The RSU then serves the request as per the scheduling algorithm provided to it and removes the request from the queue. Each request from each vehicle has it own timeout amount after which the request will be dropped if not processed.

B. *Cooperative Data Downloading:*

Firstly the vehicles are identified for their types as follows,

- Requestors: These are vehicles that request the data at the first place.
- Receiving vehicles: These are vehicles that actually receive or download the data from the RSU.
- Intermediate vehicles: These are vehicles that act as a relay towards delivering the data to the requestors. These vehicles use the store and forward[20] mechanism to deliver data to the vehicles which are out of range of communication from the RSU.

C. *Prioritization of Message Data:*

We analyse the messages and the messages classify them in to categories based on priority, timeout, message size and the order in which the request was received. Then based on our proposed scheme we use a scheduling algorithm based on the application or as an on demand request from the following.

- Data with Small Short Deadline: In this the request which is most urgent will be processed first.
- Very Small Data First: In this the request wills the data of smallest size will be processed first.
- Priority Based on Request Order: The request that arrived early will be processed first.

D. *Performance Evaluation:*

We use the following performance metrics to evaluate the performance of different on-demand scheduling algorithms in our model.

1) *Deadline Miss Rate:*

It measures the percentage of missed requests to the total number of requests received by the RSU. If the deadline miss rate is low, it means scheduling algorithm is better.

2) *Throughput:*

Throughput is the number of requests successfully processed by a RSU in unit time. Hence, many requests will be served concurrently, when the scheduler broadcasts the most popular data item and throughput increased. High throughput means better system performance.

3) *Full Response Time:*

The average response time of a RSU on receiving a request. Low average response time initiates system is improvement.

E. *Algorithm for Shortest Data First and Priority based on Request Order Schemes:*

Our aim is to schedule the maximum number of vehicles in the scheduling. With the help of scheduling schemes we can reduce the turn-around time of a process while increasing the throughput. We are also able to maintain the congestion control which helps in controlling the delay of the request. Our proposed method has reduced the congestion and delay control of the data. The CCH channel is congested if the packet queue of the beacon message exceed the define threshold value so that is why we assign the priority to the message and these message according to their priority. Highest priority is given to immediate message and after sending the immediate message we will send the urgent message and then after the information message. By sending these messages according to their priority we can control the congestion and delay of the data.

V. PERFORMANCE EVALUATION

A. *Experimental Setup:*

For evaluating the performance of the proposed scheduling algorithm we developed an ns-2[12] based simulator. The experiment is based on a street scenario with two crossings. The position of one RSU server is at the center of the area. In this model there is a two way road which is the intersection of one horizontal road and one vertical road.

To simulate the vehicle traffic we randomly deploy 11 vehicles which travel across every lane. When the vehicles are within the range of other vehicles then they can easily communicate with them and if the vehicle reaches at the end of the road which means that that the vehicle will move away from rest, its request is dropped and the vehicle primarily operates on a store and forward mode. In this mode the vehicle stores the data when it's accessible and delivers it on areas where data is inaccessible.

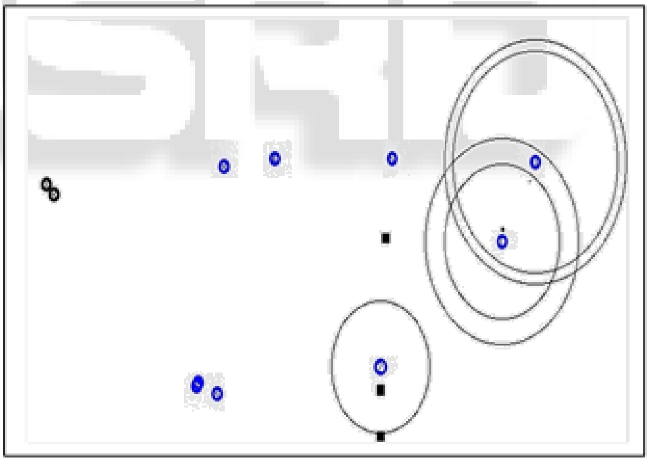

Fig. 4: Vehicles grouped and communicating with each other

In below figure 5 we compare the time delay with and without this scheme. As our proposed method has reduced the congestion and delay control of the data. The CCH channel is congested if the packet queue of the beacon message exceed the define threshold value so that is why we assign the priority to the message and these message according to their priority. Highest priority is given to emergency message and after sending the emergency message we will send the beacon message and then after the commercial message. By sending these messages according to their priority we can control the congestion and delay of the data.

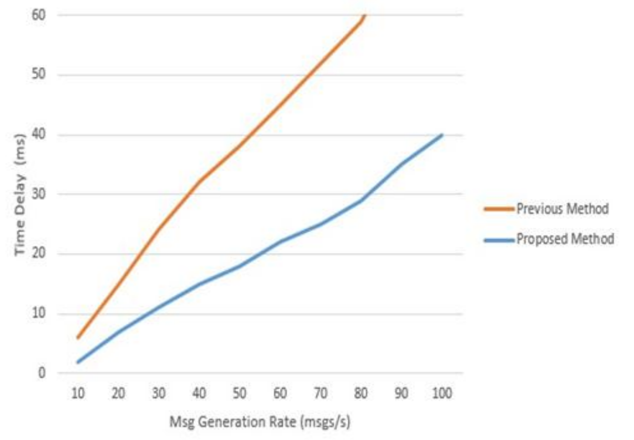

Fig. 5: Graph showing increase in performance

The message generation rate is the amount of message generated by the message manager in a given time interval. Here the messages are generated per second. If the message generation rate is 60 messages then the time delay is 15ms in our new scheme and previously takes the 40ms to generate the 60 messages. The new scheme helps in improving the performance of our system.

In the below Figure 6 the throughput of the process increases, as it is the process that completes their execution per time unit. In our proposed method as the message generation rate is 50 at the time interval of 40ms and the throughput gets increased when compared with the previous method. As the time is the inversely proportional to the throughput, the time decreases when the throughput of the process increases.

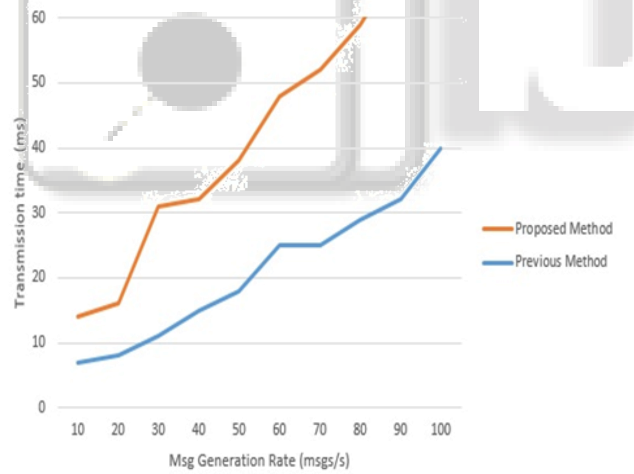

Fig. 6: Graph showing increase in throughput

VI. CONCLUSION

In this paper, we first gave a description of architecture, standards & protocols of vehicular ad hoc networks, followed by the characteristics described in Section II. Section III describes various applications based on its classification. Section IV is giving the implementation of applications at present and in future using the newly proposed scheme. In the paper, we addressed some challenges in data access by the vehicles. We proposed the framework of the congestion control approach. With the help of congestion control we efficiently deliver the data in VANET and also the time complexity reduces. As in dense network, the channel gets easily congested by the high priority messages and also by the emergency message so, we proposed to adapt priority based scheduling algorithm in our congestion control. After sending the immediate and urgent messages we will send the information messages. This will help in improving the reliability and scalability of a process. This paper also focuses on service scheduling issues in vehicle-roadside data access. With the help of congestion control approach we should reduce the channel load in order to meet the QoS requirements of the wireless network performance. This paper increases the efficiency and throughput of the process and decreases the turnaround time for the process. With the help of proposed algorithm the time complexity of a process reduces. Therefore, in the future we plan to improve security by implementing implicit acknowledgement. We also plan to inspect other improvements in terms of implementing security in the system.

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