A Survey on Congestion Control Techniques for Vehicular ADHOC Networks

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***Abstract*-- Vehicular Ad hoc network is an advanced type of MANET (Mobile ADHOC network), which is formed when vehicles are in mobile condition. These mobile vehicles communicate among themselves by establishing a secure connection by isolating themselves from other networks. Due to high mobility, the network topology becomes highly dynamic where they also result in congestion within the network. Congestion may also occur due to the overload of messages within a network. In such cases, congestion control needs to be performed at each VANET node locally, by itself in a self-organized way. This paper discusses the various congestion control techniques based on their features, capabilities and their efficiencies.**

Keywords--VANETs, Congestion, Overhead, Control.

I. INTRODUCTION

Vehicular Ad hoc network (VANET) is a tedious approach for future Intelligent Transportation System (ITS). They are implemented by the principles of Mobile Ad hoc Networks (MANET). Generally VANET consist of vehicles as nodes. These nodes are not in the fixed infrastructure so various VANET protocols are discussed in this survey by referring a number of papers, already proposed. Usually vehicle to vehicle communication takes place by three types of messages called query message, beacon message, emergency message .VANETs make use of wireless technology as their basis.

Security requirements for VANET

Authentication: Authentication is a major requirement in VANET where it allows only the actual nodes of the network to send or receive messages. It prevents the authenticated users from attacks done by greedy intruders.

Message Integrity: This ensures that the message is not modified or retransmitted anywhere in between, within the network.

Message Non-Repudiation: Repudiation is a security based system where the sender cannot deny his act of having sent the message. It does not reveal the sender's identity to all the vehicles in the network, rather only specific authorities are allowed to identify a vehicle from the authenticated messages it sends.

Entity authentication: It ensures the presence of the sender within the network till it reaches the target node.

Privacy: This prevents from third party intrusion where the user's data must be protected so that the other nodes cannot see their content. User is allowed to decide which data has to be established and which has to be protected.

Message confidentiality and access control are also some of the security requirements of VANET.

Applications of VANET

Applications of VANETs include Electronic brake lights that allow driver to react to the vehicles which apply brake even though they might get away from the danger and platooning that allows a vehicle to follow its preceding vehicle with some range of few inches between them , by receiving the acceleration and steering information wirelessly.

Traffic information system is another application of VANET which provides obstacle reports to vehicle's satellite navigation system.

II. LITERATURE SURVEY

a) A Collision Avoidance Mechanism for Emergency Message Broadcast in Urban VANET

To achieve safe and fast transmission of messages on the traffic rich urban areas, a handshake mechanism has been designed. The traffic can be reduced by avoiding the packet delivery failure while sending the messages. By considering the quality and the characteristics of the roads the handshake mechanism

has been designed. Acknowledgement handshake mechanism is not possible because of the collision of acknowledgement replies from various number of receivers. Hence the handshake mechanism, RBEN/CBEM protocol which is used for rapid

transmission of messages in the urban roads without packet delivery is been designed. The RBEM/CBEM mechanism will be used only in the emergency broadcast of messages. The tall buildings and the trees present in the urban areas creates the block of signal transmission, thus multi hop transmissions occurs in the area. The MAC layer is being used for the emergency broad cast of messages without acknowledgement. To broadcast the message, some vehicles are selected as the relaying nodes for rebroadcasting and others as ordinary nodes. Vehicles with the electronic maps identify the information and assist their one hop neighbors. Since all vehicles are considered to be in the same range, message can be transmitted rapidly. Thus the broadcast of message is done rapidly using the RBEM/CBEM handshake protocol.

b) A New Tree Based Double covered Broadcast Protocol for VANET [2]

In VANET to obtain high packet delivery ratio and to reduce the congestion, the tree based DCB protocol is been designed. This technique makes use of tree based structure for forwarding the packets with high packet delivery ratio. It uses the fixed packet length ratio during the broadcast of the messages. Trees use the shortest path technique. Build a tree where the parent node is selected by considering the node which has a large number of children nodes. This technique is based only on a single source node to control the traffic and high control overhead. Thus the tree structure helps in improving the high packet delivery ratio with fixed packet length.

c) Congestion control approach by reducing the number of messages in VANET[3].

The main essence of the method proposed for the congestion control in vehicular Ad hoc network is to exploit the existing resources of the network and for preventing overheads of nodes and the links of the network. But it faces a lots of challenges which are the consequences of the environmental specifications such as frequent modification of topology and node density etc., On taking the above mentioned points into consideration, A technique has been proposed to control unnecessary congestion by reducing the number of transmitting messages in VANET. Here, each node consists of a neighbor table for comparing the messages and discarding similar ones. This comparison is handled by using database query and makes use of control queue or service queue.

d)Communication Based Accident Avoidance and Congestion Control Mechanism in VANET[4]
To reduce the accidents occurring on the roads by considering the cars as the mobile nodes, this mechanism has been proposed. This mechanism is used to avoid the collision using vehicular Ad-Hoc network, where cars are being considered as the wireless routers. The on-board unit and the application unit is the major equipment used in this mechanism. Also, it checks whether the message has been received already to reduce the control over head and also avoids the duplication of messages. It uses the air bag system to reduce the accidents and a GPS module to alert the driver about the accident. Thus this mechanism is fast and efficient in alerting the drivers about the accidents that are going to take place.

e) Adaptive Congestion Control for Transmission of Safety Messages in VANET [5]

Many congestion control mechanisms have been proposed but there is no mechanism which provides accurate solution to the problem. In this paper, the congestion control mechanism is used to send the emergency messages to the appropriate receivers without any time delay and traffic free transmission. For the vehicle safety on the road side, the intelligent transportation system has been developed for the vehicles communicating within themselves. And this uses wireless medium only. Here two messages are been used one is beacon message and the other one is event driven message. Beacon messages are the status messages which are being used to alert the other vehicles about their speed, position. Event driven messages are the messages which are being sent when the vehicle is in the abnormal condition.

f) Novel Approach To Improvise Congestion Control over VANET [6]
The increasing demand of VANET in the communication of cars and handling large number of request and response among the vehicles has resulted in congestion. This paper provides a unique technique in controlling congestion over VANET using simple techniques on early detection of congestion .This modification has been done using AODV protocol.

These techniques are implemented using the simulation of SUMO, MOVE, NS2.Researchers include maximum of the parameters along with optimum channel utilization and efficient signal transmission. This paper clearly depicts that the congestion control has been improved independent of the size of vehicle, type of roads, speed range and characteristics of driver.

Since the congestion is detected at its earlier stage, the vehicles can be prevented from getting stuck in traffic jams.

g) The Potential Of Transmit Data Rate Control for Channel Congestion Mitigation in VANET [7]

This paper aims at increasing road safety, offering new communication based services and enhancing transportation efficiency to road users. Most VANET suffer limited scalability due to poor robustness and radio channel congestion. Most of the works on congestion control is usually based on Transmit Power Control whereas they do not deal with Transmit Data Rate.

It also aims at comparing both the Transmit Power Control and Transmit Data Rate Control. The comparison shows that the latter outperforms the former in various test scenarios and particularly of channel is concerned in a localized cluster of vehicles.

h) Theoretical model of congestion control in VANET networks [8]

This paper presents model of congestion control for the implementation of VANET network in the future. This model is based on Random Early Detection (RED) Algorithm but modifications were made on the decision thresholds and the signalling information behaviour over the network nodes was contemplated [18].

i) New Mechanism For Traffic Control Based on VTL and VANET [9]

It deals with congestion control by using the traffic light to alleviate traffic congestion and carbon emission problems.

A dynamic traffic regulation method based on Virtual Traffic Light (VTL) has been proposed for VANET.

Here each vehicle can express its desire of moving forward and sharing among others of this "will" and related traffic information at a traffic light controlled intersection. Number of simulation experiments has been conducted on different scenarios using NS3 with traffic simulator SUMO. The results demonstrate the viability of the solution in reducing waiting time and improving the efficiency of the traffic.

j) Efficient congestion control in VANET for safety messaging [10]. The primary goal of VANET is to provide life safety on roads. Vehicles use two types of safety messages to achieve this. They are periodic safety messages to exchange status information and event driven messages to broadcast messages at emergency situations. Both the messages use same control channel which results in congestion when there are many vehicles in the network thus restricting the event driven messages that compromises the safety conditions. This provides no safety and to overcome this problem researches have proposed different strategies by limiting beacon bandwidth usage level below the threshold and high priority event driven messages are reserved with separate bandwidth congestion control scheme using transmission rate and power are simultaneously considered for optimal results.

k) Dynamic and distributed channel congestion control strategy in VANET [11].

Congestion control is an important research issue that ensures safe and reliable mobile vehicular communication in VANET. It includes both safe and unsafe messages among the vehicles. This paper aims at controlling the channel congestion dynamically where the rate of data transmission is in the form of messages that are reduced among vehicles .This reduction is handled by a strategy *where only the authentic vehicles are allowed to utilize the available network resources and the attackers are revoked thus leading to dynamic channel control.

l) VANET Congestion Control Approach using Empathy [12].

The paper has introduced a new approach in congestion control of VANET using new model which is based on hop by hop congestion control methods .This implements an interesting concept of empathy .The problem is modelled using constraint programming and then a solver is given to conclude with the results that is compared with hop by hop approach. The empathic approach proved its efficiency when the packet count is very high. It insists on sharing of bandwidth and avoidance of congestion for nodes with many neighbors

III. CONCLUSION

Congestion control mechanisms in Vehicular Adhoc Networks to achieve flawless interrupted communication among the vehicles have been achieved through various means. Virtual Traffic Light targets at reducing the waiting time and improving the efficiency of the traffic. In Adaptive Congestion Control for Transmission of Safety Messages in VANET, intelligent transportation system has been used for maintaining the vehicle safety on the road. Tree based Double covered broadcast protocol controls the congestion in the network and it also provides high packet delivery ratio with fixed packet length. The communication based accident avoidance and congestion control mechanism controls the congestion in the vehicular network and in addition, it alerts the drivers about the accidents that are about to occur. Each strategy has its own merits and demerits. Different techniques are meant to be used in different scenarios. Therefore it is wise to use the appropriate congestion control solution according to the network's characteristic and issue that arise Security plays a major role in VANETs which still remains as an issue, Though many techniques have been proposed to control the congestion, the security threats that arise due to the congestion are to be solved for providing an efficient vehicular Ad hoc Network.

IV. REFERENCE

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