Road traffic notification in VANET with selective flooding

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Abstract: *Vehicular Ad-hoc Network is fundamentally new and yet to be standardized concept for inter vehicular communication where vehicles shares several information ranging from their location, speed , direction, traffic congestion to information like position of petrol pumps, ATMs and sensor information like Temperature etc. Such a network is formed with the help of simple radio communication unit deployed at the vehicles.As against other wireless networks like MANET, Wi-Max VANET plays a different role as information exchange goal is to dissipate information from one node to maximum number of nodes. Often information is duplicated and too many packets are flooded in the network causing congestion and packet drops. Thus important information's like traffic congestion or accidents are delayed. In proposed system a node periodically broadcasts its location and direction obtained through GPS system. A congestion scenario is modeled as accident where a node's speed becomes zero. All the consecutive node's speed decreases to zero till the accident or congestion is changed. Once a congestion event is detected, nodes broadcast congestion notification to its nearest nodes. Upon receiving congestion notification, nodes following the congestion areas gets slow down and bypass the congestion area through bypass. Once congestion is cleared, all nodes acceleration and speed is normalized. Through simulation we show that proposed system reduces speed to a great deal and network packet congestion is reduced through selective forwarding technique which also minimizes congestion and delay. Proposed protocol is simulated with Erlang city's realistic simulation and a custom traffic scenario of road junction.*

Keywords: *Flooding, Traffic Congestion, VANET.*

Introduction

The recent advance in wireless network with respect to locomotive is a vehicular ad-hoc network(VANET) which is class of mobile ab-hoc network. The unique features of VANET are highly mobile nodes, rapidly changing network topology, self-organizing. VANET mainly consist of on board unit (gps) built inside the vehicle and road side unit. VANET mainly developed for intelligent transportation system (ITS) , it is classified into vehicle to vehicle communication and vehicle to road side unit communication.

The main objective of VANET is that every node in an area gets the information about all other nodes in that area. Assume that nodes broadcast periodic messages (HELLO or AirFrame) and then find a route to every independent vehicle in the area then route cache of the nodes increases many a folds with increase in number of nodes. Secondly there is no control over the topology as number of nodes in the topology keeps varying. Therefore modeling existing wireless network as VANET just by incorporating the mobility model does not simulate VANET realistically. Moreover if broadcast based notification system is developed like flooding protocol in Sensor network then congestion messages are also broadcasted the nodes which have left the congestion area, thus making the simulation objective failed. Hence objective of the work is to offer a realistic simulation environment where a node encountering congestion propagates the information to the neighbors. A neighbor based on the location of congestion determines if the event needs to be processed. If the nodes are approaching the congestion area, then they propagate the information through selective flooding. The information is also propagated to nearest traffic station which is modeled in VANET through obstacle manager.

As existing simulation techniques are not realistic and do not perform simulation on real VANET nodes, understanding a congestion and time taken by the congestion to clear is tough. Such simulation cannot be used to adopt strategies in real world problems. To obtain more realist solution for real traffic problem, not only the mobility should be generated from traffic generation tool but at the same time node modeling and the communication stack must be developed to suite the simulation. So, We proposed a system where node periodically broadcasts its location and direction obtained through GPS system. A congestion scenario is modeled as accident where a node's speed becomes zero. All the consecutive node's speed decreases to zero till the accident or congestion is changed. Once a congestion event is detected, nodes broadcast congestion notification to its nearest nodes. Upon receiving congestion notification, nodes following the congestion areas gets slow down and bypass the congestion area through bypass. Once congestion is cleared, all nodes acceleration and speed is normalized.

This paper is organized as follows, section II describes related work. Section III details the system design and implementation. Section IV presents the performance evaluations of our system design. Finally, section V presents some concluding remarks.

Related Work

Recent research efforts have placed a strong emphasis on novel VANET design architectures and implementations. A lot of VANET research works have focused on specific areas including routing, broadcasting, Quality of Service (QoS), and security. Some of the recent research results in these areas are wireless access standards for VANETs, and describe some of the recent VANET trials and deployments in the US, Japan, and the European Union [1].

In this paper author [2] examine, a set of step-by-step enhancements to the level of details in mobility models for VANETs and evaluate the sensitivity of simulation results toward those modeling details. Through this process,several new mobility models, that account for vehicular movement constraints such as traffic lights, multilane roads, and acceleration/deceleration. Using real and controlled synthetic maps, we compare our mobility models and two prior models. Our results demonstrate that the delivery ratio and packet delays in VANETs are more sensitive to the clustering effect of vehicles waiting at intersections and acceleration/deceleration of vehicles..In this paper [3] author, present *CityMob*, a mobility pattern generator that allows researchers to easily create urban mobility scenarios including the possibility to model car accidents and to use a flooding based alert protocol to announce events.

In this paper author says[4], existing distance vector routing protocols viz. DSDV , AODV and AOMDV are analyzed not as done earlier over grid topology, but considering details of road layout from grid topology. Road topologies such as Highway, Intersection and Bridge are common in city or urban areas. Author proposed to run these protocols for each road topology to obtain more accurate evaluation. Different performance metrics such as PDR , end to end delay and routing overhead are used to obtain the result for all three routing protocol. Finally this analytical study helps to compare and decide better of routing strategy for city scenario with all possible road topologies.

Here [5] author gives a survey of the VANETs routing mechanisms, this paper gives an overview of Vehicular ad hoc networks (VANETs) and the existing VANET routing protocols; mainly it focused on vehicle to vehicle (V2V) communication and protocols. The paper also represents the general outlines and goals of VANETs, investigates different routing schemes that have been developed for VANETs, as well as providing classifications of VANET routing protocols (focusing on two classification forms), and gives summarized comparisons between different classes in the context of their methodologies used, strengths, and limitations of each class scheme compared to other classes. Finally, it extracts the current trends and the challenges for efficient routing mechanisms in VANETs.

In this paper author [6] gives a survey of routing protocols in vehicular ad hoc networks. The routing protocols fall into two major categories of topology-based and position-based routing. Topology-based routing uses the information about links that exist in the network to perform packet forwarding. Geographic routing uses neighboring location information to perform packet forwarding. Since link information changes in a regular basis, topology-based routing suffers from routing route breaks.

In this paper[7], simulation of one of the routing protocols i.e. AODV is done on simulators which allow users to generate real world mobility models for VANET simulations. The tools used for this purpose are SUMO, MOVE and NS2. MOVE tool is built on top of SUMO which is an open source micro-traffic simulator. Output of MOVE is a real world mobility model and can be used by network simulator NS-2.

This paper author [8] presents a class of road-based VANET routing protocols that leverage real-time vehicular traffic information to create paths consisting of successions of road intersections that have, with high probability, network connectivity among them. Furthermore, geographical forwarding allows the useof any node on a road segment to transfer packets between two consecutive intersections on the path, reducing the path's sensitivity to individual node movements.

Here author [9] has been proposed an innovative approach to deal with the problem of traffic congestion using the characteristics of vehicular ad-hoc networks (VANET). The system is developed and tested using AODV protocol of ad hoc mobile network to deal with the problem of vehicle traffic congestion in vehicular networks. The performance is measured in terms of no. of packets broadcasted, percentage of packets delivered, and percentage of traffic diverted and overhead to manage the problem of data traffic congestion in computer networks.

In this paper[10] author said, to reduce traffic congestion with the help of vehicle-to-vehicle communication. Periodically emitted beacons are used to analyze traffic flow and to warn other drivers of a possible traffic breakdown. Drivers who receive such a warning are told to keep a larger gap to their predecessor. By doing so, they are less likely the source of perturbations which can cause a traffic breakdown. Author also analyze the proposed strategy via computer simulations and investigate which fraction of communicating vehicles is necessary until a beneficial influence on traffic flow is observable.

METHODLOGHY

In vanet the basic objective is to propagate critical information like congestion from the node detecting the events to maximum number of nodes. Most of the current protocols in vanet propose either an end to end routing or flooding for information propagation system. In either cases routing and packet overhead is increased delaying the notification therefore we need routing technique that combines end to end routing with selective flooding to maximize delivery and minimize latency

here each node forms a multicast group with its nearest nodes. One member from each group randomly generates the packet about the location of the group which first propagated to its nearest group and group nearer to that uses routing protocol called wise route which determines amounts of load in the network selects a forwarding group. Once a packet reaches to any of the group member it is flooded within the group.

The speed of some vehicle are made as zero and all the vehicles that are following it would be stationary leading to congestion, once the congestion appears the node which is first suffers the congestion and generates a notification. Once notification reaches to first node which is approaching the congestion area it first reduces the speed followed by changing vehicle diversion which tries to bypass the congested area. All the vehicles that follow these vehicles could follow the same approach. In case of the congestion it determinate by derivate of speed (ds/dt) which is registered by application layer. If there is a significant change in this value a packet is generated with highest priority irrespective of scheduling model and total number of packet exchanged increases, when the congestion is reduced the packet transmission rate gets stabilized marking clearance of the congestion.

Algorithm

Step1: let N be the number of vehicles which is virtually divided into application layer, network layer, link layer and physical layer. Each vehicle also have a sensor layer which is responsible for acquiring vehicle position.

Step2: For i = 1 : N

Get x(i),y(i) as position data of i in the application layer embed this information in packet p(K) and forward it to network layer, at network layer broadcast identity packet to let the neighbour know about current vehicle.

Step3: Upon receiving the packets we should calculate the delay and update the routing table. The vehicle looks inside the routing table and determines the path to each vehicle where it presents in its routing table. Upon receiving the application packet, vehicle forwards the packet should determine route to all the vehicle that are present in its routing table.

Step4: At application layer,

If at any instances of time the rate of change of position becomes zero and remains zero, then generates congestion notification at network layer.

Step5: Upon receiving congestion notification packet determine if the current vehicle is approaching the congested area if it is so displace the speed and current direction to avoid the area.

Step6: Update the statistics.

Step7: End

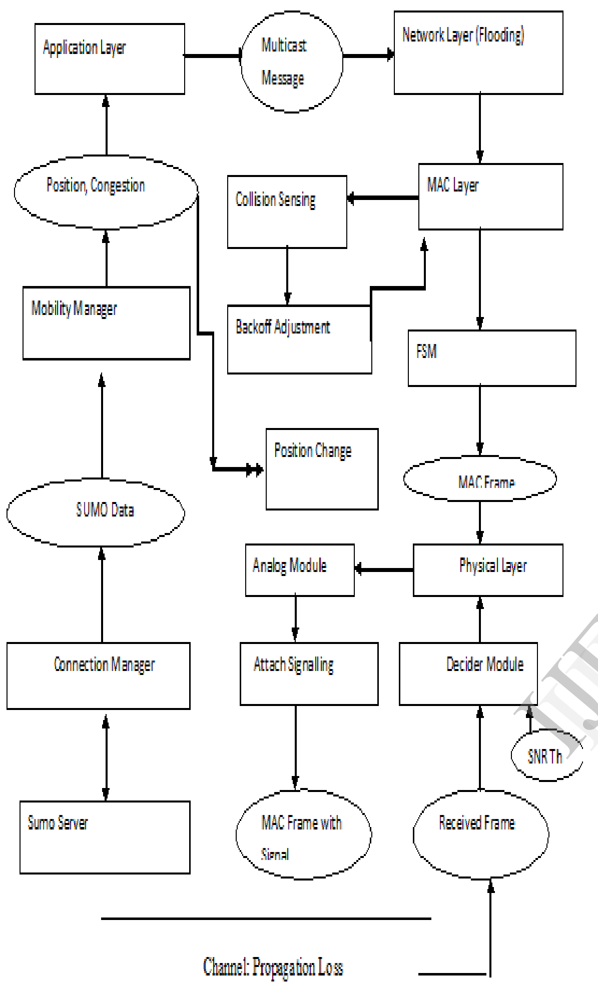

Fig 1. Flow diagram of packet routing

In the above flow diagram sumo is connected to the omnet++ through TCP connection manger the information such as, position of the vehicles, routes, congestion and connection between vehicles etc generated by the sumo simulator is given to the mobility manger (traci manager) which links omnet++ and sumo road simulator. The mobility manager gives the information about position of the vehicles, routes etc to the application layer. Application layer generates the multicast message about position or congestion of the vehicles which is multicast to the network layer where the packet is flooded to the one hop neighbour. Now the MAC layer senses the channel if the channel is not ideal then it goes for back off adjustment otherwise frame goes for fair scheduling management if the MAC frame is about traffic congestion then it sends the frame with higher priority. Now physical layer receives the frame from the MAC layer this layer uses analog modulation i.e QAM with noise cancellation now the frame is ready to transmit through the antenna. Once the signal is received by the vehicle the decider module checks the signal strength if the signal to noise ratio(SNR) is greater than SNR threshold then the frame is accepted otherwise its rejected. If the frame is alredy received then the decider module does not send to the upper layer.

IV Results

In the below graph as the simulation time increases the carbon di oxide footprints also increases because as the simulation time increases the more number of vehicle enters and also occurrence and clearance of traffic congestion. Once the traffic jam is cleared carbon di oxide foot prints reduces.

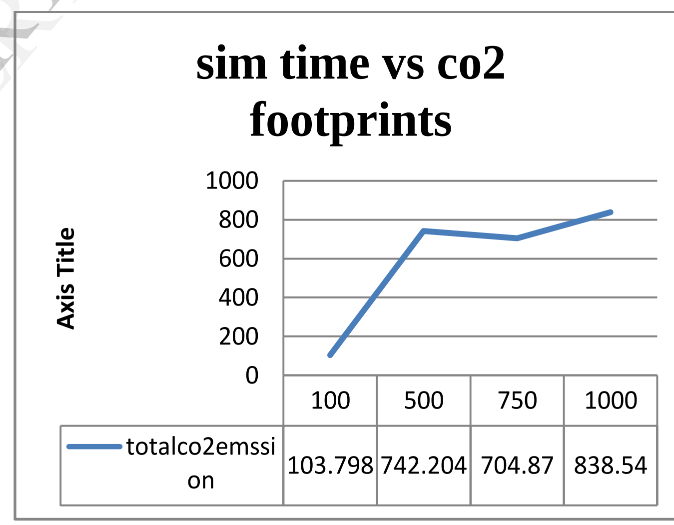

Fig 2. Simulation time vs. Carbon di oxide foot prints

In the below figure, bit rate is number of bits transmitted per second . as the bit rate increases throughput and packet delivery ratio increases also increases. At 512bps PDR and start decreasing because of congestion clearance in the network so, optimum value below 512bps

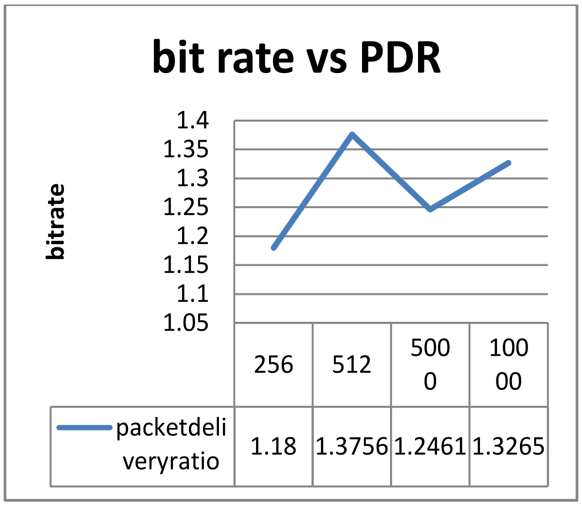

Fig 3. Bit rate vs. packet delivery ratio

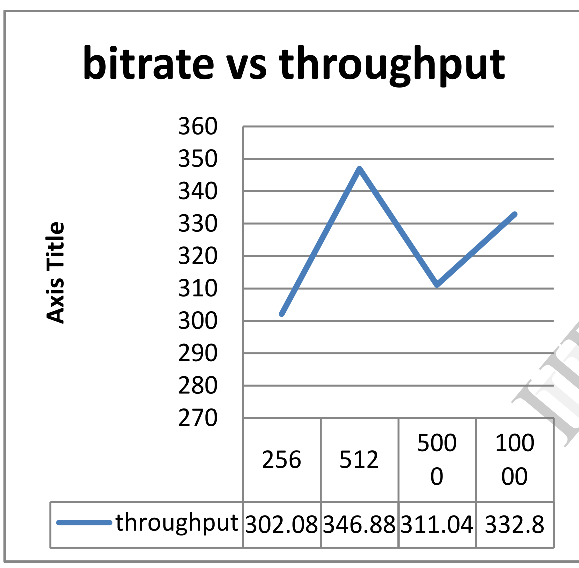

Fig 4. Bit rate vs. throughput

Conclusion

Vehicular ad hoc network (VANET) is a wireless ad hoc network that operates in a vehicular environment to provide communication between vehicles. VANET can be used by a diverse range of applications to improve road safety. Vanet plays a different role as information exchange goals is to dissipate information from one node to maximum number of nodes. Often information duplicated and too many packet are flooded in the network causing congestion and packet drop thus important information like traffic congestion are delayed. To minimize the congestion and delay. In the proposed work we have reduced the speed of vehicle and generate the congestion notification and it is flooded in the vehicle. The vehicle approaching the congestion area receives the notification and the vehicle bypass. Through simulation the proposed system reduces speed variability to a great deal and network packet congestion is reduced through selective forwarding technique which also minimize congestion and delay. We have also observed that carbon di oxide footprint is reduced with some extent.

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