A Congestion Control Approach to Ensure the Delivery of Event Driven Messages in VANET

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ABSTRACT

Mobile ad hoc network (MANET) is a collection of mobile computers or devices that cooperatively communicate with each other without any pre-established infrastructures such as a centralized access point. There are several issues in VANET. One of them is congestion control. In case of increase in the number of beacon messages broadcasted by many vehicles, the communication channel will easily be congested. So, to overcome this problem we have proposed an algorithm that increases the availability of communication channel for emergency messages over the beacon messages.

Keywords

MANET, VANET, Emergency messages, Mobility,Communication Channel

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Introduction

Vehicular ad hoc network has received a lot of interest in a last couple of years. To ensure safe and reliable communication within VANET message priorities are evaluated according to the type of message whether it is event driven or beacon. As one of the main issues of VANET is the high demand of ITS applications for both safety and comfort purposes, it is not good to alter the performance of these applications (by reducing the transmission of power or beacon transmission rate) to prevent network congestion. To cope with this problem we have proposed an algorithm that ensures the availability of control channel for the emergency messages. Information exchange between vehicle to vehicle and vehicle to infrastructure plays very important role to decrease the message crowd and to improve the performance. In this we will concentrate on the feasibility of deploying the safety application by reducing the number of beacon message propagation and also simulate the result.

Literture Review/Related Work

Congestion control algorithm in Vehicular Networks (VANETs) has been extensively studied. However, most of congestion control algorithms are directly applicable for event-driven safety messages. The event-driven safety messages stringent requirement has on delay and reliability. If any event driven message is lost then it will result in loss of life. It's very important to keep the CCH channel free from Congestion.

In research paper [6], Bouassida, M.S., and Shawky developed a congestion control approach based on the concept of dynamic priorities-based scheduling. On the other hand, the congestion control algorithm for event-driven safety messages was developed by Zang, Y.P., Stibor, L., Cheng, X., Reumerman, H. J., Paruzel A., & Barroso, A in [7]. This congestion control approach evaluated the performance of the Safety Electronic Brake Light with Forwarding (EEBL-F). In [8], J,,Chen, H.C. proposed congestion control algorithm for DSRC based on safety applications. However, they just assumed the CCH channel is successfully reserved for event-driven applications without testing the success rate for event-driven safety messages.

By Yu-Chih Wei1 and Yi-Ming Chen in [9], the idea of beacon-based trust is introduced to estimate and to verify constantly a vehicle's position, velocity, and drive direction. In a similar study in [10], YOUSEFI Saleh, FATHY Mahmood, BENSLIMANE Abderrahim emphasized on theoretical analysis for finding the best values of design parameters such as road traffic situation, e.g., speed, density, level of danger and develop methods for setting optimum or sub-optimum values of the design parameters. Again this work is not sufficient to make the control channel free in case of safety messages.

Research by W. Zhang, A. Festag in [11] proposed smart efficient rebroadcast scheme algorithms to prevent the congestion channels problem by limiting the forwarded packets. The blindly broadcasting beacon message will cause a lot of redundancy packets and lead the broadcast storm problem. The purpose of this algorithm is to ensure the delivery of higher priority message before the less priority message. According to [12], Robert Lasowski and Claudia Linnhoff-Popien consider beaconing as a service (BaaS).For this they propose two approaches service-oriented beaconing strategies, Beacon Forwarding Service (BFS) and Beacon Rate Control Service (BRCS), which are based on the following design principles:

Vehicles send beacons with a minimum interval of 2 Hz and 500 ms lifetime.

Every vehicle can request a beacon update from its neighbors. Hereby, the requestor is

specified as a service user (SU) that triggers a service at the service provider (SP) by

sending a service request message (SREQ).

The behavior of SP and the particular service characteristics can be influenced by an
SU specifying appropriate service attributes within the SREQ message.
Single-hop propagation is basically used. However, a requested beacon is forwarded
using one additional hop.
A dual radio concept is mainly applied.
These are the specific conditions or assumptions at which beaconing can be considered as service.
The challenges for the existing research are that any congestion control algorithm is not able to control the beacon message. Above research only discusses how we can check the worthiness of the nodes that are transmitting the beacon message at very high rate or how we can compensate beaconing as a service. This research includes the detection of type of message (beacon or event driven) and after detection how we can control the situation.

Proposed Solution

The event driven detection mechanism first checks the event driven safety message and then decide when to apply congestion control algorithm. Congestion control algorithm will launch queue blocking mechanism for all MAC transmission except event driven safety message.

3.1 algorithm

First of all, we have to check whether the communication channel is available or congested. If jamming occurs in our system then find out whether it is due to emergency message or beacon message.
Emergency Detection
Beacon Detection
b. after detection of type of congestion, we can schedule the transmission of messages with the help of priority scheduling.
c. Rebroadcasting scheme is used to control the broadcast storm due to transmission of same type of message again and again.
/*Congestion control*/
If (occurrence of emergency messages takes place whether locally or globally)
{
Close all the MAC queues except for the emergency message
}
Else
{
If (number or periodic message>threshold value)
{
Ignore the beacon messages
}
Else
{
If (Number of emergency message>1)
{
Block all MAC queues except for the event driven
}
}
}

3.2 the flow-chart of proposed ccmda algorithm

a. First of all we have to check communication channel is available or congested. If congestion occurs in our system then find out it is due to emergency message or beacon message.
i. Emergency Detection
ii. Beacon Detection
b. after detection of type of congestion, we can schedule the transmission of messages with the help of priority scheduling.
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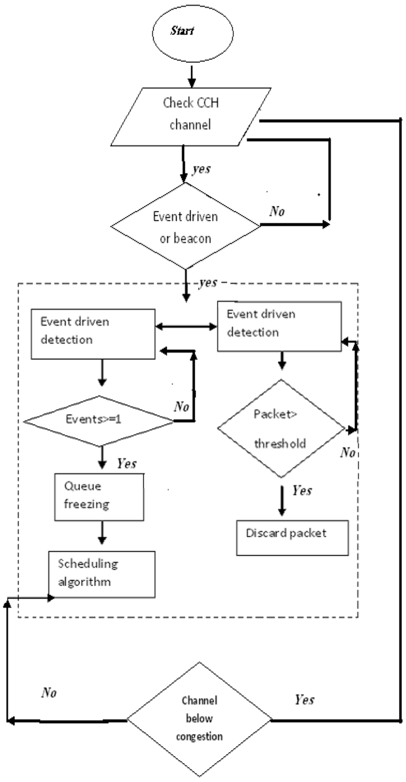

Figure 1. Flow-chart of proposed CCMDA algorithm

Simulation Results

4.1 effective of network density

The number of nodes in a specified network is known as network density. Network density varies time to time in a network because number of vehicles is not fixed. Here, I have considered both types of communication, vehicle to vehicle communication and vehicle to roadside communication. In vehicle to vehicle communication connectivity is good but at a cost of high network density that leads maximum probability of collision and congestion among the nodes. This is the reason behind broadcast storm. So, our main emphasis is how to handle heavy data packets collisions and control of congestion, which is closely related to the performance of the network and routing protocol. To overcome the above problem CCMDA has been discussed but it can't handle the situation completely as [13].

4.2 simulations parameters

The simulation parameters are shown in Table. This table shows the parameters of single LAN of motor-cars in medium density of motor-cars. Here, we used NS-2.34 tool for simulation result. Simulation area define 2000 square meter, mobility of motor-cars 25/s, no. of nodes are 15, range define to communication is 250 meter, data packet size define is 512 bytes, MAC protocol 802.11 is used and simulation duration take 40 seconds. The parameters taken in average delay of networks are given below.

Table 1. Show the parameters used in end-to-end delay of networks.

Parameter	Value
Simulator	NS-2.34
Simulation Area	2000m x 2000m
Mobility of motor-cars	25(meter/second)
Number of node	15
Transmission Range	250m
Constant Bit Rate	2datapacket/second
Data packet Size	512 bytes
MAC Protocol	IEEE 802.11
Simulation duration	40 Seconds
Performance Metrics	Average Delay

Table 2. Show the parameters used in Data packet delivery ratio of networks.

Parameter	Value
Simulator	NS-2.34
Simulation Area	2000m x 2000m
Mobility of motor-cars	45(meter/second)
Number of node	15
Transmission Range	250m
Constant Bit Rate	2(datapackets/second)
Data packet Size	512 bytes
MAC Protocol	IEEE 802.11
Simulation duration	40 Seconds
Performance Metrics	Average Rate

4.3 results evaluation and analysis

Network communication performance is analyzed on the basis of three parameters that are end-to-end delay time (EDT), Data packet delivery ratio (PDR) and throughput.
End-to-End Delay Time (EDT)
It refers to the duration of a message sent from source to destination over the network
[38].
Data packet Delivery Ratio (PDR)
It represents a ratio of successful message deliveries source node to destination node.
Throughput
It refers number of messages delivered per unit time.

4.4 result in various dense network

Figures 22, 23, 24, 25, 26, and 27 compare EDT and PDR results by applying Congestion Control Message Delivery Algorithm (CCMDA), implementing Ad hoc On-Demand Distance Vector (AODV) and Traffic Message Delivery Algorithm (TMDA) routing protocol in low and high density of networks separately. The overall aim is to investigate whether CCMDA leads to less EDT and higher PDR in various scenarios rather than an existing routing protocol. How number of messages impact on communication performance and how the trend of EDT and MDR changes in different network conditions eg. Low density network, medium density network and high density network Yueyue Li (ICWMC 2012) [13].

Low Desnsity Network

Figure 2 and 3 compare average delay of messages and average rate of messages, results by applying Congestion Control Message Delivery Algorithm (CCMDA), Traffic Message Delivery Algorithm (TMDA) and On-Demand Distance Vector (AODV) routing protocol in low density network. According to the graphs CCMDA exhibits smallest delay from message 1 to 10 per testing time, that reflects average delay in figure 2 and highest average rate in figure 3 that is obtained with TMDA and AODV protocols.
So, it is clearly shown in graphs that low average delay and high average rate of CCMDA better than AODV and TMDA in low density medium.

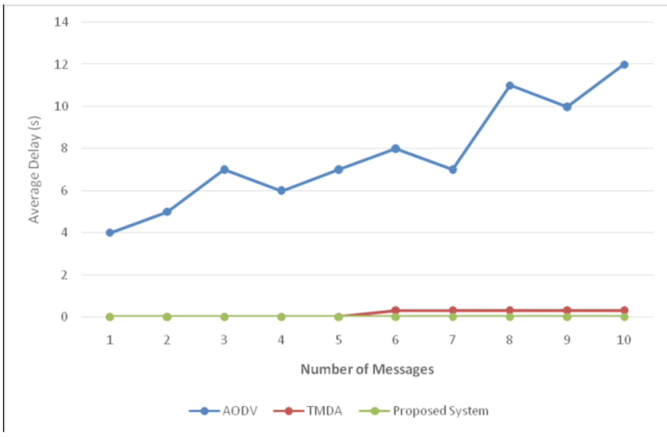

Figure2. Delays in the low density of networks

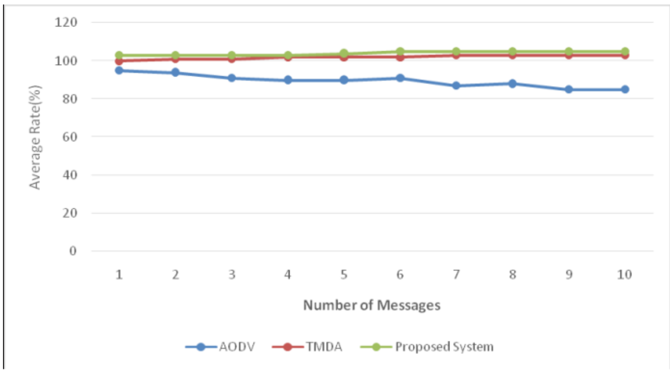

Figure 3. PDR in the low density networks

High Density Network

Figure 4 and 5 compare average delay of messages and average rate of messages, results by applying Congestion Control Message Delivery Algorithm (CCMDA), Traffic Message Delivery Algorithm (TMDA) and On Demand Distance Vector (AODV) routing protocol in high density network. According to the graphs CCMDA exhibits smallest delay from 1 message to 50 messages per testing time, reflecting on the average delay in figure 4 and highest average rate from the above lines in figure 5 than obtained from TMDA and AODV protocols.
So it is clearly shown in graphs that low average delay and high average rate of CCMDA is better than AODV and TMDA in medium density medium.

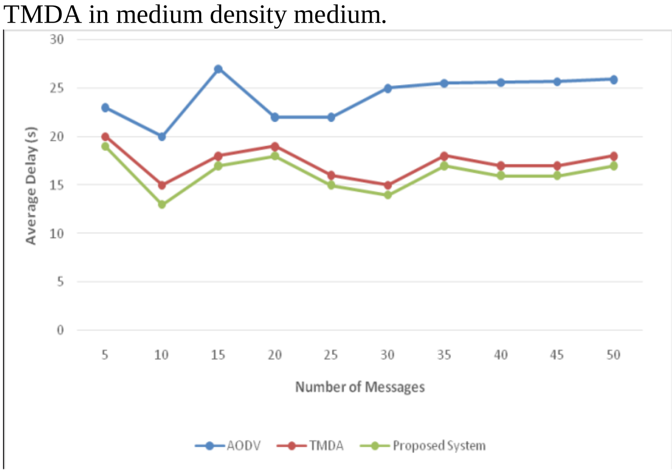

Figure 4. Average delays in high density network

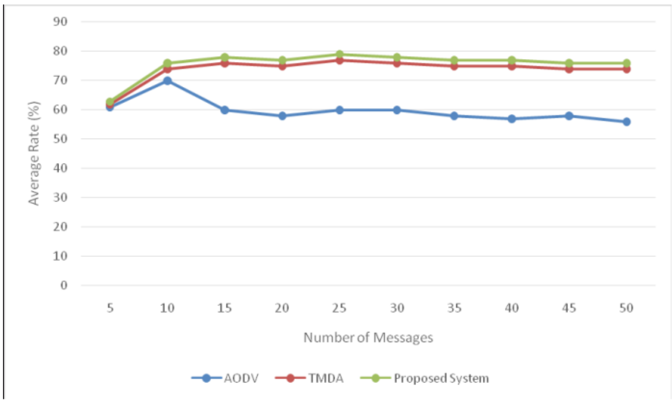

Figure 5. Average PDR in high density networks

Conclusion And Future Work

5.1 conclusion

This thesis represented the comparison of communication performance of EDT and PDR by using various routing protocols (AODV, TMDA and DSDV) in a novel VANET architecture. AODV, DSDV and TMDA are published protocol used commonly in ad hoc network, whereas, CCMDA is a newly created and improved TMDA algorithm. It not only adopts principles based on existing broadcasting algorithms but also include high-way traffic route information. The advantage of such new routing strategies is to elevate the impact of the problems caused by previous routing protocols and also provide the best service for the implementation. We design a Vehicular Ad-Hoc Network architecture which contains two types of ad hoc communication objects-mobile (motor-car), and static (road side units).
So far, investigations indicate that CCMDA generally shows better results than the others (TMDA, AODV and DSDV) in terms of data packet delivery time and successful data packet delivery ratio and throughput in dense, moderate dense and sparse networks Yueyue Li (ICWMC 2012) [13].

5.2 future work

For future enhancement of the research work we can apply the above algorithm in the real life application like any city and then investigate the results of simulation.
One more challenge in ad hoc network is energy efficiency. We can integrate the energy concept with the congestion control algorithm. To avoid the congestion in the communication links a lot of energy is wasted. So, we have to maintain the trade-off between energy consumption and congestion control.

References

[1] Car 2 Car Communication Consortium, http://www.car-to-car.org/.

[2] [2]. US Department of Transportation, National Highway Traffic Safety Administration,“Vehicle safety communications consortium,” http://www-nrd.nhtsa.dot.gov/pdf/nrd-12/CAMP3/pages/VSCC.htm.

[3] M. Khabazian, and M.K. Ali, “A Performance Modeling of Connectivity in Vehicular Ad Hoc Networks”, IEEE Transactions On Vehicular Technology, vol. 57, no. 4, pp. 2440 – 2450, July 2008.

[4] M. Li, W. Lou, et al., “OppCast: Opportunistic Broadcast of Warning Messages in VANETs with Unreliable Links,” Proc. of 6th International

Conference on Mobile Ad- hoc and Sensor Systems,Macau, pp. 534-543, 2009

[5] Vedha Vinodha.D, Mrs.V.Seethalakshmi“Analusis of safety measures and quality routing in vanets” In International Journal of Modern Engineering Research (IJMER) www.ijmer.com Vol.2, Issue.2, Mar-Apr 2012 pp-062-066 ISSN: 2249-6645

[6] Bouassida, M.S., and Shawky, M. (2008). “On The Congestion Control Within Vanet”.1stIFIP Wireless Days. pp. 1-5.

[7] Zang, Y.P., Stibor, L., Cheng, X., Reumerman, H. J., Paruzel A., & Barroso, A. (2007).“Congestion Control in Wireless Networks for Vehicular Safety Applications”. In Proc. Of The 8th European Wireless Conference.

[8] He, J., Chen, H.C. et al. (2010). Adaptive Congestion Control for DSRC VehicleNetworks, IEEE Communications Letters, Vol. 14, No. 2.

[9] Yu-Chih Wei12 and Yi-Ming Chen2“Efficient Self-Organized Trust Management in Location Privacy Enhanced VANETs”

[10] YOUSEFI Saleh, FATHY Mahmood, BENSLIMANE Abderrahim“Performance of beacon safety message dissemination inVehicular Ad hoc NETworks (VANETs)” Journal of Zhejiang University SCIENCE A 2007 8(12).

[11] W. Zhang, A. Festag, et al. “Congestion Control for Safety Messages in VANETs: Concepts and Framework”, In Proceeding 8th Conference on ITS Telecommunications (ITST), Thailand, 2008, pp. 199-203

[12] Robert Lasowski and Claudia Linnhoff-Popien, University of Munich “Beaconing as a Service: A Novel Service-Oriented Beaconing Strategy for Vehicular Ad Hoc Networks” IEEE Communications Magazine October 2012

[13] ICWMC 2012 : The Eighth International Conference on Wireless and Mobile Communications New Traffic Message Delivery Algorithm for a Novel VANET Architecture Yueyue Li School of Science and Technology Nottingham Trent University Clifton Lane, Nottingham, NG11 8NS, UK .

[14] Sonali Ghodke and Rohini Bhosale “Authentication And Security Scheme Against Dos Attack For VANET” International Journal of Innovative Research and studies (IJIRS) Vol. 8, Issue 2, Feb 2018.

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