

An Enhanced Clustering Based Technique for Congestion Control in VANET

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ABSTRACT: VANET (Vehicular Ad-hoc Network) is a network where multiple movable vehicular nodes are used to connect to communicate over a wireless channel. Multiple node simultaneously accessing the communication channels, which generates congestion in the channel. Thus there are various techniques like priority based scheduling, elimination of the redundant messages from the channels etc. are presented by the researcher to optimize the bandwidth of the channels. But these techniques not able provide better search results for the user. Thus a clustering based technique to avoid collision in the VANET channels is presented in this chapter. Which clusters nodes and then perform message transmission operation. That enhance the performance of the whole technique. A comparison analysis of the results is presented in IV experimental results and analysis section which shows that proposed technique provides better performance as compare to the existing technique.

KEYWORDS:- VANET (vehicular Ad-hoc Network), Congestion Control, Clustering.

I. INTRODUCTION

VANET is analogous to the MANET which used to communicate among the vehicles by the use of wireless network to share information related to the traffic. In Figure 1.1 a demonstration of the congestion control system is presented. In this system DSRD (dedicated short-range devices) are used to provide wireless network for the vehicles, these devices having approximate bandwidth of 5.9 GHZ to 7.9GHZ. To form a VANET these devices are used on vehicles and road side units to form a wireless Network. As shown in the Figure 1.2 satellite communication is also used to update the data about the traffic. So when any emergency event occurs message is send to the nearby vehicles to update about the event. VANET provides a wide range of services like traffic information system which uses to provide the information about the traffic and broadcasted to all the vehicles. An overview of the events (accidents) which are occurs on roads, are presented below in Figure 1.1, a message is broadcasted to inform about the event to the other vehicles, to avoid traffic jam over roads. RSU (Road Side Units) are used to transmit that message, there is a message is transferred to the yellow color car to provide information about the event.

In this paper a survey over the collision and congestion avoidance techniques is presented. In that there are many techniques like braking model, dichotomized headway model, greenwich algorithm model are used to provide are used to provide congestion control system.

VANET is one of the influencing areas for the improvement of Intelligent Transportation System (ITS) in order to provide safety and comfort to the road users. VANET assists vehicle drivers to communicate and to coordinate among themselves in order to avoid any critical situation through Vehicle to Vehicle communication e.g. road side accidents, traffic jams, speed control, free passage of emergency vehicles and unseen obstacles etc.

Since VANET offers various opportunities to increase network performance, but it also faces various challenges at the same time. The characterization of VANET has rapidly changing topology. In VANET the network is frequently fragmented and the diameter of the VANET networks is small. It has limited redundancy both temporally and functionally.

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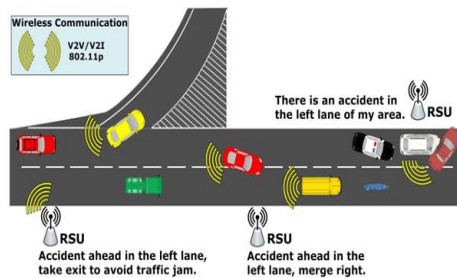


Figure 1.1. Occurrence of Events Which Causes Collision On Road

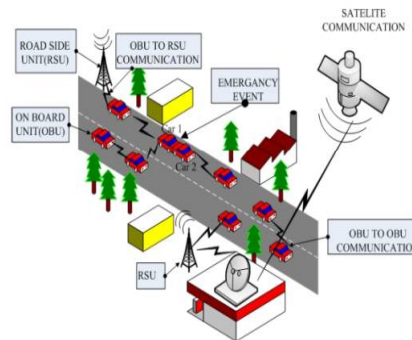


Figure: 1.2 Congestion control system in VANET.

It possess many security challenges apart from other networks. These challenges occur because of the high vehicle mobility, the topology that changes frequently in VANET and the communication link between the vehicles is more complex. Since vehicle travels at high speeds, the link between the vehicles is of short lifetime. The connecting links form in such networks are for less time, this happens due to the high speed of moving vehicles. In such networks, large number of vehicles broadcast the safety messages at high frequency or the event driven messages are broadcast multiple times through which network is easily congested. So it is necessary to control congestion in vehicular ad-hoc networks. The high mobility results into a highly dynamic topology due to which congestion control should be performed at each node of the network. It should be performed in decentralized and self-organized way.

Rest of the paper organizes as follows:

II Related Work, a brief description over the existing technique is presented in this section. III Proposed Work, a description of the proposed technique is presented in this section. IV Experimental Setup and Result Analysis, comparison analysis of the results is presented in this section. V Conclusion.

II. RELATED WORK

VANET is an ad-hoc network where multiple movable nodes are used to transmit data about the networks. But due to simultaneous transfer of messages and data packets generates congestion in the channel which causes loss of the packets and also degrades the performance of the whole system. Congestion control technique is required to maximize the throughput of the system and packet delivery ratio (PDR). In [1] scheduling based technique is presented. In that technique a rescheduling scheme is used to handle congestion in the VANET channels. Monitoring of the event driven messages is performed. If the system receives messages which are within the range of the channel bandwidth these messages are passed by the service channel. If message are not in the range of the bandwidth or more messages are transmitted simultaneously then the scheduling algorithm is started. Priority based scheduling is used to perform the scheduling task and then messages are transmitted on priority basis. In [3] a congestion control management technique in VANET is presented. In that technique reduction of the messages in VANET is performed to release bandwidth of

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the channel to transmit other messages. A mechanism of discarding similar messages are conducted to reduce messages in the channel. Metadata information from the messages are extracted and compared with the neighbour table data. If match found that data will be discarded, else put into the table. To perform reduction task a control queue or service queue is used in which data is stored on temporary basis.

In [2] clustering based technique for connectivity maintenance is presented, which manage connectivity in the VANET scenario.

A new technique which uses clustering for the congestion management in VANET communication channels is presented in this paper.

III. PROPOSED WORK

VANET is an ad-hoc network where various vehicular nodes are connected to communicate with each other over a wireless channel. In that network multiple users communicating over a wireless channel simultaneously which generates congestion in the channel. That causes loss of packets and also degrade the performance of the whole system. There are various techniques like [1] rescheduling based technique in which a priority based scheduling is used to avoid congestion in the channel, [3] a technique in which removing duplicate messages in the channel is conducted.

But these techniques are efficient to provide better solution for the problems. In [2] clustering technique for connectivity management is presented. Thus that technique can be used to avoid congestion in the channel and provide better and efficient results for congestion avoidance.

A clustering based technique for congestion control is proposed. In that technique clustering of the nodes is performed because take all the nodes at once causes over head for the whole technique. A clustering based technique can reduce the overhead and increase throughput and PDR.

Proposed Algorithm

Vehicle node in a network has to elect cluster head node, which is able to do proper advertisement and endorsement operation on the behalf of initiator node. This cluster head is an ultimate place holder in cluster for other nodes. Type of communication strategy which used in this algorithm is advertise / endorse for both internal as well as external, but communication responsibility is all in the shoulder of cluster head. Algorithm is as follows:

Cluster Head Selection: For finding the cluster head, vehicle sends a hello packet containing (Speed, Last Info-station Passed, and Connecting Link) in the network at regular time interval and wait for its reply. When reply come, OBU counts the number of reply; these replies are refer as connection links. These packets were collect in a queue where OBU compare them with its last info-station information if information matched send information in to next array. Now this OBU compare this array with its connecting links; after comparing if two or more values are same than those values are again send to the next array and this time comparison employed on the basis of their speed if speed of OBU is greater than other one it is selected as cluster head else it will wait for cluster head notification. Assume connecting link of vehicle is "A", speed of vehicle is "B", last info station is "C". Algorithm for above process as follows:

- i) Broadcast hello packets in network (Speed, Last Info-station).
- ii) Put packet in a queue a $[C_i]$.
- iii) if $(C = a [C_i])$
- iv) Put packet in a queue b $[A_i]$.
- v) if $(A \geq b [A_i])$
- vi) if $(A = b [A_i])$
- vii) Put above packet data in a queue c $[B_i]$
- viii) if $(B \leq c [B_i])$
- ix) Broadcast its address as Cluster Head.
- x) Else

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- xi) Discard Packets.
- xii) Else
- xiii) Wait for Cluster Head notification.
- xiv) Else
- xv) Broadcast its address as Cluster Head.
- xvi) Else.
- xvii) Wait for Cluster Head notification.

Input Module: When any data packet comes to onboard unit of vehicle it checks its source address if this address is same as the cluster head address then onboard unit check what kind of data is in advertisement, endorsement or forwarding and match this data with its tables if value is true discard regarding entry from table else follow regarding procedure for dissemination.

- i) Extract input data id (vehicle id, advertisement/ endorsement/ Forwarding/ noti)
- ii) Match input data id with cluster id.
- iii) If (cluster id = input id)
- iv) Discard related entry from regarding tables.
- v) Else
- vi) Put entry in regarding table.
- vii) Follow regarding procedure for dissemination.

Procedure for advertise: This module defines that how vehicle node can advertise its information in a network. Advertise primitive is defined as advertise (advertisement specification, TTL, vehicle id); TTL is stands for time to leave or is the time for which a advertisement is considered to be active.

Procedure advertise (advertisement, TTL, vehicle id)

- i) Store advertisement in advertisement Table.
- ii) if (advertisement Active, Check TTL)
- iii) if (any vehicle in 1-hop range).
- iv) Send advertisement
- v) Else
- vi) Keep on moving for some time
- vii) Goto step ii
- viii) Else
- ix) Discard the advertisement.

Procedure for endorse: This module defines that how vehicle node can endorse its desired information from a network. Endorse primitive is defined as endorse (endorsement specification, TTL, vehicle id); TTL is stands for time to leave or is the time for which an advertisement is considered to be active.

Procedure endorse (endorsement, TTL, vehicle id)

- i) Store endorsement in endorsement Table.
- ii) if (endorsement is Active, Check TTL)
- iii) if (any vehicle in 1-hop range).

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- iv) Send endorsement
- v) Else
- vi) Keep on moving for some time
- vii) Goto step ii
- viii) Else
- ix) Discard the advertisement.

Procedure for Forwarding: This module defines that how vehicle node can forward their incoming data packet in a network. Forwarding primitive is defined as Forwarder (advertise / endorse / notification, TTL, vehicle id); TTL is stands for time to leave or is the time for which a advertisement is considered to be active.

Procedure Forwarder(advertisement/endorsement/notification, vehicle id, TTL)

- i) Store advertisement / endorsement / notification in forwarding table
- ii) Call Matcher (advertise / endorse / notification, vehicle id)
- iii) If (advertisement/endorsement/notification still active, check TTL)
- iv) If (any vehicle in 1-hop range)
- v) Forward advertisement/ endorsement /notification
- vi) Else
- vii) Keep on moving for some time
- viii) Goto step iii
- ix) Else
- x) Discard advertisement/ endorsement/ notification

Procedure Matcher (advertisement/ endorsement/ notification, vehicle id)

- i) Case: (notification)
- ii) If (notification for itself)
- iii) Accept
- iv) Else return
- v) Case: (endorsement)
- vi) Match with advertisement table and forwarding table
- vii) If (Match = True) then call Forwarder () to notify
- viii) Else return
- ix) Case: (advertisement)
- x) Match with advertisement table and forwarding table
- xi) If (match = true) then call
- xii) Forwarder () to notify
- xiii) Else return

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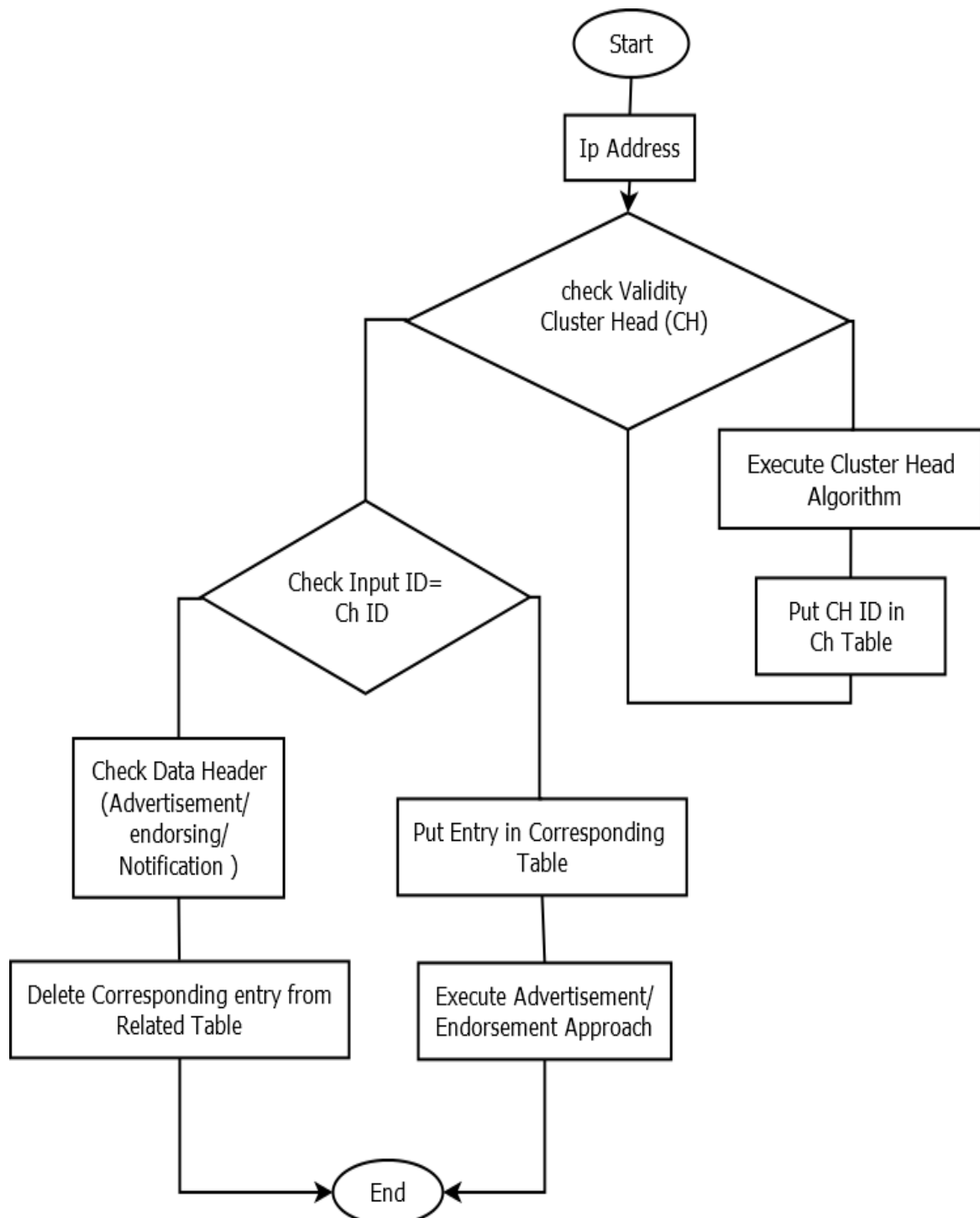


Figure 3.1: Flow Diagram for proposed technique.

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IV EXPERIMENTAL SETUP AND RESULT ANALYSIS

To implement proposed technique a NS2 simulator is used. NS2 is an object oriented event driven network simulator is used. It used to implement protocols like TCP and UDP, traffic behaviours FTP, routing mechanism etc. it is a simulator written in C++ and OTcl language and developed by UC Berkeley.

To initialize setup of the NS2 user must have to write an OTcl script that initiates event scheduler, various network objects are used to form topology of the network. Plumbing function is used to setup the network. Plumbing is a library which used to control the transmission of the packets. Neighbour objects of the network objects are used to form the path among the various objects. Simulation parameters for the proposed technique are presented in Table 4.1.

Table 4.1: Simulation Parameters.

Parameters	Values
Routing Protocol	AODV
Propagation Model	Two Ray Ground
Mac Layer	MAC / 802.11p
Radio range	250m
Packet Size	512 bytes
Node's Speed	23, 26, 29, 32
Number of Nodes	20 Nodes
Simulation Time	200 Seconds

STATISTICAL ANALYSIS

A statistical analysis of the results is presented in this section. In that Table 4.2, contains comparison of the results over the Packet delivery Ratio (PDR). That table contains value of PDR for both the technique at different velocity. That result analysis shows that proposed technique provide better PDR as compare to the existing technique.

Table 4.2: Packet (Undelivered 1-PDR) Delivery Ratio.

Velocity	AODV-CV	Proposed Technique
23	1.61	1.52
26	1.53	0.52
29	1.55	0.87
32	1.54	0.36

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Table 4.3: comparison of Throughput.

Velocity	AODV-CV	Proposed Technique
23	68.5	82.64
26	65.5	83.48
29	67.2	82.34
32	67.1	83.61

In Table 4.3, a comparison for the throughput of the both the techniques is presented. That Table contains a details about the throughput of both the techniques at different speed. That analysis shows, proposed technique provides better throughput as compare to the existing technique.

Because a clustering based technique is used to provide better performance to communicate over the wireless channel because it reduces the search space and provide an efficient technique to communicate in VANET.

GRAPHICAL ANALYSIS

Graphical comparison of the results is presented in this section which provide comparison analysis of the results of proposed and existing technique.

In Figure 4.1, a graphical comparison of the results over the parameter called PDR is presented which shows that proposed technique provides better PDR as compare to the existing technique. In that figure blue bars represents existing technique and orange bars are represents proposed technique.

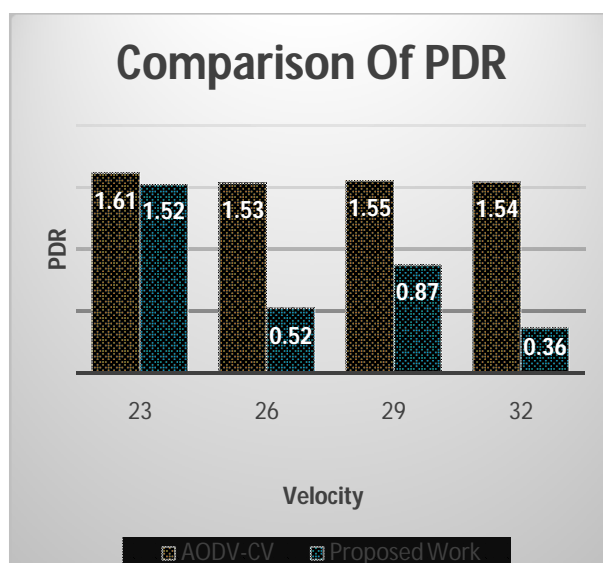


Figure 4.1: Comparison Of PDR.

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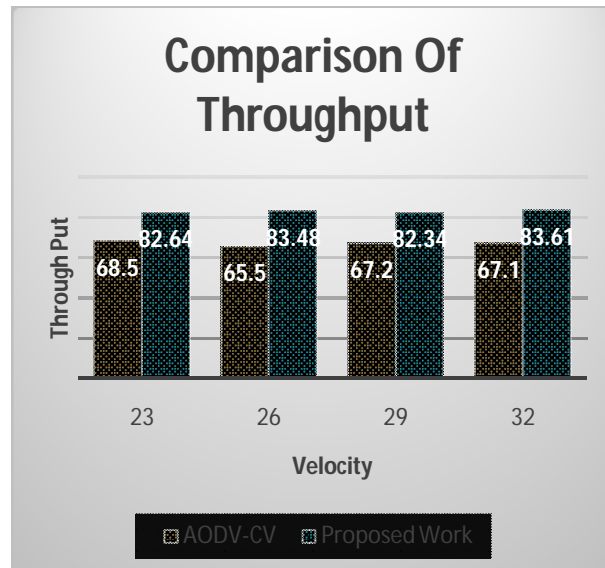


Figure 4.2: Comparison of Throughput.

In Figure 4.2, a graphical comparison of throughput of the techniques is presented which shows that proposed technique provides better throughput as compare to the existing technique.

V. CONCLUSION

VANET is network where multiple vehicular nodes are connected to communicate over wireless channel. But there are multiple nodes simultaneously accessing a communication channel which causes congestion in that channel. That degrades the performance of the whole technique and also cause loss of packet during transmission. Thus there are various techniques like priority based scheduling, and reducing duplicate messages in the channels can be conducted which requires provide a congestion control mechanism in VANET. but these technique performing on the whole network without taking care of the heterogeneity of the netywork. Thus a clustering based congestion manage ment technique is presented in this paper which provide efficient and accurate way to avoid congestion in the VANET. A comparison analysis of the result is presented in IV result and analysis section which shows that proposed technique provides better results as compare to the proposed technique.

For future work an enhanced clustering like passive clustering technique can be used to provide an enhanced and efficient technique to avoid congestion in the communication channel.

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