A REVIEW OF BROADCASTING STORM MITIGATION TECHNIQUES IN VANETs

Raghu Sharma, Sandeep Kad
Research Scholar, Associate Professor
Department of CSE
IKG PTU, Kapurthala, India

ABSTRACT : The new class of intellectual wireless technology adopted among vehicles is known as Vehicular Ad Hoc Networks. The vehicles in this network share their assets either through Vehicle-to-Vehicle (V2V) or Vehicle-to-Infrastructure (V2I) communication. Broadcasting in Vehicular Ad Hoc Networks is the finest approach to deliver emergency messages all over the network. High speed of vehicles may cause the connectivity between vehicles last a short time. The maintenance of links and neighbor discovery requires a lot of HELLO packets exchanged among the vehicles. This leads to congestion and broadcast storm in the network. Consequently the network will suffer lot of packet drops leading to reduced bandwidth and less packet delivery ratio. This paper investigates various techniques that focus on mitigating the broadcast storm problem in VANETs.

***Keywords*: VANETS, Broadcast storm problem, V2V, V2I, Packet delivery ratio**

I. INTRODUCTION

Vehicular Ad hoc Networks (VANET) is the developing technology. VANETs are disseminated, self-organize communication networks. Each vehicle acts as a node within VANET. Vehicular Ad-hoc Networks are used for communication among vehicles and between vehicles and roadside equipments. Some characteristics that differentiate VANET from MANET are [1]:

- High mobility of vehicles leads to particularly dynamic topology.
- Regular movement, constrained by both road topologies and traffic rules.
- Vehicles are usually conscious of their arrangement and spatial environment.
- Vehicles have sufficient power, computing and storage capacity.

VANETs focus on the development of Intelligent Transportation System (ITS) in order to offer a broad spectrum of applications, plus safety applications like to avoid road accidents, traffic jams, speed control, free course of emergency vehicles and unnoticed obstacle etc. Besides safety applications VANET also provide comfort applications to the road users. For example, weather information, mobile e-commerce, internet access and other multimedia applications [2]. There are many difficulties in VANETs systems design and completion, including: security, privacy, routing, connectivity, and quality of services. The most challenging task in VANETs is the routing of data. This is due to the high mobility of the vehicles which induces a rapid change in the network topology [3]. Among various issues, broadcasting storm problem is one such issue that occurs when vehicles are involved in exchange of many HELLO packets during the neighbor discovery or link maintenance. This procedure leads to unnecessary bandwidth consumption and packet drops in the network thus reducing its performance.

This paper discusses broadcasting in VANETs that is done to formulate the routing paths between source and destination pair in Section II. Section III discusses about the broadcasting storm problem in these networks. Finally the literature about the mitigation techniques has been presented in the section IV and summary in section V. The paper has been concluded in the last section.

II. BROADCASTING IN VANET

Broadcasting in Vehicular Ad Hoc Networks (VANETs) has turned into a dynamic field of research. In MANET broadcasting happens amid route discovery or route maintenance, such as AODV route request hello messages but in VANET broadcast routing is regularly utilized in numerous safety critical ITS applications. The network disconnection problem for VANET is more extreme than MANET due to high versatility caused by quick moving vehicles, sparse traffic densities during off-peak hours, and the limited market penetration rates of vehicles with equipped communication devices, especially in the initial stage. This disconnection time (on the order of a few seconds to several minutes) makes MANET protocols such as AODV unsuitable for VANETs. Hence, new network protocols are necessary to improve broadcasting in dense networks and routing choices in adequate networks [4]. The broadcasting is normally done in VANETs using GPSR routing, some of the techniques do use the AODV routing protocol also. Over the years there have been many researches on developing applications and usage models for VANET type of communication. Some of the latest applications developed related to VANET are online file sharing, real time video updates and entertainment via connection to the internet through RSUs or V2V type of connections [3].

- Safety applications: Safety applications are most basic factor to diminish the road accident and loss of life of the inhabitants of vehicles. There are such an expansive number of accident happened because of the crash of vehicles.
- Car speed cautioning: With assistance of these conventions utilize a combination of GPS and computerized maps are utilized to judge risk level for driver approaching a curve quickly.
- Traffic signal violation cautioning: It is expected to send a notice message when driver recognize the vehicle is in danger of running the traffic signal.

The choice to communicate something explicit is made on the reason of traffic signal status and timing the vehicle position and speed.

- Collision chance cautioning: In this framework vehicle and RSU recognize chances of crash between numerous vehicles are not prepared to communicate among themselves. The system will assemble data about vehicles that are coming inverse way and are approaching towards the goal.
- Lane change cautioning: In this application vehicle screen the situation of vehicle inside a roadway lane and caution a driver in the event that it is unsafe to move to another lane.

III. BROADCASTING STORM PROBLEM

In VANETs, the distribution of messages within a specific area used for safety and security related applications. The traffic message should exist in the system for longer time. So, the Road Side Unit (RSU) that broadcasts the messages should periodically rebroadcasts that traffic messages to the vehicles to keep alive for longer periods. As the traffic density and frequency at which RSU broadcasts the messages are high, broadcast storm occurs in VANETs. This would thusly prompt of wastage of transferring speed, preparing expand time and medium access delay. The more serious problem is disturbance i.e., other urgent safety messages might get lost (or) delayed during the broadcast storm [5].

A few approaches have been created to address the broadcast storm problem. They are:

1. The counter-based scheme: In this scheme each and every node has counter 'c' to keep track of the number of times the broadcast message received. This counter 'c' is compared to a threshold value 'C'. Whenever c≥C, rebroadcasts are inhibited.

2 The distance-based scheme: This scheme uses the relative distance 'd' between vehicles to decide whether to rebroadcast the message or not. When the distance 'd' between two vehicles is short, the Additional Coverage (AC) of the new rebroadcast is lower. So, rebroadcasting the warning message is not recommended. But when the 'd' is larger, AC will also be larger and hence rebroadcast takes place.

3. The location-based scheme: It is similar to the distance-based scheme, though requiring more precise locations for the broadcasting vehicles to achieve an accurate geometrical estimation (with convex polygons) of the AC of a warning message. Since vehicles usually have GPS systems on-board, it is possible to estimate the additional coverage more precisely. The main drawback is that high computational cost of calculating the AC, which is related to calculating many intersection areas among several circles.

IV. LITERATURE REVIEW

Different approaches were used to overcome broadcast storm problem and also to enhance dissemination process more efficiently. Some approaches have proven to be better in urban scenario while other in highways. Different authors have different views to suppress broadcast storm problems. This section describe literature review for the different techniques used.

G. Preethi et. al [6] deals with a variety of broadcasting protocols which are used to disseminate messages in VANET. Its advantages and disadvantages are also discussed since purblind broadcasting could cause severe problem called as Broadcast Storm Problem (BSP) which eventually affects the Quality of Service (QoS) in VANET. To overcome the problem of broadcast storm problem the paper surveys some of the existing suppression techniques in various scenarios such as urban scenario and highway scenario in VANET environment. N. Wisitpongphan et al [7] only a few studies have addressed this issue in the VANET context, where versatile hosts move along the roads in a specific restricted arrangement of directions as opposed to randomly moving in arbitrary ways within a limited area. In contrast to others, the authors evaluate the impact of broadcast storms in VANETs in terms of message delay and packet loss rate in addition to ordinary measurements such as message reachability and overhead. Given that VANET applications are right now limited to utilizing the DSRC protocol at the data link layer, they propose three probabilistic and timer-based broadcast suppression techniques: weighted p-persistence, slotted 1-persistence, and slotted p-persistence schemes, to be used at the network layer.

M. Chitra and S. Siva Sathya [8] have proposed Broadcast Storm Suppression Algorithms (BSSA) to control this Broadcast Storm. These mechanisms attempt to control BSP by either decreasing the quantity of rebroadcasting/ transferring nodes or by recognizing the best relay node. The suppression mechanisms help to defeat BSP to certain degree, still there is have to still decrease the number of rebroadcasting nodes in existing mechanisms and also to identify the best possible rebroadcasting node. This paper shows a near investigation of various prominent BSSA so as to recognize the hidden issues and difficulties in controlling BSP completely. The result of this paper would provide the requirements for developing an efficient BSSA overcoming the identified issues and challenges. Umar Hayat et al [9] In this examination, a relative speed based waiting time algorithm has been exhibited for avoiding broadcast storming problem in the VANETS particularly in dense environment. This proposed algorithm calculates the waiting time for each vehicle after receiving the safety/ warning messages according to the general speed of the vehicles, the separation between the vehicles and range of vehicles. The results show that the proposed relative speed based algorithm is superior than already existing algorithms like blind flooding and powerfully broadcasting waiting time algorithm which uses number of neighbors and distance between the vehicles for calculating the waiting time.

Suriyapaibonwattana et al. [10] proposed an algorithm for limiting broadcast storm in VANETs and called it "The Last One broadcasting method". In this technique, when a vehicle get data, it rebroadcasts this data by utilizing arbitrary probability. This strategy is exceptionally valuable to limit the telecom storm in VANETs yet can't completely take out the communicate storm. Roberta Frachia et al. [11] proposed a broadcast storm avoiding algorithm which depend on separation between the vehicles. Their separation aware flooding technique depends on separation between the present node and nearest neighboring node. This algorithm produce a waiting time for a message to rebroadcast. By using simulation results they have concluded that their proposed distance aware delayed flooding algorithm yields better performance to avoid

broadcast storm in VANETs than other broadcast suppression techniques. NajafZadeh et al. [12] proposed a waiting time based algorithm named "Dynamic Broadcasting Algorithm" to lessen the quantity of rebroadcasts of same message over and over. In this technique, they describe that nodes set up their neighbor's list by utilizing hello beaconing. Their calculation computes the waiting time for a node to rebroadcast a message by number of neighbors and the separation between sender node and the other vehicles. By utilizing simulation results, they have inferred that their introduced dynamic broadcasting algorithm is preferred in performance than flooding technique and random waiting time protocol. This waiting time based algorithm helps to reduce the redundancy of safety messages and minimizes the broadcast storm. Chang An et al [13] The proposed scheme chooses distinctive edge nodes for various sorts of communications with various context data such as connection-dependency (connection-dependent or connection-independent), communication type (unicast or broadcast), and packet payload size. The authors have dispatched extensive simulations to assess the proposed scheme by contrasting and existing communicate conventions and unicast conventions for different system conditions and traffic designs.

Ademar Takeo Akabane et al [14] have concentrated on a broadcast protocol over VANETs to proficiently spread the data among the vehicles inside an Area of Interest (AoI). The proposition of their broadcast protocol -ATENA- is to dispose the broadcast storm problem and boost data spread with short delays and low overhead. ATENA was contrasted with five well-known protocols from literature: DBRS, DV-CAST, SRD, Flooding, and AID. It shows, through the simulation, that the proposal has performed better than other five protocols, outperforming them in different scenarios in all the evaluations carried out. M.Chitra S and Siva Sathya [15] the paper is motivated to tackle the issues in the existing Broadcast Strom Suppression Algorithms (BSSAs) like p-Persistence, TLO, VSPB, G-SAB and SIR. This paper proposes to suppress the Broadcast Storm Problem and to improve the Emergency Safety message spread rate through a new BSSA based on Selective Epidemic Broadcast Algorithm (SEB). The simulation results clearly show that the SEB outperforms the existing algorithms in terms of ESM Delivery Ratio, Message Overhead, Collision Ratio, Broadcast Storm Ratio and Redundant Rebroadcast Ratio with decreased Dissemination Delay. Different strategies have different features, objectives, limitations which are to be explained below using tabular form.

Table 1: Comparison of different broadcasting algorithms in VANETs

Title	Objective	Scenario	Feature	Pros/Cons
Avoiding broadcast storms in intervehicular warning delivery services	The proposed algorithm based on separation between the vehicles and their separation aware flooding technique depends on separation between the present node and nearest neighboring node.	Urban/ Highway	The proposed algorithm is best suited for disseminate warning delivery service in inter-vehicular ad hoc network	The main problem of this algorithm is it gives inaccurate result when Poisson-based mobility models are used in uncongested traffic conditions.
Broadcast storm mitigation techniques in vehicular ad hoc networks	This paper tries to evaluate broadcast storm problem using a four-lane highway scenario	Urban/ Highway	The three probabilistic and timer-based broadcast suppression techniques provide good attainability in connected network	Its major drawback is that it applies on only single-lane and multilane topologies as opposed to generic two-dimensional square or torus topologies. It can also have higher value of end-to-end delay for multihop applications.
An Effective Safety Alert Broadcast Algorithm for VANET	The technique proposed by this paper uses GPS information for the better output of safety alert application	Highway	This technique is to be helpful to overcome telecom storm in VANETs	The algorithm depends on GPS information which can proves to be challenging part if GPS provide incorrect information
Dynamic Broadcasting in Vehicular Ad hoc	The author proposed a waiting time based algorithm named "Dynamic	Urban	This technique makes better utilize of the resources by setting the waiting time for	The main problem in this algorithm is if appropriate waiting time is not set then it

Networks	Broadcasting Algorithm" to lessen the quantity of rebroadcasts of same message over and over.		rebroadcasting the message.	would results in unnecessary transmission
Issues And Challenges In Broadcast Storm Suppression Algorithms Of Vehicular Ad Hoc Networks	This paper focuses on list out the functioning and limitation of existing Broadcast Storm Suppression Algorithms to solve BSP with better approach	Urban/ Highway	This paper focuses on to identify the hidden issues and difficulties in controlling BSP.	This paper chooses algorithm based on location, timer and probabilistic based schemes to solve BSP which can be useful for later research work
Eliminating Broadcast Storming in Vehicular Ad-Hoc Networks	This paper proposed a relative speed based dynamically broadcasting waiting time algorithm for broadcasting the messages in the Vehicular Ad-Hoc Networks particularly in dense environment	Urban/ Highway	ZigBee technology used in this paper is power efficient and low cost communication technology.	The proposed relative speed based algorithm is better than already existing algorithms like blind flooding and powerfully broadcasting waiting time algorithm.
A Survey On Broadcasting Protocols In Both Urban And Highway Scenarios	The objective of this paper is to analyze various broadcasting protocols in both highway and urban scenario for efficiently broadcasting messages in new designed algorithm	Urban/ Highway	Broadcast suppression techniques discussed in this paper proves to be helpful for designing new algorithm	The techniques explained in this paper cover both scenarios for better addressing the broadcast storm problems.
Selective epidemic broadcast algorithm to suppress broadcast storm in vehicular ad hoc networks	The author proposed a new BSSA based on Selective Epidemic Broadcast Algorithm (SEB) in which the message is spread only to selective vehicles which later rebroadcast the messages, resulting in lesser messages being sent.	Highway	The proposed algorithm is best suited for Bi/multi directional highway scenarios and performs better in all aspects.	The problem that may arise in the SEB is related to sending information to the neighbors or the vehicles that are moving away from the geographical coordinates of the event. Another issue related to the farthest vehicle that may send the ESM packets to the nodes that have already received it resulting broadcast storming and duplication.

V. SUMMARY

Various techniques have been implemented to overcome the broadcast storm problem and to improve the network performance. Some of the techniques give better result in urban scenario; some on highway while few of them optimal for both scenarios. Various issues have been identified from time to time and various type of work have been done to filter out the issues and to enhance performance. But some issues yet being unaddressed which can also have a importance in broadcasting. The safety messages should be broadcasting to only those nodes that really need these types of messages. Rebroadcasting also needs to check some network requirements to avoid congestion and to preserve network resources.

VI. CONCLUSION

The broadcasting storm problem has been discussed in this paper that occurs in vehicular ad hoc networks. This problem leads to degraded network performance. Some of the mitigation techniques has been presented in this paper. One of the techniques uses passive acknowledgment method to suppress the BSP in the network. The ESM is broadcast to only those available neighbors who reply back with the passive acknowledgement. This paper however does not consider the direction of the vehicles movement in context of the event occurrence which can be used in the future work to further suppress the problem.

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