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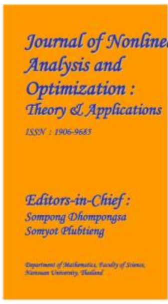

A NOVEL DRIVER SAFETY USING VANET TO CONTROL BROADCAST STORM BASED ON EFFECTIVE CLUSTER-BASED REBROADCASTING (ECR-B)

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Abstract:

The development of networks and technology has prompted the integration of safety systems into automobiles. Vehicular Ad-hoc Networks (VANET) is unique among the mounting area to alert dangerous situations among roads, as road safety is a concern for everyone. VANET connecting vehicles to broadcasting messages with one another for safety purposes. VANET broadcast messages in dense area; therefore it can lead to message retransmission, transmission failures, which in turn can cause collisions. The rebroadcast of messages led to broadcast storm. The main aim is to reduce the redundant data transmission by sending the packets to the appropriate node. By clustering the vehicle according to Zone Routing Protocol (ZRP), the proposed Effective Cluster based Re-Broadcasting (ECR-B) ensures the best throughput and packet delivery ratio by sending packets to every node within its transmission range.

Keywords:
VANET, Broadcast Storm, ZRP, PDR.

I. INTRODUCTION

A VANET is a kind of MANET designed to facilitate short-range communication between automobiles for the mutual support of safety applications. The transportation system's fast development has led to an increase in traffic and auto accidents. Consequently, a unique network known as VANET is used to communicate with the vehicles regarding traffic management, road safety and other necessary information. In VANET, vehicles are node connected together to communicate each other and form a network it is referred to as Vehicle to Infrastructure (V2I). Vehicle-to-infrastructure technology records information about the state of the roads, including traffic jams, weather alerts, bridge clearance levels, traffic light status, and other relevant data. The purpose of the data transmission between nodes is to identify nearby vehicles and give them information about traffic. The following figure shows the V2V and V2I communication of VANET.

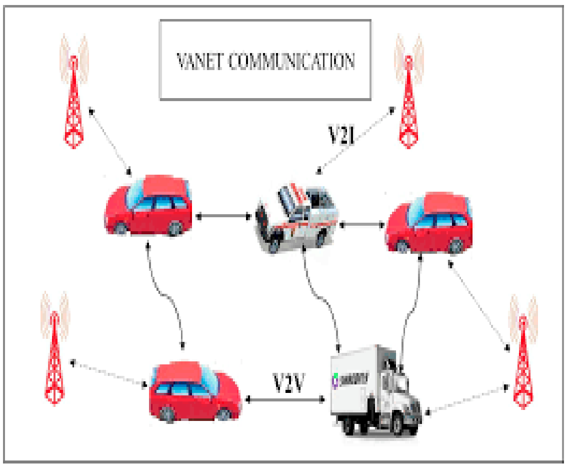

Fig 1: V2V and V2I communication of VANET

The nodes in VANET create a cluster that facilitates easy communication. Nevertheless, various network architecture modifications, varying vehicle speeds and unconnected conditions can cause communication break between different clusters. Even if the broadcasting is accomplished, the message related to same event between the nodes in a high density network may create frequent contention and collisions. Additionally, there is a significant rise in transmission of message repetition between nodes, which obstructs the network's performance.

There are a lot of repetitive messages send in VANET because it's true that when a car transmits a message, other cars have previously received it. This redundant message causes a major problem and it is mainly referred to as broadcast storm. This broadcast storm problem effect inter-vehicle communication and also the performance of the network. Therefore, designing a reliable and efficient routing protocol to support highly diverse node structure and to control redundant message rebroadcast for this irregularly connected vehicular network topologies remains a challenge.

The aim of this proposed work Effective Cluster based Re-Broadcasting (ECR-B) to control the impact of broadcast storms by clustering vehicles on the road. The suggested work maintains good network performance by minimize the count of packets while transmit informations with great efficiency and propagation speed. The Proposed work is divided in to following sections. Section II demonstrate the study of related work, Section III illustrate the work of Zone Routing Protocol (ZRP) in addition to this section also shows how Effective Cluster based Re-Broadcasting (ECR-B) reduce the broadcast storm. Section IV explains the performance and result of the ECR-B and the conclusion with future work is followed in Section V.

II. LITERATURE REVIEW

This section reviews different studies and methods aimed at reducing the broadcast storm problem. It mentions several clustering methods; each one focused on issues and which causes problem in VANET. In addition to that the authors submit various solutions are also proposed for the issues. The goal is to discuss the recommended clustering techniques and explain how this work is different and works well than other methods to avoid the broadcast storm and other problems, it looks at how well the current traffic signal controller works and its weaknesses in vehicle-to-vehicle communication.

The suggested work submitted by the author Luhach & Gao by combines different routing methods to make communication faster and easier. Two methods were used: Hybrid Routing with Grid Location Service (HRGLS) and Hybrid Routing with Hierarchical Location Service (HRHLS).The tests showed good results in how many packets were delivered, the speed of communication, and the amount of control messages needed [1].

Tsado et al. proposed Location aided Routing Protocol (LARP) for Latency in packet delivery that led to collision in VANET [2]. The suggested protocol achieved high reliability and maximizes the throughput in data transmission multi-hop manner. In this LARP protocol only response time is considered for the performance evaluation but not by request time.

Clustering aims to divide a network into smaller groups that exhibit similar traits. Communication between the Vehicle Ad Hoc Network (VANET) and the backbone infrastructure, specifically the Roadside Unit (RSU), can occur in two primary ways. In the first method, vehicles connect directly to the internet via the RSU. Alternatively, in the second method, vehicles establish clusters and engage in intra-cluster communication to share information [3].

Zareei et al. describe a method called Robust Mobility Aware Clustering (RMAC) that helps find nearby nodes and choose the best Cluster Heads (CHs) based on how fast they move, where they are, and which way they are going. RMAC works independently of other technologies and helps with routing in networks by forming groups based on location. It addresses the issue of cluster members being too far from the CH by creating 1-hop clusters for better communication. This clustering method should work together with geographic routing methods [4].

VANET nodes changes its position time by time, finding a way to send messages to a destination, the speed of vehicles, and managing them directly is very important in vehicle networks. However, keeping a connection between vehicles is hard because they move around a lot [5].

Almalag et al. contribute a new way for vehicles to share time slots for communication called Time Division Multiple Access (TDMA) based on vehicle groups. This method allows vehicles in a group to talk to each other without needing to find nearby vehicles first. A leader for the group, called a cluster-head, is chosen to keep the group stable. When picking this leader, the lane position of the leader is taken into account. The lane and direction most of the group members are traveling in also affect who becomes the leader. The TDMA Cluster-based MAC protocol (TC-MAC) lets vehicles send non-safety messages while mainly focusing on important safety messages. With the TDMA method, vehicles can listen to control and service channels at the same time. However, this method only works for single-hop communication and is not suitable for fast-changing multi-hop vehicle networks [6].

Hierarchical Clustering Algorithm (HCA) present by Nazhad et al, focuses on fast topology control and scheduling for the timely delivery of time-sensitive messages in VANET. HCA is a randomised hierarchical cluster with two utmost nodes and the CH. Thus, the maximum number of possible hops is limited to four. This size-limited cluster formation allows message transmission without needing GPS to identify the cluster members since four hops are considered reasonably local to transmit safety-critical messages. Scheduling of messages within a cluster is controlled by CH [7].

Roy and Das used fixed tools, like roadside units, to collect information from cars and to help when data packets are lost. They tested their method by looking at how vehicles move on a highway [8]. A unique protocol presented by Esmaeily Fard and colleagues indicates that a non-cluster head (non-CH) node is not required to transmit its message to a designated cluster head (CH). Instead, when a non-CH node communicates with a CH, the CH collects and consolidates beacons from its surrounding area. The problem with this protocol is that it can create duplicate beacons because of the overlaps between clusters [9].

Wang et al. created a Wireless Computing System (WCS) to make data transmission faster and use less energy. It gets real-time feedback by collecting and managing data with a log computing node. The WCS cuts down on the number of connections needed to save power, even when some connections are added back. There is a delay in transmission, but it is within an acceptable range [10]. After the study of related work, an idea for the broadcasting method is formed, to picking up the right node to help with broadcasting along to that to choose a relay node shows where the emergency message is sent to or sent from again.

III. PROPOSED WORK

The routing protocol in a Vehicular Ad Hoc Network (VANET) shows a deserve role in overseeing the movement of data packets between nodes within the network. It determines the appropriate node responsible for forwarding packets to their intended destination. Consequently, the effectiveness of the routing protocol is vital in VANET. This entails the incorporation of innovative criteria to identify the optimal node, thereby enhancing the routing process and improving overall performance.

1. Effective Cluster based Re-Broadcasting (ECR-B):

VANETs are vehicular networks that are divided into numerous clusters. Vehicles can be organized into various clusters based on position, speed and direction of moving vehicle and other factors. Vehicles inside a partition can interact with all other nodes. While there are gaps between succeeding clusters, which prevent inter-cluster communications. Fig 2 shows the formation of cluster in VANET.

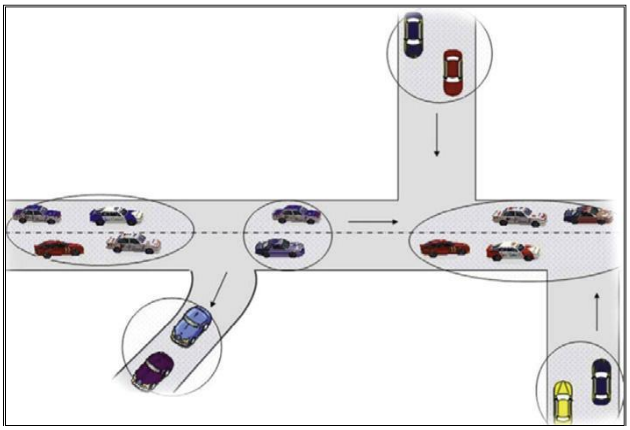

Fig 2: Formation of Cluster

The Effective Cluster based Re-Broadcasting (ECR-B) protocol is expected to reduce the amount of rebroadcast messages by grouping the vehicles (nodes) on the route. The Fig 3 shows the Cluster based broadcasting technique that reveals vehicles in the same cluster communicate with Cluster Head only and they not allowed communicating with each other. Similarly, the Cluster Head (CH) can't directly communication with other intra-cluster node. The Cluster Head is the only nodes that communicate with other intra-Cluster Head (CH) nodes.

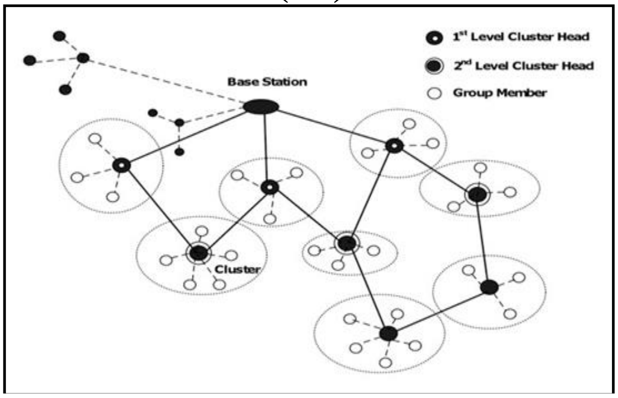

Fig 3: Cluster Based Broadcasting Technique

The following criteria are used by this approach to elect Cluster Head (CH) in an efficient manner. Three techniques are used by reliable protocols: (i) rebroadcasting, in which the source node repeatedly broadcasts the similar information (ii) ACK, in which the sender only needs the acknowledgement from a intra group of the nodes (iii) changing parameters, in which the sender modifies the transmission parameters based on the network's predicted state. The Node Grouping Phase and CH Election Phase are the two phases that make up the suggested work.

a) Node Grouping Phase:

It is desirable to broadcast messages in the VANET network using the suggested technique, which requires fewer transmission nodes and less delay. The suggested method gathers the vehicle's location using the GPS receiver, based on the three points mentioned below. Vehicle fast (V), Hierarchy of messages from various nodes (MSG_No), and rebroadcast possibility (Pij) and transmit the message to CH. It quickly and effectively locates vehicle clusters and selects one to serve as the CH vehicle for each cluster. Rebroadcasting of message responsibility is done by the new cluster head to avoid broadcast storm. Fig 4 shows if a node is involved in a collision it will immediately send a message to the network with its Vehicle ID and location to its Cluster Head and this proposed work treats the two-sided roadways as one-sided in order to prevent collisions and for ease broadcasting.

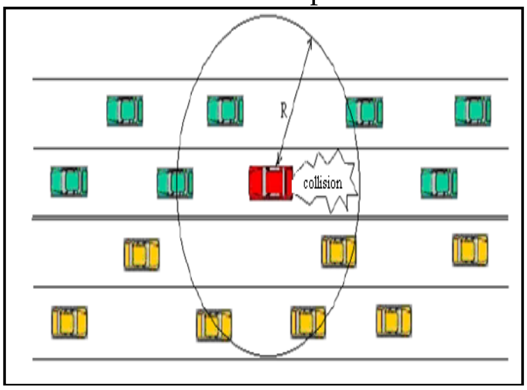

Fig 4: Node in Collision

b) CH Election Phase:

Each cluster head is responsible for rebroadcasting warning messages a novel cluster head is nominated to improve the process based on the comparison of vehicle speed of the existing cluster head. This phase consists of, a new cluster head is chosen at each level, in order to rebroadcast, the messages are numbered in order and this order is maintained until the next cluster is created. The basic rules and algorithm for CH election are given below:

- Even if the node is father, there is a great possibility that the cluster head will be chosen. The rebroadcast parameter of pi, j, which is defined as $P_{i,j} = D_{i,j} / R$, is used to compute it.
- The moving node's speed is the next parameter.

- Additionally, the node is more likely to be chosen as the cluster head if it receives fewer warning signals.

Step 1 - Initialization of Cluster_Head among the nodes.
Step 2 - Broadcasting of warning messages.
Step3 -To receive acknowledgement messages (ack_msg) from cluster nodes.that contains node identifier (ID), node velocity (V), location of node (Loc), direction of movement in node (Dir_Veh).
Step 4 - Nodes those are moving in the direction of cluster head, puts into Cluster_Mems group should satisfy the following condition

For (j=1, j<=Cluster_Size;j++)
If $Dir\_Veh_i = Dir\_Veh$
$Cluster\_Members \leftarrow Veh_j;$

Step 5 - Each member of the group should follow the criteria with three factors distance, speed and warning message of each nodes.

For (j=1, j<= Size (Cluster_Mems); j++
$P_{i,j} = D_{i,j} / R$
$Result_j \leftarrow P_{i,j} * V_j * 1/MSG\_No;$

Step 6 - Create Table_Vehi is formed by current cluster head from the obtained information.
Step 7 - Selection of next Cluster Head (CH) can be obtained from the above table between nodes in the Cluster_Member
Step 8 - Stop the Process.

2. Zone Routing Protocol (ZRP) :

The cluster region is partitioned into two separate zones by the Zone Routing Protocol. First one is Zone of Interest (ZOI) and another one is Zone of Forwarding (ZOF). The distinction is that it exclusively makes use of the network's energy-efficient nodes. The Base Station is then in charge of cluster formation when the network first starts. The main goal of facilitating communication between the Cluster Head and Cluster Member within the same cluster can only be achieved once the cluster member node receives the Zone of Interest (ZOI) message. Once the Cluster Head (CH) is elected, CH broadcasts hello messages that include the cluster_id along with its location to form a cluster.

When the vehicle obtains a distance that is under the defined threshold (10 m) and the time stamp of the message, those vehicles sent request message to join the cluster by Zone of Interest (ZOI) messages to Cluster Head. The ZOI message have Acknowledgement message (ACK) that contains vehicle ID, location, direction message to CH. After receiving ZOI message from the node CH continue broadcast the messages to the cluster members through Zone of Forwarding (ZOF) message. Due to rapid changing environment the cluster creation and Cluster Head selection procedure is again done by ECR-B. The following Figure 5 shows the flowchart for ZOR.

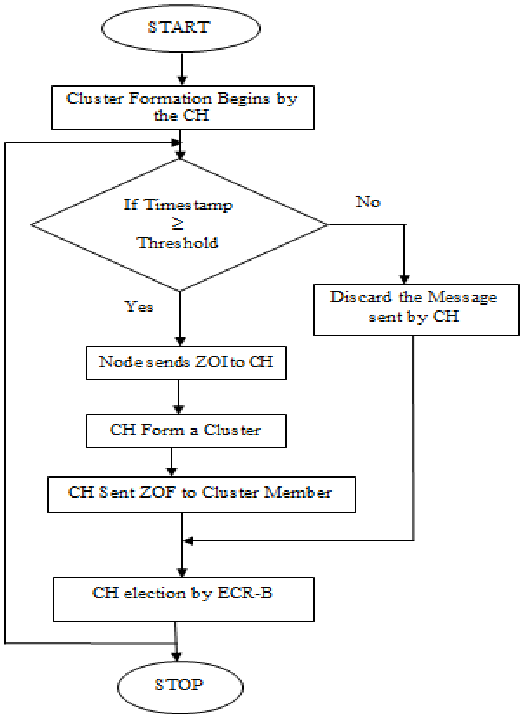

Fig 5: The Flowchart for ZOR

IV. PERFORMANCE AND RESULT

This division displays the performance of the ECR-B protocol when implemented with NS3. The efficiency of the suggested protocol is matched with the existing CDP and ROAC-B. A detailed analysis of all the parameters used in the suggested simulation can be found in Table I.

Table 1: Simulation Parameters

Parameters	Value
Channel	Wireless Channel
Antenna	Omni/Directional Antenna
MAC Protocol	IEEE 802.11
Routing Protocol	Proposed ECR-B
No. of Nodes	100
Transmission Rate	250 Kbps
Area Coverage	1000 x 1000m
Direction	Bidirectional
Simulation Time	500 Sec

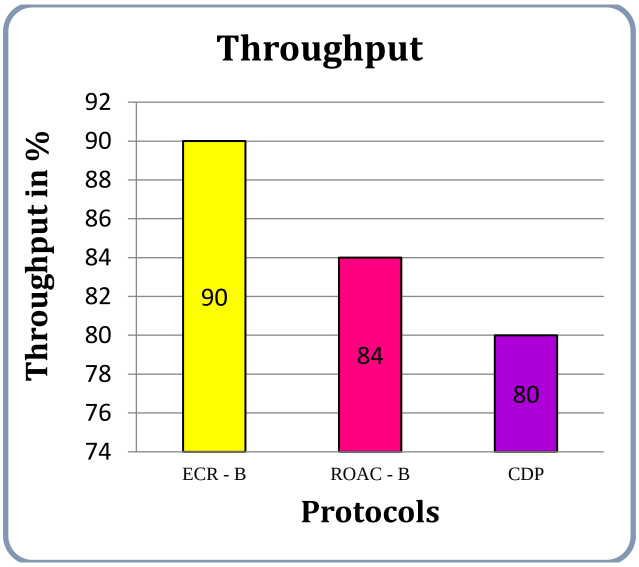

Fig 6: Throughput Comparison

Figure 6 analyse the proposed ECR-B protocol with the existing protocol. The result of the comparison state that the proposed ECR-B achieve 90% of throughput compare to existing ROAC-B (84%) and CDP (80%) protocol.

V. CONCLUSION

One ubiquitous issue in networks is the broadcast storm. A protocol that limits message retransmission and reduces network overload is created to address this problem by electively broadcasting messages within a transmission range.

Many efficient protocols have been defined to conflict the broadcast storm. Since the network has not completely eliminated the broadcast storm. As a result, the suggested SRC protocols discovered a useful method for retransmitting the packets to the Zone of Interest in order to destroy the storm, and the ECR-B performance indicates that the broadcast storm has disappeared from the VANET. In the future, the ECR-B can enable in the Internet of Vehicles (IoV) to improve security in preserving data transmission.

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