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PORTIONING CLUSTER RELIABLE BROADCAST (PCRB) THROUGH INDEX BASED MESSAGE -TRANSMISSION (IBM-T) TO AVOID COLLISION IN VANET

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Abstract: Vehicular Ad-hoc Networks (VANETs) perform a power position in improving various aspects of international transportation. VANETs support the exchange of safety-critical information among vehicles, help to avoid collision and increase overall road scenario. One popular method for increasing the effectiveness of data distribution in VANETs is cluster-based routing. VANET depend on robust broadcast transmissions because they exchange information (such as messages) among the close vehicles regarding traffic conditions, accidents, and similar events. This continuous message broadcast result in redundant data and cause broadcast storm and result in collision in VANET. The proposed work named Portioning Cluster Reliable Broadcast (PCRB) and Index Based Message-Transmission (IBM–T) reduce the broadcast storm though grouping the vehicle by messages and by index the message that transmit before message transmission The proposed work improve better performance like PDR and throughput parameters.

Keywords: VANET, Broadcast Storm, Portioning Cluster Reliable Broadcast (PCRB), Index Based Message-Broadcast (IBM–B), PDR

I. INTRODUCTION:

VANET is a kind of network specifically designed for establishing communication between Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I). Vehicles share and transmit information about their location, path, and speed, which improves road safety. This can help prevent accidents and improve traffic management. VANETs can help in optimizing traffic flow, reducing congestion, and improving route planning by means of facilitating better communication between vehicles and infrastructure [1]. On-Board Units (OBUs) are installed in VANET vehicles which manage communication, navigation, and other tasks. The Infrastructure is established with Roadside Units (RSUs) that are fixed along roads and highways, providing connectivity and data exchange points [2].

The Communication types of VANET are divided into the following: *Vehicle-to-Vehicle (V2V):* Vehicles can communicate directly to exchange data, including location, speed, and direction. *Vehicle-to-Infrastructure (V2I):* Vehicles communicate with RSU (Road Side Unit) to share information about traffic signals, road closed and various information regarding road environment. *Vehicle-to-Network (V2N):* Interaction between vehicles and broader networks, enabling access to cloud-based services and traffic management systems [3]. Ensuring the communication at correct time to vehicle is crucial because of randomly changing of nodes with high speed velocity. Managing network performance and transmission of message is a challenge if the number of vehicles increases [4]. The design of VANET is shown in Fig 1:

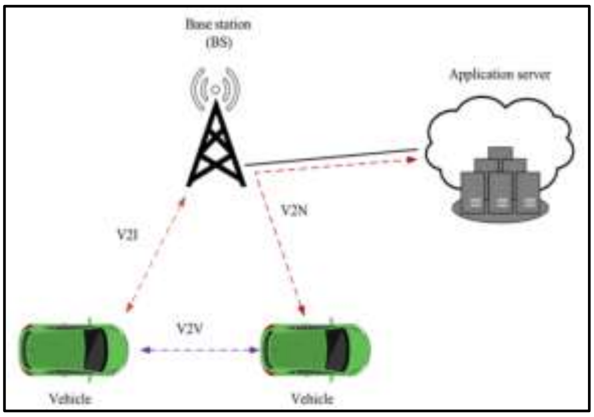

Fig 1: The Design of VANET

Due to vast network topology clustering vehicles in VANETs is important because it enhances communication efficiency, scalability, data management, and network stability. Cluster organizing vehicles into groups that can more effectively interact. Cluster reduces the network overload and distributing the message and managing network resources, such as bandwidth and energy, more effectively. Clustering the Vehicles within range exchange information directly, reducing the need for long-range communication and thereby minimizing delays and congestion in the network. Instead of each vehicle communicating directly with every other vehicle, they can communicate with them, which then communication with other clusters. This reduces the number of messages and bandwidth required [5]. This paper present Portioning Cluster Reliable Broadcast (PCRB) for better cluster-based broadcasting technique using Index Based Message-Transmission (IBM–T) for improved message transmission. This paper is divided into sections: Section II illustrations literature review about related work of the past works in the same area. Section III tells about the proposed PCRC protocol using IBM-T data transmission and Section IV presents the result of the proposed work and in Section V this paper concludes with future work.

II. RELATED WORK

The earlier work of VANET to control the broadcast storm associated with cluster-based technique is discussed in this section

The author [6] **Huang et al.,** proposed that there are two methods of facilitating communication between VANET and the backbone infrastructure, RSU. The first involves direct utilization of the RSU by the vehicle to establish an internet connection. Alternatively, the second approach entails the formation of clusters by vehicles, which allows for intra-cluster communication in order to exchange information**.**

Robust Mobility Aware Clustering (RMAC) present by **Zareei et al.** it defines the characteristics of CH that Selects the most suitable CHs by considering metrics related to the mobility of nodes, including speed, location, and direction of travel [7].

Almalag et al. [8] Time Division Multiple Access (TDMA) slot reservation strategies, which leverage the clustering of vehicles, facilitate one-hop communication within each cluster, thereby negating the necessity for the discovery of neighboring nodes. Ensuring the stability of the cluster relies heavily on the careful selection of a cluster head node.

Distributed and Mobility aware Cluster-based MAC protocol (DMMAC) presented by **Gupta et al.** [9] guarantees the robustness of its cluster members by accurately forecasting their future velocity and location. The main difficulty with TDMA lies in its requirement for precise synchronization and thorough pre-planning of geographical areas for TDMA slots. The protocol could be enhanced by taking into account the time spent by potential cluster members on the road before they are permitted to become part of a cluster group.

The Hierarchical Clustering Algorithm (HCA) is designed by **Nazhad et al.** [10] to prioritize rapid establishment of network topologies and efficient scheduling to ensure the prompt transmission of urgent messages within a Vehicular Ad-Hoc Network (VANET). This algorithm operates as a randomized hierarchical cluster, featuring two primary nodes and a central hub. Consequently, the algorithm restricts the maximum number of potential connections.

The issue of safety message authentication in a high-density traffic scenario was covered by **El Sayed et al.** (2020) [11]. Additionally, it proposed a prioritised verification strategy as a means of resolving vehicular message authentication issues in high traffic situations. Based on the physical characteristics of the nearby vehicles, priority scores were assigned to the safety messages [12].

III. PROPOSED WORK

Index Based Message-Transmission (IBM-T)

In order to prevent rebroadcast of message, each message transmission in Index Based Message-Transmission (IBM-T) is assigned a specific key. The packets are delivered to entirely possible vehicles with high dependability and little latency. The network is prevented from broadcast storms by the proposed IBM-T, which involves sharing a distinct key for each message transmission. The following Fig 2 explains specific index message transmission contains of three identification alphanumeric specific numbers for each broadcast.

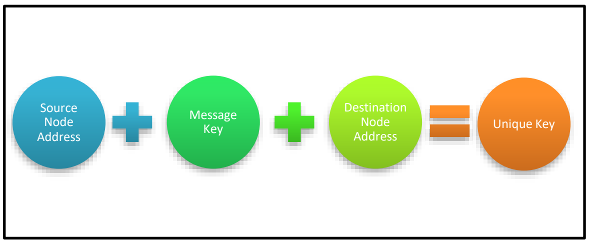

Fig 2: Specific Index Based Message-Transmission

The address of the destination vehicle (8 bits) represents the destination node address, whereas the 8-bit key combination from the original message aids as the message key. The destination nodes and RSU receives the data from the source node address that contains the address of a source vehicle (8 bits).

Every node communicates with its Cluster Head (CH) by sending a hello packet to join the cluster. In the process of sending the hello packet, the node generates its specific address, which is then transmitted to the concerned node. Similarly, for every RSU, it generates a unique address that helps identify the RSU.

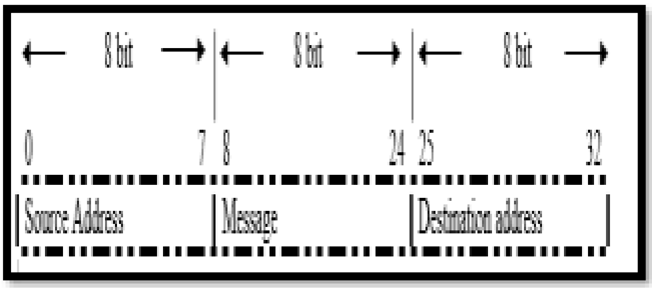

Fig 3: Index Message Format

For every data transmission, a different index message format is shown in Fig 3. Instead of sending the same messages over and over, this special format lets the sender know that their message has already been received and makes it obvious that it was received early. The following Fig 4 shows the algorithm of IBM-T.

Index Based Message-Transmission (IBM-T) Algorithm:

Step – 1: Unique value between 0 to 1 is assigned to all node through LEACH's dynamic value allocation as in setup phase.

Step – 2: Threshold value is identified using

$$T(n) = \frac{P}{1-P\times(r \bmod \frac{1}{P})} \quad \forall n \in G$$

Step – 3: Node that holds nearer or equal value to the threshold value is chosen CH for the first round

Step – 4: Initialize the CH and send message to nearer vehicles to form cluster
Step – 5: Cluster members forwards the unique node address to each other to forward/receive messages between the vehicles.
Step – 6: Once the node addresses are transmitted, the key generation will be processed.

$$Index \ = Source_{addr} + \frac{original_{msg}}{Key_{gen}} + destination_{addr}$$

Where, $Source_{addr}$ is source address of the node and $destination_{addr}$ is destination address of the node. $original_{msg}$ is original safety event message content of (254 bytes) and Key_{gen} is the Index generation process consist of 254 bytes alphanumeric keys that generate a unique Index of size 8 bit (1 byte by 254 bytes message content/254 alphanumeric keys)

Step – 7: Start message transmission by transmitting unique key to all nearby nodes
Step – 8: Destination node checks the unique key with received key to identify the uniqueness of the Index.
Step – 9: IF index is unique, the destination node sends the ACK (acknowledgement) and the original message will be forwarded.

ELSE index is not unique then the destination node sends an alert message stating that the message is already received to the sender. Whenever, the alert message is received, the transmission of the particular message is stopped.
Step – 10: Stop the process

Fig 4: Index Based Message-Transmission (IBM-T) Algorithm

Portioning Cluster Reliable Broadcast (PCRB):

After the messages are keyed by Based Message-Transmission (IBM-T) the vehicles are grouped by Portioning Cluster Reliable Broadcast (PCRB) protocol. PCRB reduces the amount of packets that are transmitted for rebroadcast messages. In order to substantially decrease the number of forwarder vehicles, packets are re-sent towards the next hop utilizing a method of dynamic vehicle selection.

The proposed protocol possibly reduces retransmission by identifying vehicle clusters quickly and effectively. Additionally, choosing one to be the CH vehicle for every cluster is identified, and the PCRC protocol mainly focuses on to limit the broadcast storm. The PCRC protocol divided the vehicle into two groups, LSV (Linked Set of Vehicle) and RSV (Remove Set of Vehicle), according to the message transmission and it’s explained in Fig 5.

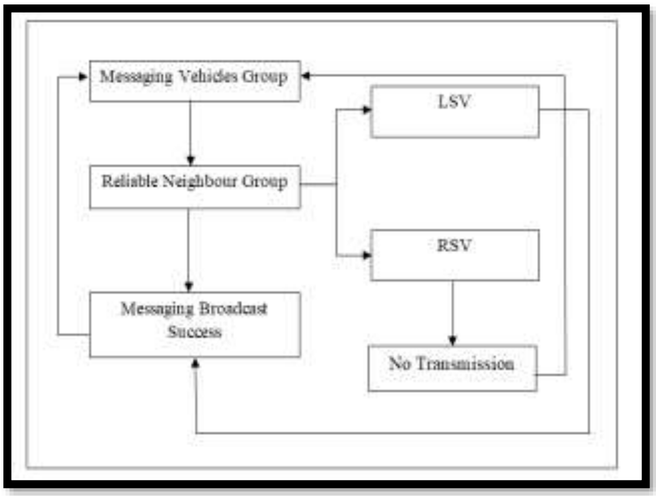

Fig 5: Block Diagram of PCRB

Vehicles are categorized as either RSV or LSV according to how reliable they are. The reliability of the vehicle is confirmed prior to the start of broadcasting. LSV will enable the successful broadcasting of the message transmission. A vehicle's broadcasting is turned off and transmission is halted when its dependability with RSV is jeopardized. The complete infrastructure is established within this segment, facilitating communication between vehicles and between vehicles and infrastructure. To cover the vehicles, the RSUs are fixed on the roads. The RSU gathers data from the roads during this time and sends it to the server.

The vehicle's dependability is used to determine the LSV. On the other hand, the timestamp and vehicle speed are often generated using the fundamental packet format. The classification of the vehicle as an LSV will depend on the timestamp and the established threshold value. The vehicle remains in the CSV as long as the timestamp continues to rise. The message transfer will be handled after the reliability has been successfully verified.

Usually, the LSV check is followed by the RSV set joining. The car will automatically join the RSV whenever it is unable to join the LSV. For the purpose of classifying the vehicle as either an LSV or RSV, it will review its threshold and timestamp values with each message received.

Furthermore, the cars in the RSV are checked for distance and the fundamental threshold value of distance. Naturally, cars that go less than the threshold distance are given another look at joining as LSV; otherwise, they stay in RSV. The following Fig 6 shows the vehicle portioning into LSV and RSV. An LSV is indicated by a red dotted circle, and an RSV is shown by a yellow dotted circle, because of shared elements such as speed and time. Thus, before to each message transfer, the data transmission will be examined.

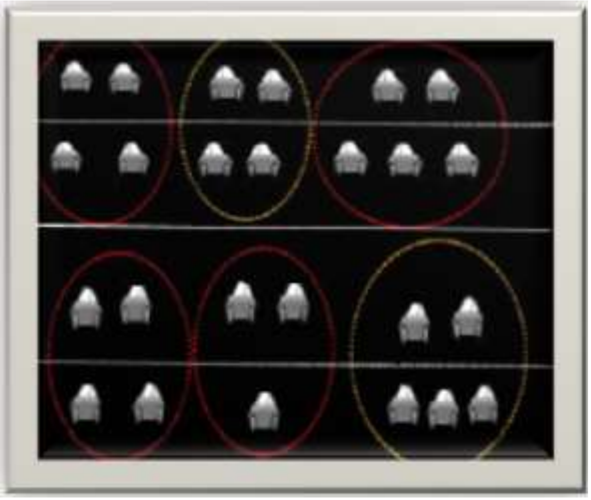

Fig 6: PCRB – LSV and RSV

The Algorithm for Portioning Cluster Reliable Broadcast (PCRB) is given below:

- Step – 1: The designated index j is greater than the ID of the reachable transmitter vehicle, with j identified as the median vehicle.
- Step – 2: The gap between the two nearest vehicles in the cluster.
- Step – 3: The gap between the two vehicles that is furthermost apart within the cluster.

IV. RESULT OF THE PROPOSED WORK

The objective of this proposed work is to mitigate broadcast storms in Vehicle Ad Hoc Networks (VANET) by enhancing throughput, improving packet delivery ratios, and extending the overall lifespan of the network. The various simulation settings utilized in the suggested work are shown in Table I. The performance of the proposed PCRB is evaluated by comparing it with existing methods using metrics such as packet delivery ratio (PDR) and throughput. For a network to continue serving its intended purpose of developing without encountering any problems, network lifetime is crucial. The PDR performs better, though, thanks to the lifetime improvement. Improved CH node selection advances the goals of the network; consequently, the suggested work focuses on enhancing member node and CH selection for network enhancement. The proposed and current methods' network lifetimes are displayed in Fig. 7.

TABLE I: **SIMULATION PARAMETERS**

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

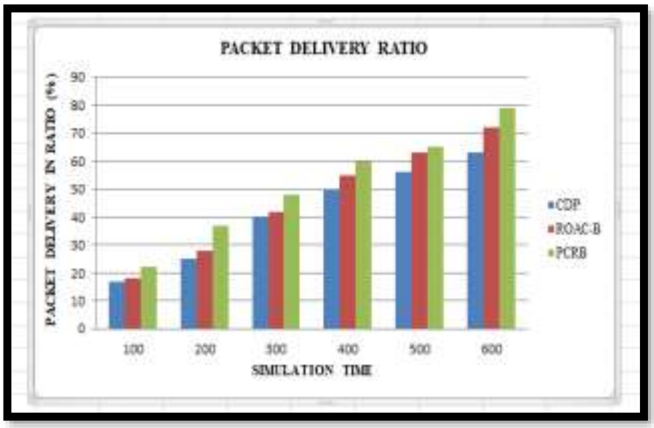

FIG 7: PCRB PACKET DELIVERY RATIO

Figure 7 explains PDR (in percentage) comparison results, existing algorithms CDP achieve 63%, and ROAC-B achieves 72%. The PCRB Protocol being proposed shows a 79% of quantity of data packets delivered by the source and the number of packets that reach their destinations.

The proposed PCRB Protocol has a 79% ratio between the number of data packets supplied by the source and the number of packets received by the destinations. This shows proposed PCRBs PDR is higher than the existing system. The proposed PCRB is significantly higher than 16% and 7% of existing CDP and ROAC-B results.

V. CONCLUSION AND FUTURE WORK

The VANET is a newly developed network in which cars communicate with other nearby vehicles about pertinent information including traffic conditions.

Although VANET does a great job of communicating and transferring data, it often experiences broadcast storms that can disrupt the network's performance. Several useful protocols have been defined in order to combat the broadcast storm. Considering that the network has not completely eliminated from the broadcast storm.

To address the storm, the proposed PCRB protocols identified an effective approach for retransmitting data to the area of interest, demonstrating superior performance compared to current protocols. In the future, the Internet of Vehicles (IoV) can use the same protocol, which includes the PCRB, to improve security in data transmission.

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