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SIMULATION OF QOS PARAMETERS IN VEHICULAR AD HOC NETWORKS

M.V.H. Bhaskara Murthy, G.S.S.S.V.Krishna Mohan Professor, Department of Electronics and Communication Engineering, Aditya Institute of Technology and Management, Tekkali, Srikakulam, Andhra Pradesh, India, 532201 **Email Id: mvhbmurthy@gmail.com**

J. Pavan Kalyan, T. Jeevitha Student, Department of Electronics and Communication Engineering, Aditya Institute of Technology and Management College, Tekkali, Srikakulam, Andhra Pradesh, India, 532201

ABSTRACT: Vehicular Ad-hoc Network (VANET) is one of the widely used networks across various intelligent transport applications in order to support the autonomous driving, reduce network congestion and overcome any kind of the accidents occurring on the road. This report involves in focusing on the safety applications where the vehicles involve in broadcasting the safety messages that are highly time critical and reliability sensitive. The importance of delivering the broadcasted safety messages of VANET in highly timely and reliable manner has resulted in undertaking this research work. In order to support the reliable delivery of the broadcasted safety messages, this research has developed a model called Reliable Vector Clustering (RVC) which involves in neighbour node identification, vehicle cluster formation and broadcasting the coded data using the network coding method. In order to evaluate this developed model, analytical model developed and simulation studies have been carried out in this report. The analytical model has developed a criterion that helps in choosing the best vehicle as the cluster head node and the simulation studies have compared the effectiveness of the developed method. These simulation studies have revealed the effectiveness of proposed RVC method in improving the packet error recovery probability and packet delivery ratio when compared to the existing methods. The QoS parameters such as packet delivery ratio, packet drop is simulated in vehicular ad hoc network.

Key words: Vehicular Ad hoc Networks, Cluster Communication, QOS, Reliable Communication, NS2 simulator.

I. INTRODUCTION

A wireless network allows devices to stay connected to the network but roam untethered to any wires. Access points amplify Wi-Fi signals, so a device can be far from a router but still be connected to the network. When you connect to a Wi-Fi hotspot at a cafe, a hotel, an airport lounge, or another public place, you're connecting to that business's wireless network.

A wired network uses cables to connect devices, such as laptop or desktop computers, to the Internet or another network. A wired network has some disadvantages when compared to a wireless network. The biggest disadvantage is that your device is tethered to a router. The most common wired networks use cables connected at one end to an Ethernet port on the network router and at the other end to a computer or other device.

Using a recently developed technology called a "vehicular ad-hoc network" (VANET), communication between cars is established. Within a limited range of 100 to 300 meters, it enables communication between vehicles to vehicle's Within a limited range of 100 to 300 meters, it enables communication between vehicles to vehicle's Every node in a VANET interacts by exchanging information about traffic jams and unintended alarms while driving. It madean extra effort to improve the state of the road- related systems, such as collision detection and avoidance, traffic visibility, message exchange,and crash reporting; all these body tasks must be performed safely. The main goal of the created system is to provide reliable transmission of the whole message among the nodes (vehicles). To prevent accidents, vehicles should adhere to the traffic pattern and the speed limit. The rogue nodemight cause a variety of issues and send out incorrect information, such as inaccurate reports of accidents and traffic jams.

Vehicular Ad Hoc Network (VANET), a type of Mobile Ad Hoc Network (MANET) gained high attention among practitioners and researchers due to its wider benefits to the working of Intelligent Transport Systems (ITS). VANET is similar to MANET in which several vehicles are interconnected to each other in order to communicate and exchange useful information. The communication in VANET is provided in two schemes namely Vehicle–to-Vehicle (V2V) communications and Vehicle-to-Infrastructure (V2I) communications. Taking these two types of the communications that are offered by VANETs, they help the moving vehicles either to access the internet, other kind of services or to communicat0e with other vehicles while on road.

VANETs consist of Road-Side unit (RSU), On-Board unit (OBU) and Trusted Authority (TA). RSU is based on infrastructure which is fixed node and all the messages are transferred by the RSU to all the vehicles within its range. It also helps the vehicles to connect to the internet. OBU is a sensor which is located in the vehicles to collect all the data from the surroundings. Its main function includes reliable message transfer and routing information. Trusted Authority is a third party which provides security to the network. Certificate authority provides the keys and certificates to the vehicles or RSUs and authenticates the vehicles for the secure communication. All the messages are encrypted with the keys provide which is generated by the TA and also identify an attack performed.

Therefore, the main applications of VANET are of two types namely (1) safety applications and (2) comfort applications. The safety applications involve in mobile vehicles sharing information about the road accidents, traffic congestion, about the road conditions and the comfort applications involve in allowing mobile vehicles to access web browsing.

Among these two applications, the safety applications of VANET gained high importance due to the ability of these applications in saving people from road accidents, improving the driver experience and enhancing the level of road safety. Proper working of these safety applications of VANET requires reliable delivery of the packets from source to destination. In other words, the main benefits of VANET safety applications can be obtained only when the packets sent from the source reach the destination accurately without any kind of errors.

The unique characteristics of VANET such as high and random mobility of vehicles, wireless communication, channel contention, geographical constraints, and dynamic network topology due to frequent changes in node positions make reliable data transmission highly complex in the VANETs. The wireless communication medium among the vehicles causes channel interference due to shared radiointerferences and the low channel strength results in the increase of Bit Error Rate. All these aspects increase the chance of packet losses during transmission, thereby affecting reliability of data transmitting over these VANETs. The biggest obstacle to the provision of QoS and to support reliable transmission in VANET is presence of high node mobility with random node movements making the wireless links in the network unreliable. On the other hand, VANET when using contention-basedIEEE 802.11 protocol, offering delay-bound QoS becomes highly challenging issue. In this situation, the number of vehicles that are contending for the same wireless channel increases and thereby increases the level of packet-delay and also data-congestion.

II. REALATED WORK

This section details the previous works of VANET to avoid the broadcast storm in cluster- based approaches.

VANET possess unique characteristics such as dynamic connectivity, high vehicle mobility, and frequent changes in the topology and self-organizing in nature. In VANET, this clustering is defined as the process of arranging the vehicles into various groups depending on specific rules or specific criteria. Each cluster also known as a virtual group is characterized with the presence of cluster head, cluster members and cluster gateways. Therefore, any vehicle in a VANET cluster plays the role of cluster gateway, cluster head and cluster member. According to Cooper et al 2020 [2], the formation of VANET clusters works in such a way that each clusterconsists of only one cluster head that is chosen based on specific criteria.

Benrhaiem et al approach's Multi-Hop Reliable Broadcasting (MHRB), is suggested for anumber of VANET applications for the metropolitan area. The suggested methodology is based on regional state data that divides the streets into various units. These many cells are created together to form grid-like zones. A To take use ofthe periodic beacons' characteristics, proactive local state processing is suggested. As a result, in multi-hop broadcasting, the quality of the neighbour is estimated, suitable forwarders are found, and desired dependability is achieved in each hop. Moreover, the network's lifespan is extended and bandwidth usage is minimised. In terms of dependability and bandwidth utilisation, M-HRB outperforms the current methods. Even though it achieves better performance in terms of reliability and forwarder selection, MANET, where the forwarder selection must be maintained and chosen for each transmission, is unreliable, which hurts the network's performance when thereare a lot of vehicles on it.

For transmitting emergency messages on VANET, Selvi & Ramakrishnan describe an effective message prioritising mechanism with thescheduled partition. The amount of time that the same messages are broadcast to the same nodes isreduced by prioritising the messages beforebeginning the transmission [13]. In order to prioritise the transmission in VANET, this is the top priority. Data identification focuses on dividing the data into regular data and data connected to emergencies in order to prioritise. Compared to regular data, emergency data is high before it ever reaches the nodes. As a result, the nodes get the emergency data transmission as a high priority. Second, two techniques—i) based on SMTP similarity metrics and ii) based on the adaptive scheduled partitioning technique—are used to process emergency transmissions and regular data transfer. Although the SMTP transmits normal data, an adaptive scheduled approach is used to send emergency messages.

A location-based reliable broadcasting for VANET was proposed by Pramuanyat et al. Many safety applications that need to transmitinformation quickly, safely, reliably, and in a constrained area is made possible by ITS onVANET [11]. These applications need to provide the appropriate information to the right vehicles. The Global Positioning System (GPS), which provides inaccurate results in enclosed spaces, is the most common method used to determine position awareness ability.

R. Shiddharthy and Dr.R. Gunavathi 4452 Energy The suggested study focused on dependable broadcasting protocol based on distributed energy conservation (DECA). To more accurately locate the nodes in VANET, DECA offers a better location service. As a result, data transfer accuracy is compromised.

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To send traffic safety data in VANET, Oliveira et al. presented a trustworthy data transmission protocol. Designing an adaptive broadcast protocol to identify the broadcast storm is one of the key difficulties facing VANET. This study presented a unique Adaptive data distribution Protocol (Addp) to handle the broadcast storm by lowering the number of beacons and messages in the network and employing periodic and dynamic adjustments for beacon periodicity. The suggested treatment performs better than the other current methods when its efficacy is tested. The same protocol maintains its level at a minimal throughput for big metro regions, despite the suggested work's greater performance in throughput for urban areas than the existing work.

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For the purpose of distributing safety messages (overall safety messages) among the vehicles, Abbasi et al. suggested the Intelligent Forwarding Protocol (IFP) on VANET. Several methods are presented in a dynamic environment to allow cars to communicate safety messages. The majority of the proposed work operates effectively with little to no traffic.

For effective collision resolution, the suggested protocol takes advantage of handshake- free communication with ACK decoupling. Simulated experiments and real-world testing are used to conceptually model IFP. The suggested protocol's Packet Delivery Ratio (PDR) is enhanced by reducing the message propagation delay.

Reliability and energy-efficiency for safety message broadcast on VANET were proposed by Sattar et al. [12]. The model concentrated on flooding's dependability as a foundational data broadcast mechanism to convey a time-sensitive safety warning. The network layer provides end- to-end dependability and provides information on the flooding method. After a set number of message rounds, maintaining the threshold value increases the PDR rate, which extends the network's lifespan.

The suggested technique compares simulation results with the current systems to assess the improvements. The next Internet of Vehicles will absolutely require energy-efficient protocols (IoV). According to the aforementioned published papers, it is crucial to address the broadcast storm in VANET in order to create a more accurate network model.

M.V.H. Bhaskara Murthy & B. Prabhakara Rao (6) developed a "Ant Colony Based OLSR for Improved Quality of Service in Multimedia Traffic". To overcome this issue, in this paper, an ant colony optimization is incorporated with OLSR routing protocol. Algorithms like ant colony optimization (ACO) algorithms are nature-inspired algorithms that are capable to efficiently construct routing algorithms for MANETs. The observations show the efficiency of the proposed ACO OLSR when compared to OLSR. Thus, the proposed routing enhances the QoS of the network. The proposed ACO algorithm was also compared with the works of Toutouh et al and Gomez et al. It can be seen that the end-to-end delay is the lowest in the proposed technique. However, the PDR is lower than Toutouh et al. Future work needs to be carried out to improve packet delivery ratio.

III. METHODOLOGY

In this study, a clustering technique for VANET is proposed. This technique makes sure that receives broadcasting packets in a dependablemanner. Clustering method and network coding method are coupled to address the problem ofpacket errors that might happen during wireless communications. As a result, the suggested model relies on the two approaches of clustering and network coding, which are described in more depth below, to provide QoS and reliable packet delivery.

They are the two key techniques used in this suggested model. As a part of the proposed paradigm, the goals of each of these techniques and the actions taken in each of these techniques are,

1. The three steps of the clustering method— neighbour node identification, cluster head selection, and packet broadcasting—are used to organise the VANET into different clusters.

2. The data received from each car is coded using the network method, which is implemented in each cluster head.

Every cluster vehicle that has experienced a packet loss or error is retransmitted the XORed packets using this network coding. With the help of this network coding, network congestion can be decreased and network dependability can be increased.

In this study, a mix of mathematical analysis and simulation modelling is used to assessthe efficacy of these strategies in the suggested model.

FLOW CHART:

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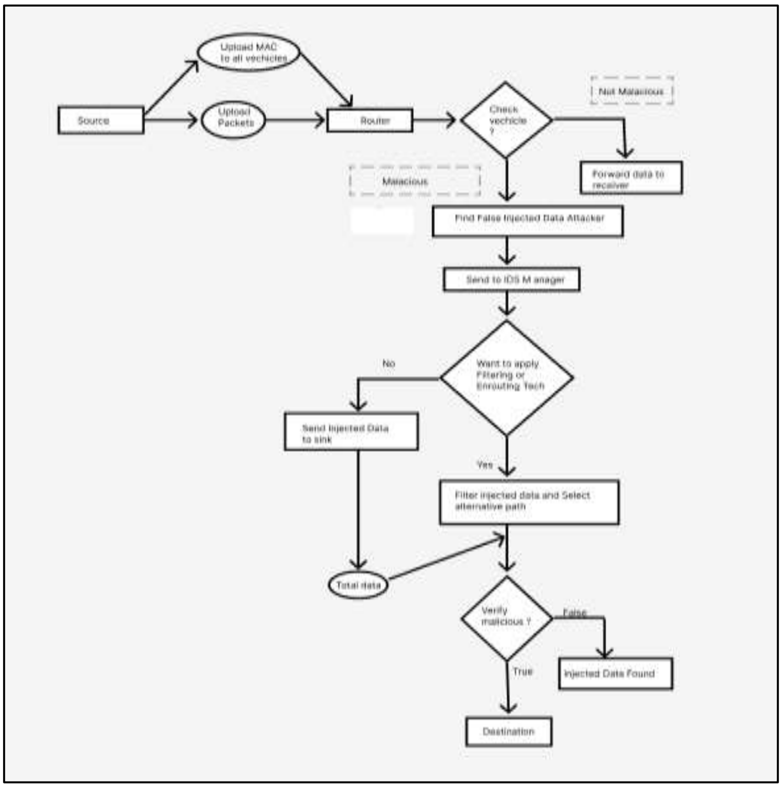

Figure 1: Proposed Flowchart of Model

This section includes a flowchart outlining how the suggested model functions. This flowchart fully explains each step that must be taken both ensure the packets are delivered reliably.

III. SIMULATION RESULTS

This chapter details the effectiveness of the RVC protocol, which is using NS 2.35. When compared to the current schemes, the suggested protocol's performance is evaluated. This is a description of the various settings utilized for the suggested simulation. It is possible to utilize a vehicular ad-hoc network (VANET) to wirelessly transport data from onecar to another.

Vehicle-to-vehicle (V2V) and vehicle- to-infrastructure (V2I) communication is provided by VANET to allow information sharing between cars. To evaluate how well VANET performs, certain parameters must be examined.

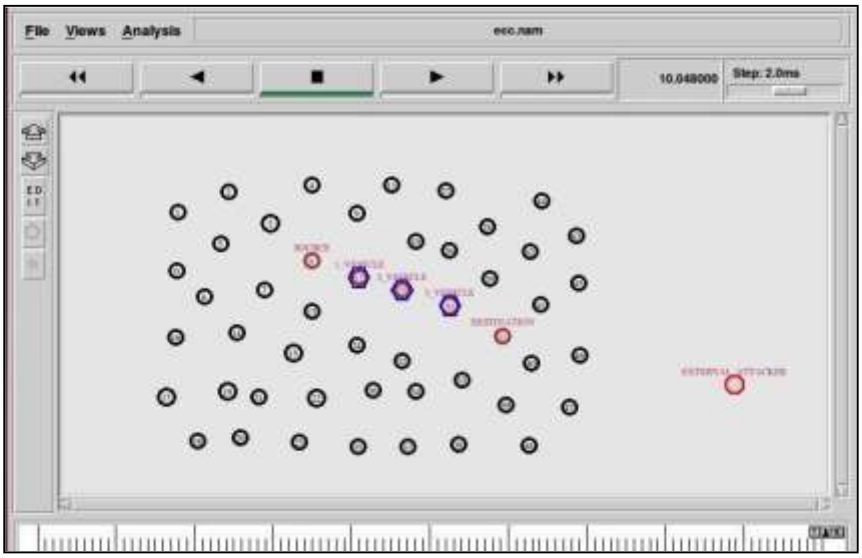

Figure 2. Transfer of Data Packets

The Figure 2 depicts the transfer of data from source to destination in the form of packets. It can be observed that there are different nodes involved in this data transmission process. The project includes a network coding method which enables us to transmit data without any loss of information.

To evaluate the criteria, the simulation and proposed model w

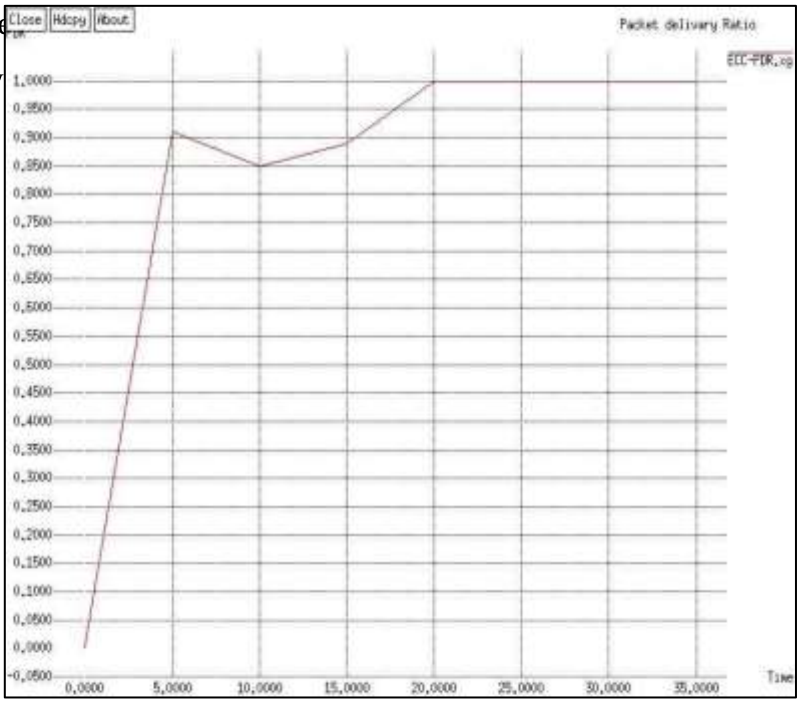

Figure 3. Packet delivery ratio (PDR)

The PDR (%) between the suggested reliable vehicular clustering approach (RVC), which is superior than the other current systems, isshown in Figure 3. RVC maintains a packet delivery ratio of 100% while the SRC protocol only maintains a ratio of 98%. The primary cause of this is the cluster head node's capacity to accommodate a greater number of RVC retransmissions, which increased the likelihoodthat a packet would be successfully delivered to the receiver and consequently raised the packet delivery rate.

The above figure shows the graphical representation of packet delivery ratio. In Figure 3 x-axis represent time and y -axis represents PDR percentage. In the above graph observed that number of packets sent per second.

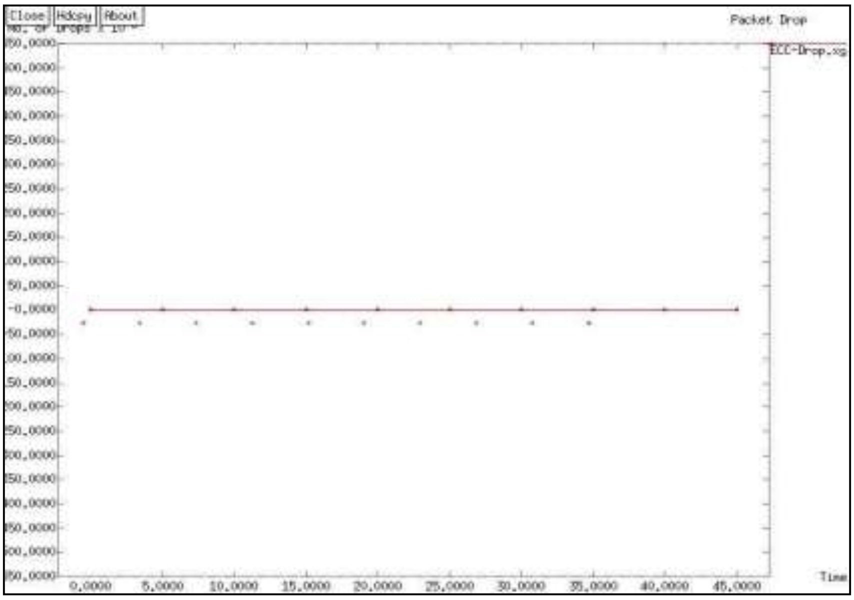

Figure 4. Packet Drop

Packet Drop graph between the suggested reliable vehicular clustering approach (RVC), is shown in figure 4. RVC maintains 0% packet dropwhereas the existing works. Data packets that werelost while being transferred across a network are described in figure 4. Packet loss or packet drop occurs when network congestion, hardware issues,software bugs, and a number of other factors causedropped packets during data transmission.

Figure 4 shows the number of packetsdropped for each second, Time is represented on the X-axis, while the number of drops is on the Y-axis. Zero packet dropouts in the following diagram indicate that all packets were successfully carried from the source to the destination

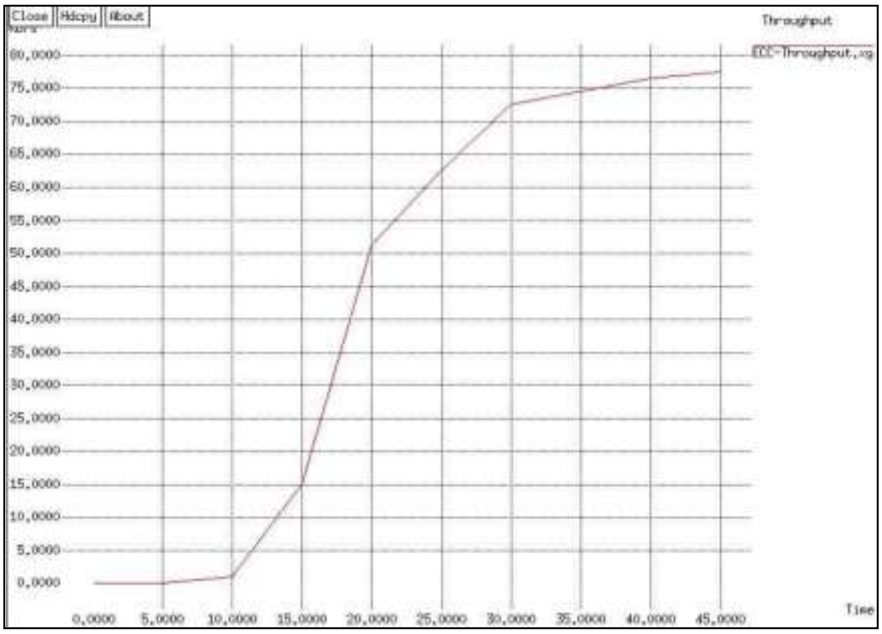

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Figure 5. Throughput

The suggested RVC protocol's throughput (%) is shown in Figure 5. Better Throughput Percentage is shown when compared to the currentworks. A high throughput eliminates thepossibility of packet loss. Figure 5 depicts the x axis as time and the y axis as the quantity of data received from the server to the client at the first stage, when there are no packets sent. If throughput is high than packets transformed with high energy.

The aforementioned data shows that the suggested RVC maintains a greater performance when compared to the SRC approach.

IV. Conclusion & Future Work

Vehicle ad hoc networks are utilized in anextensive variety of safety applications as a resultof the complexity of traffic management systems.This research has proposed a method called reliable vehicular clustering method, which involves using a set of techniques in order tosupport reliable delivery of broad casted safety messages to the intended receiver in a wireless adhoc network. The use of vehicular ad hoc networksin these safety applications requires the need of delivering safety messages to the intended receivers in a timely manner and without any errors. The clustering plan involves the implementation of three key steps, namely theretrieval of nearby nodes, cluster creation, and datapacket broadcasting. In the proposed paradigm, thebroadcasted packets are encoded by random network coding.

In order to improve error recovery capabilities and reduce the amount of datareduction that could occur during data broadcasting, the suggested model uses random network coding to encode the broadcasted packetsby cluster head.

The usefulness of these strategies in the proposed model is evaluated by combining mathematical analysis with computer modelling. An analytical model was initially developed for choosing the cluster head node in a certain clusterand calculating the packet delivery failure rate in anetwork.

Due to packet broadcasting and the existence of the hidden node problem, there is a high likelihood that packet collisions may occur. Given the widespread occurrence of the concealed node problem in VANET as reported by Gholibeigi et al., it is imperative to address this issue in order to ensure the dependablecommunication of the broadcasted data. Further work on this project will focus on creating an innovative technique, like the handshake signal, to locate hidden nodes, lessen packet collisions, and ultimately increase the trustworthiness of broadcasted data when utilized for safety applications.

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