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Multicasting Model for Efficient Data Transmission in VANET

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Abstract—VANETs (Vehicle Ad hoc Networks) are networks made up of a number of vehicular nodes that are free to enter and leave the network. The Location Aided Routing (LAR) protocol is the one that is most frequently utilized among them. Here, the route request packets are flooded across many pathways to the source node using the broadcasting strategy. The vehicles that have a direct path to the destination send the route reply packets back to the source. The least number of hops and the sequence number are used to determine the route from source to destination. This research study has used the multicasting approach to construct a path from the source node to the destination node. Within this multicasting strategy, the root nodes from the network are selected for data routing. The path between the source and the destination is chosen using a root node. The suggested approach is put into practice using the NS2, and some parametric values are computed to produce analytical findings.

Keywords- VANET, LAR, Broadcasting, Multicasting, Zones.

I. INTRODUCTION

The Intelligent Transportation System (ITS) has advanced quickly over the past few decades as a result of the quick advancement of wireless network technologies and the rising demand for transportation. In recent years, the vehicle ad hoc network (VANET) has emerged as a promising research area with the potential to increase transport efficacy, reduce traffic jam, increase road security, and provide internet access for both drivers and passengers. VANET is a key factor of an ITS. Short-range wireless transceivers are a requirement for RSUs, such as roadside sink nodes or APs, and automobiles in the VANET. Using V2I or V2V, each vehicle can communicate with an RSU or with other cars (V2V) [1]. A unique wireless technique called dedicated short-range communication (DSRC) aims to accommodate both V2I and V2V communications. In DSRC, OBU-equipped car is able to interact with both other vehicles and RSUs, which are stationary structures placed on the road for offering applications and services for vehicles. Additionally, choices for the next-generation vehicle networks include LTE network and the current Wi-Fi network.

Other mobile ad hoc networks can be distinguished from VANET by a number of its difficult problems (MANETs). A topology which is highly dynamic is produced by the volume of traffic under various traffic scenarios, such as rush hours and traffic congestion. Furthermore, the increased mobility of vehicles causes sporadic connectivity within the vehicles or amid the vehicles and Roadside Units. As a result, when sharing information, communication lines in VANET may experience frequent disruptions. Deterministic routing and opportunistic routing are the two basic routing methods. If network circumstances remain constant over time, a sender will always choose the same vehicle in deterministic routing as the best relaying vehicle [2]. In the greedy forwarding strategy, for instance, a sender vehicle always chooses the relaying vehicle with the highest geographical progress provided that both internal and external parameters don't change. Even if network circumstances do not alter over time while using opportunistic routing, a sender may choose a different vehicle as the best relaying vehicle. For instance, in the opportunistic routing protocol, a sender vehicle broadcasts a packet and chooses one of its successful recipient neighbor as a relay candidate based on the neighbor with the highest priority. Keep in mind that each neighbor on the link has a chance of losing a packet. Despite the fact that all the variables are the same, the two procedures may choose two different relaying vehicles [3]. Finding the right metric to compare multiple streets is crucial for choosing a street at an intersection; for the picking relaying vehicle along the intra-street, a good routing system is also necessary in addition to the right metric. Opportunistic routing is more appropriate for VANETs in dynamic urban environments because it can deal with changing network dynamics better than

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deterministic routing. A vehicle can decide instantly based on the shifting real-time network conditions when it locates a relaying vehicle along the intra-street. However, the majority of current works on VANET mostly concentrate on broadcasting routing protocols. In actuality, message broadcasting uses up bandwidth and increases transmission overhead. Finding the right metric to compare multiple streets is crucial for choosing a street at an intersection; for the picking relaying vehicle along the intra-street, a good routing system is also necessary in addition to the right metric [4]. Opportunistic routing is more appropriate for VANETs in dynamic urban environments because it can deal with changing network dynamics better than deterministic routing. A vehicle can decide instantly based on the shifting real-time network conditions when it locates a relaying vehicle along the intra-street. However, the majority of current works on VANET mostly concentrate on broadcasting routing protocols. In actuality, message broadcasting uses up bandwidth and increases transmission overhead. All the nodes must remain connected during the transmission for AODV to create a routing path at initial phase and transfer packages via an effective routing path. The routing discovery process will restart in case of termination of the existing route, pausing data transmission while a novel route is located and chosen [5]. It is clear that Ad-hoc On-demand Distance Vector is unable to be applicable to the regular and quick variations in network architecture that occur in VANETs. In what is known as the "greedy forwarding approach," GPSR employs vehicular Global Positioning System to determine the positions of other cars and chooses the mote closest to the destination node within the signal radius as the next-hop node. General Packet Radio Service is incapable for the greedy forwarding technique to transfer the data packets to the next-hop mote in some circumstances at which every node is placed far away from the target mote in contrast to the present transmitting mote. The present node sends the data packets using the boundary forwarding approach to solve this issue. But this could lead to a long routing latency and poor reliability. While these conventional routing protocols can operate effectively in MANETs, they may perform poorly when satisfying the high routing reliability requirements of VANETs [6]. Today's emphasis is on using metaheuristic routing algorithms to streamline chores such as to discover the route and upkeep. These routing protocols are designed to operate in a distributed mode and use MAs to locate paths with particular characteristics. They are motivated by the behavior of entities in nature. A routing protocol can be designed using the Ant-Colony Optimization (ACO) technique, which uses bioinspired ant colony-inspired schemes to solve optimization problems. These protocols are based on how ants identify routes with particular characteristics, such as the shortest path. ACO-based algorithms generate and maintain routes by using the algorithm's optimization mechanisms. Additionally, Ant Colony Optimization model is modified to operate with different objectives according to the issue at hand, such as deploying MAs to discover the path with the greatest degree of connectedness rather than the quickest path Low computing costs, shortened execution times, search in a smaller area of executions, and discardable wide knowledge related to the system are the key computational benefits of using algorithms based on ACO.

ARA, ANTNET, and POSANT are three bioinspired protocols that are pertinent to studies looking into routing in VANETs. An ACO-based reactive routing protocol for mobile networks is called the ARA. The two parts of this protocol are to discover the route and maintain it. The origin is responsible for transmitting an ant in the direction of the target during the discovery phase, and it is repeated transmissions to each intermediary node until it reaches it. The ant is then returned to its starting point using the same route but in the opposite direction [7]. Before reaching the origin, the ant leads to enhance a value corresponding to the target on its way back. The process to maintain the route, begins and the data packets are transferred when the source receives this ant. The future data packets will maintain the route, modifying the value of the pheromone, based on the value of the already established path from the origin to target. An example of a routing protocol that makes use of the ACO is the ANTNET protocol. The primary goals of this approach are to maintain constantly updated routing tables and to determine the shortest route from the origin to target motes. The proactive routing method used by ANTNET is planned on the basis of routine releases of MAs toward motes selected at random. Based on Ant Colony Optimization algorithm, ants use a stochastic policy to randomly search for the destination node [8]. Following the same route, they took to get there, the ants return to the anthill after finding their destination. In this manner, the newest routing data regarding the position of target is updated within the routing tables along the trip. ACO is also the foundation of the POSANT, which may locate optimal or nearly optimal routes. For determining the optimum path amid the origin and target nodes, this routing algorithm draws influence from the behavior of MAs and the positions of the nodes. This algorithm adopts a hypothesis that each mote has information regarding its own position as well as that of its neighbors and the destination. Since POSANT is a reactive protocol, only in the requirement of transmitting the data packets amid source and target, are paths established.

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II. LITERATRUE REVIEW

A. Gopalakrishnan, et.al (2020) projected a BRP for discovering a precise gateway (GW) and sink so that the service request was routed amid the service requester and the extensive server [9]. GW was selected for promoting only the authentic origin to accomplish optimal communicating objectives via sink. The effective routing was offered over the networking nodes. VANET (Vehicle Ad hoc Network) sources employed SDN (software-defined networking) for stabilizing the networking topologies. The projected protocol was capable of delivering the packets in least time and density related restraints.

M. S. Azhdari, et.al (2022) presented a FLR technique having verification potential in VANET [10]. This technique was executed in three stages. Initially, an effectual method deployed to cluster the vehicles. The presented technique emphasized on describing two kinds of data packets namely immediate and ordinary. The second stage employed to define diverse data packets supported several procedures of discovering the route. Eventually, NS2 applied to quantify the presented technique. The experimental results indicated that the presented technique performed more successfully as compared to other methods concerning E2E delay, PDR, PLR and throughput. But, this technique led to maximize the routing overhead slightly.

Z. Cao, et.al (2020) developed a RMFD (Routing Protocol Based on Multi-Factor Decision) algorithm in which a variety of attributes were employed [11]. There were 2 sections of this algorithm in which the vehicular decision as well as intersection decision was managed. The vehicular component aimed at establishing a route amid two adjacent static nodes. for this, a TFN (Triangular Fuzzy Number) exploited to compute the fuzzy efficacy. The second section decided the suitable road segment, to which the data was transmitted, by selecting the static nodes present at the intersection. The fuzzy number was employed and various factors were introduced to illustrate the results. The findings exhibited the superiority of the developed algorithm against the conventional methods and it assisted in maximizing the PDR and lower E2E delay.

S. Zhou, et.al (2021) suggested a process of selecting multiple intersection on the basis of RSCPR protocol to establish a V2V broadcasting in VANET (Vehicle Ad hoc Network) [12]. To achieve this, the vehicle distribution affected with the traffic lights was taken in account [12]. First of all, a technique was put forward for computing the RSCP of a two-way lane. After that, the effectual road path was selected amid source and target node using an optimization system. In addition, the selecting process of relay node was analyzed on the road section subsequent to determine the effective rod route. Hence, the amount of neighbor vehicles was discussed in the communicating notion of the vehicle in which packets comprised and the location, and track of vehicles were considered cooperatively. The simulation outcomes depicted that the suggested protocol was useful for augmenting the increases the PDR and alleviating the E2E delay.

R. Han, et.al (2022) introduced a SPDR for disseminating EM in VANET (Vehicle Ad hoc Network) [13]. A parameter DGR was put forward for offering a dynamic hop-by-hop re-broadcasting of Emergency Message. Thereafter, the introduced algorithm utilized for shrinking the RDA on the basis of velocity variation of candidate neighbours and prioritizing the vehicle available at distance in the shrunk Routing Decision Area as the optimal next-hop, due to which the Emergency Messages were transmitted more reliably. In the end, the candidate neighbour's became capable of collaborate in communication through a collaborative forwarding method. NS-2 and Vanet MobiSim implemented to simulate the introduced algorithm. The results reported the superiority of the introduced algorithm as it maximized the PDR (packet delivery ratio), throughput and mitigated the dissemination delay.

Y. Xia, et.al (2018) established a routing algorithm known as GTLQR in which several components were integrated for diminishing the packet loss occurred when the vehicle was clustered at the connection and balancing the traffic load amongst vehicles [14]. The real time situations were modelled in accordance with the uneven vehicle distribution occurred because of traffic light, and queuing delay during congestion. The simulation outcomes revealed the effectiveness of the established algorithm over other position-based technique concerning PDR and E2E delay under numerous scenarios.

M. Sindhwani, et.al (2021) designed AODV (Ad-hoc On-demand Distance Vector) and ACO method and emphasized on transmitting the data is transmitted [15]. The primary algorithm deployed preliminary coordinates of every node. The reactive routing algorithm presented a path which comprised higher probability of congestion in network and led to utilize a huge volume of network bandwidth. The major concentrate was on establishing a path amid source and destination with the implementation of multicasting technique, and also alleviating the probabilities of jam in the network. Hence, a route was created at minimal distance. In the experiments, the applicability of the designed approach was proved to increase the throughput, lessening the packet loss and delay in contrast to the conventional algorithms.

III. RESEARCH METHIDOLOGY

In this research work, a technique will be proposed which use the multicast approach for the path establishment from source node to the destination node. The vehicle nodes that may build a path for accepting route request packets are

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considered to be applying multicasting concept. The zonal based routing concept, which establishes a path in the shortest amount of time, will be used to implement the multicasting concept. The network's routing overhead will decrease after the multicasting strategy is put into place. The source node won't send a route request path to any nodes that can't connect to the destination. The multicasting approach also reduce path establishment time from source to destination. In this research work, we will propose scheme for the path establishment using the concept of multicasting. The numerous activities that are taken for the path establishment are as follows: -

1. A sizable number of cars make up VANET. The vehicle to vehicle and vehicle to infrastructure interactions in this use the roadside parameters.

2. The second activity involves sending the control message to every network node by the roadside units. The vehicle nodes examine the number of nodes within their direct range after receiving that message.

3. This phase involves each node in the network presenting the other nodes with how many nodes are in their proximity. The zonal head node is chosen as the vehicle node with the greatest number of nodes within their range.

4. The source node sends a message to its zonal head, which confirms whether or not it is in its zone. If the asking node is within its zone, a direct path will be built from the source to the destination; otherwise, the zonal head will send the request on to the next zonal head. Until the desired path is found, the process is repeated.

The solution that is suggested in this study effort for the path establishment from source to destination is multicasting. The path establishment process used in the broadcasting strategy will be improved by the multicasting approach. The network is set up with a limited number of vehicle nodes in a multicasting network. The two characteristics, speed and distance, are used to partition the entire network into different zones. The best node is chosen from among the vehicle nodes with the lowest speed and distance. The network's zonal head is chosen from among the top zones. When a path to a destination needs to be established, all nodes in the zones will communicate information to the zonal head. The multicasting strategy will result in lower overhead and quicker path establishment between two end points.

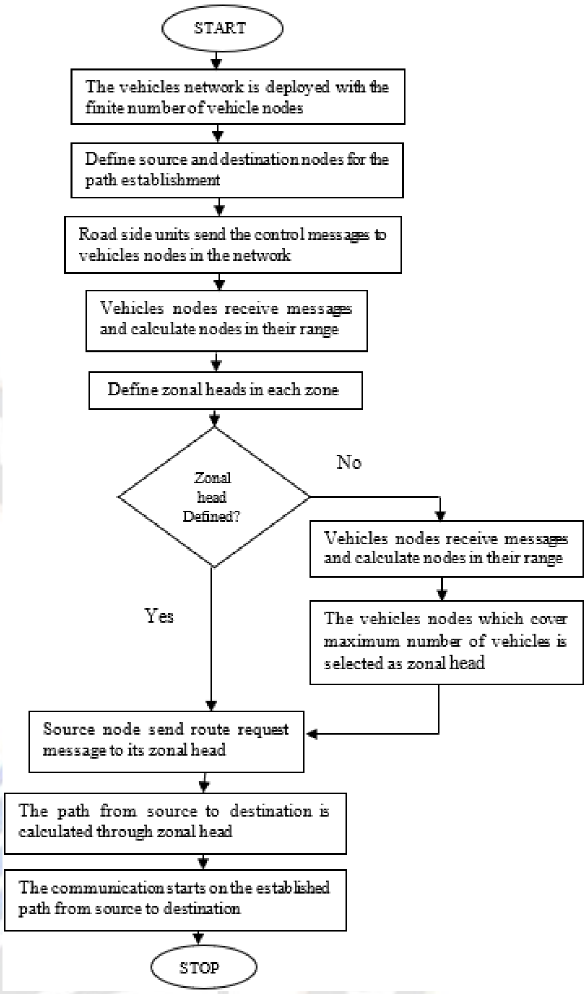

Figure 1: Proposed Model

IV. RESULT AND DISCUSSION

The network in which car nodes move from one place to another is known as a vehicular ad hoc network. The proposed model's simulation is one that specifies nodes in the specified region.

When simulating the suggested model in NS2, different parameters listed in table 1 are taken into account.

Table 1: Simulation Parameters.

Number of Nodes	41
Antenna type	Omi-directional
Queue type	Priority queue
Standard	802.11
Packet size	1000
Queue size	50

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Table 2: Normalized Route Lifetime Analysis

Time	Broadcasting Method	Multicasting Method
2 Second	50 Packets	20Packets
4 Second	130 Packets	70 Packets
6 Second	135 Packets	120 Packets

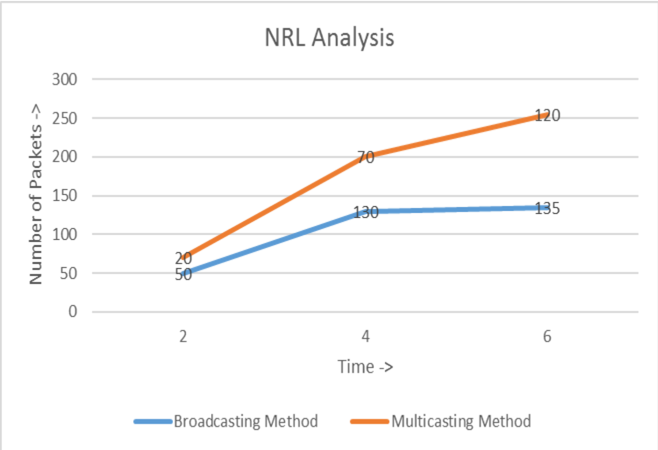

Figure 2: NRL Comparison

The performance of the suggested technique is contrasted with the state-of-the-art in Figure 2 in terms of NRL. Comparing the suggested technique to the current one, the NRL ratio is improvised

Table 3: PDR Analysis

Time	Broadcasting Method	Multicasting Method
2 Second	10 Packets	13Packets
4 Second	25 Packets	35 Packets
6 Second	38 Packets	40 Packets

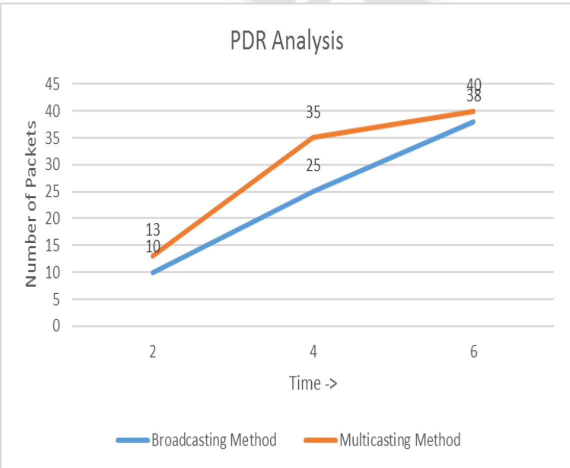

Figure 3: PDR comparison

As shown in figure 3, the PDR analysis of the broadcasting approach is compared with multicasting approach which is proposed method. It is analysed that multicasting has high PDR ratio as compared to existing method

Table 4: Route Life Time Analysis

Time	Broadcasting Method	Multicasting Method
2 Second	24 Packets	30Packets
4 Second	50 Packets	60 Packets
6 Second	75 Packets	87 Packets

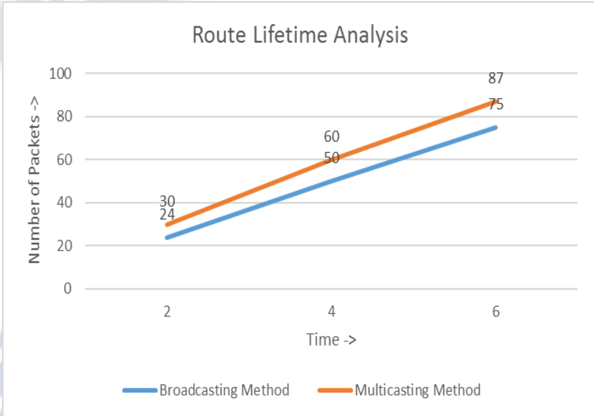

Figure 4: Route lifetime

Figure 4 illustrates how the centralised party creates the path from source to destination. The proposed technique has a longer route lifetime than the present one, which reduces link failure. This leads to improve throughput of the network.

Table 5: Throughput Analysis

Time	Broadcasting Method	Multicasting Method
2 Second	150 Packets	200Packets
4 Second	400 Packets	320 Packets
6 Second	450 Packets	550 Packets

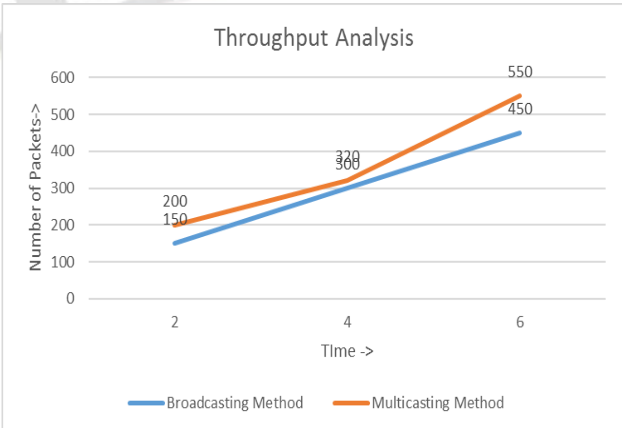

Figure 5: Throughput Comparison

Figure 5 depicts a comparison of the proposed and existing approaches' throughputs for the performance analysis. In findings, proposed approach has high throughput due to apply of multicasting technique as compared to existing technique

V. CONCLUSION

Vehicular Ad-Hoc Network (VANET) is a significant network, utilizes for developing an ITS for all applications. It becomes a major field of interest among researches worldwide. This network assists in enhancing the security in vehicles on road, and makes the traffic effective. Consequently, the quality of comfort is maximized for the individuals. Earlier, various algorithms are put forward in MANETs. However, this work considers Vehicular Ad-Hoc Network scenarios to implement and test diverse techniques. The most important challenge here is to reduce the delay related to passing the information from one node to another. If these challenges from MANET protocols are overcome, these protocols can be applied within real time VANET applications. The prior work presented the broadcasting technique in the route establishment from source to destination. The results indicated that this technique is ineffective because of its higher usage of bandwidth while establishing a route. This work proposes a multicasting method to establish a route in the least amount of time and also consume least network bandwidth.

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