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Various Routing Protocols of Vehicular Ad hoc Network: A Survey

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Abstract: A vehicular ad hoc network is a type of network divided by an area where car nodes can join or leave the network. Due to the flexibility of the network environment active contractual routes are used in the development of the route from the source to the destination. Various active and active protocols are updated in this paper. Active routing protocols are those that use current network information in the development of the route from the source to the destination. Active routing protocols are those that use the pre-defined network information in the route setting. Active route agreements use route tables in route development. In this review paper, a literature survey was conducted on VANET route protocols. It is analyzed that an effective route protocol offers higher performance compared to active router protocols.
Keywords: VANET, Reactive, Proactive Routing

I. INTRODUCTION

A. VANET (Vehicular Ad hoc Network)

The time for 5G (fifth generation) is approaching. The mode of human transport is changing with ingenuity and communication as the use of automotive internet and 'Internet +' technology is rapidly evolving. At the same time, there are a variety of problems related to the high requirements for mobility, safety and the environment. Internal and external features are aided in promoting the automotive internet technology and gaining more attention. Recently, road accidents have become a serious problem due to the development of automotive safety equipment. Various researchers have suggested that if warning information is passed on to drivers ahead of time, this could help prevent 60 percent of road accidents [1,2]. VANET (car ad network) is a modification of MANET (mobile ad networks). VANET facilitates the sharing of information between portable vehicles. Vehicle communication plays an important role in VANET promoting improved traffic safety and comfort. According to the forecast, VANET communications equipment on board will be used in many vehicles in the future. The Schematic diagram of the Vehicular Ad Hoc

Network is represented in Figure 1.

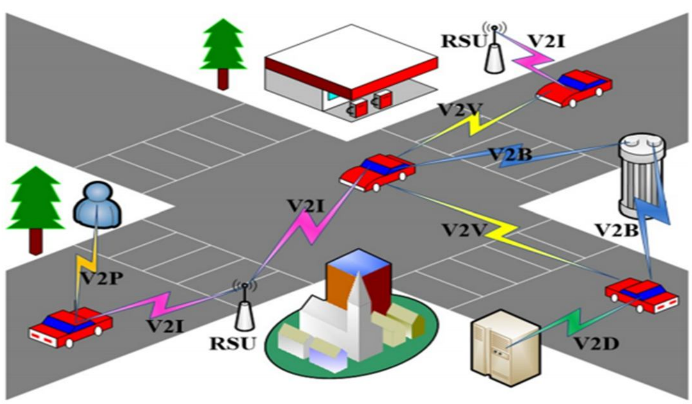

Figure 1: Schematic Diagram of VANET

Figure 1 shows that a set of vehicles such as the OBU device is installed in each vehicle with fixed paved and road units built on VANET. Some roadside units (RSUs) are useful for connecting to other networks, such as the Internet. All OBU contains a wireless network that uses direct connections that can be established with other vehicles and RSUs are available on an active connection list [3]. As shown in the picture above, V2V (car to car), V2I (car to infrastructure), V2B (car to broadband) or V2X (car to everything) is used on VANET enabling familiarity with various road safety equipment, passenger infotainment. and road traffic efficiency. This is also a major factor in raising VANET's popularity in government, in the education sector and in industry.

1) *Network Architecture:* Vehicular Ad Hoc Network architecture focuses on establishing connections between adjacent vehicles and equipment using mathematical side-by-side calculations leading to three things. VANET structures can be divided into three categories such as ad hoc, infrastructure or compound represented in Figure 2 as [4]:

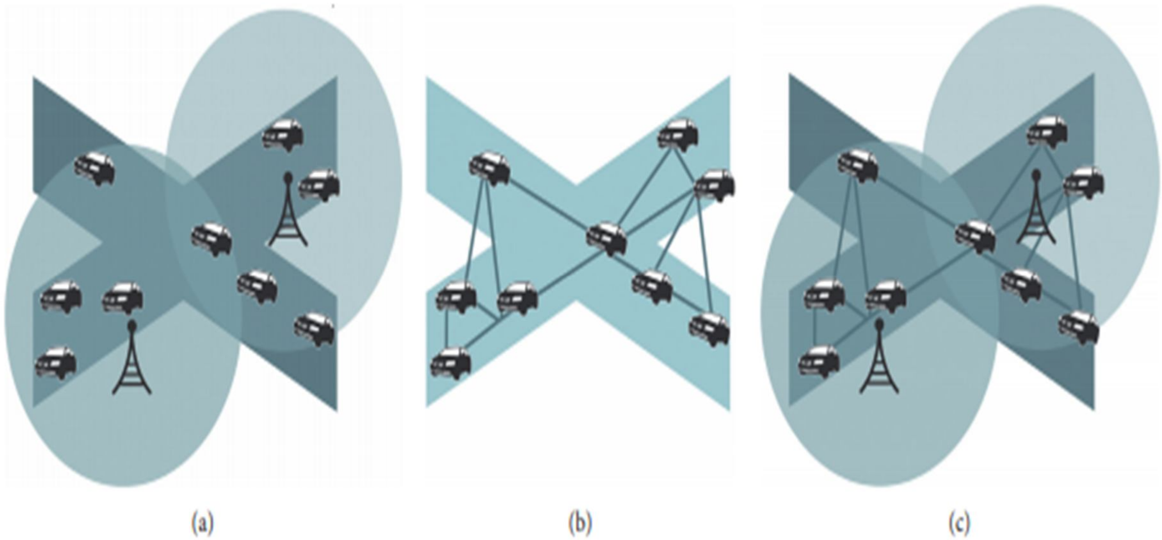

Figure 2: Network architectures for VANETs. (a) Infra-structured. (b) Ad hoc. (c) Hybrid.

Figure 1 (a) represents the infrastructure mode called V2I (vehicle to infrastructure). Fixed access points are used on VANET for the purpose of connecting vehicles to the internet and gaining traffic or data information. Links are established between vehicles and fixed access points [5]. Figure 1 (b) shows a temporary mode called V2V (car to car) which makes the use of all his vehicles a full mobile network. In this case, the information is exchanged directly without using any central access point. -e nodes must be able to interact with each other and these nodes play the role of routers and transmit messages between the root node and the target. Figure 1 (c) shows the combination of buildings in which infrastructure and temporary structures were built and used on VANETs. Various applications use such structures to exchange information between vehicles and internet connection using a fixed access point [6].

a) Communication Types in VANET

In particular, four types of connections are available on VANETs described in Fig. 1

- *V2V (Vehicle To Vehicle):* This connection helps to establish the connection between vehicles in ad-hoc network mode. Vehicles are used to send, receive or exchange important traffic information with other vehicles, such as traffic congestion or accidents.
- *V2I:* Important information related to road conditions and safety issues between infrastructure and vehicles is transmitted and transmitted using this link [7]. Vehicle to infrastructure uses vehicles and RSU (Road Side Unit) to establish a useful connection to external networks such as the Internet. This connection is less vulnerable to attack and greater bandwidth is required compared to a V2V connection
- *V2B:* For VANET, a car connection is essential for computer installation of car performance as driver behavior which is essential for public safety. This connection uses 4G or 5G networks to connect vehicles through a broadband wireless system. The V2B works well for assisting busy driving and vehicle tracking as additional monitoring data and information about traffic and entertainment are contained in the broadband clouds.
- *V2P:* This connection is approved to detect pedestrians and avoid accidents. Basic wireless technology for smart phones works remarkably well to stop the car from communicating with pedestrians.
- *V2X:* This program is designed to ensure reliable and independent operation. In addition, it is an integral part of the coming smart cities and self-driving cars. The vehicle is connected to any unit in this connection like other vehicles or road infrastructure [8]. It is divided into four main components such as V2V (vehicle to vehicle), V2I (vehicle to infrastructure), V2P (vehicle to pedestrians) and V2N (vehicle to network) communication. In this regard, vehicles are allowed to share their speed information related to their speed, links and acceleration with other vehicles and critical infrastructure.

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2) *Routing in VANET:* Vehicular Ad-hoc Networks (VANETs) enable vehicles to communicate with one another and create a large network with vehicles acting as the network nodes. Considering the huge number of vehicles (hundreds of millions worldwide on the road on a daily basis), the benefits of VANETs would be tremendous. Various types of information (e.g., traffic conditions, advertising news and e-coupons) can be shared among vehicles via VANETs as long as minor delays are acceptable in the specific applications of interest [9]. For example, a vehicle can send inquiries to vehicles around certain landmarks to obtain up-to-date parking information. Another interesting emerging application, called Infotainment, provides multimedia services to subscribed vehicles in a particular location by using vehicle-to-vehicle (V2V) communication.A key requirement for the realization of VANET applications is the availability of efficient and effective routing protocols for message dissemination. Routing protocols are used by a router to find out the optimal path for communication between nodes.

a) *Routing Protocols for VANET:* Without well-defined and efficient route protocols, vehicles may not be able to share important messages and enjoy the benefits of advanced technology provided by VANETs. To address these issues, a number of VANET protocols have been proposed. Route protocols can be categorized according to different criteria such as protocol features, route information, service quality and network structure. Figure 3 shows the classification criteria that can be used to classify VANET route contracts [10].

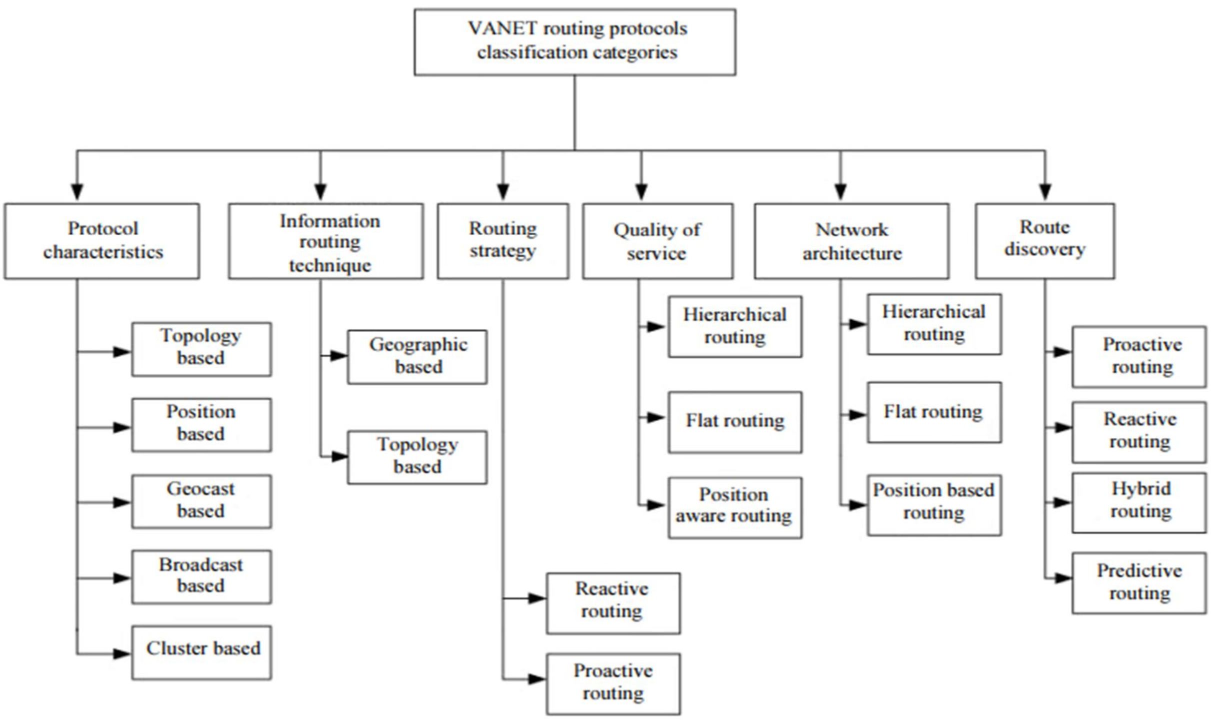

Fig. 3: Protocols' classification categories

B. *Topology Based Protocols*

The concept of linking different parts together is known as topology. These algorithms help to find the shortest route from the source site to the destination on the Vehicular Ad Hoc Network. The Route table is used to store all information about all routes. The division of topology-based processes can be done in 3 classes on a time-by-time basis which is considered to update route tables. The three types of protocol which are active tracking systems, active route protocol and hybrid route protocols are described in [11]:

1) *Active Route:* This legal process stores route information in the Route table at all nodes. Due to the high flow of nodes, it is important to maintain current router entries related to the entry of new nodes and the departure of nodes from the network. Therefore, the update step is taken by an effective protocol for keeping routing tables of all new and ready-to-use nodes in the event of joining and leaving space in the network or breakage and link establishment [12]. This process leads to the development of the overhead of the protocol and affects the mobility of the network. DSDV (Destination Sequence Distance Vector), OLSR (Optimized Link State Routing) and FSR (Fisheye State Routing) are various active protocols.

a) *DSDV:* The BellmanFord algorithm is the basis of this legal process. This algorithm focuses on maintaining a route as a table for all people who know places everywhere. Quick ads from neighbors are used to stimulate topology changes. Vertical Range Vector automatically updates the table in the event of a complete transfer of node information to other nodes or continuously updated in the event of a deltas transfer only to other nodes.

b) *OLSR:* This legal process develops a neighborhood set that is accessible by 1-hop and 2-hops in a timely manner and each node keeps it in place [13]. Thereafter, the number of active relays required to reach all 2-hop neighbors is reduced and reduced using MPR (Multi-Point Relay). Therefore, a node transmits packet when selected as a transfer point with the source node. In this case, the MPR algorithm has been developed. Link state packets are transmitted to improve route tables and storage in the OLSR through the use of selected transfer nodes. Thus, effective routes to reach any location on the network are achieved after stabilizing the algorithm.

2) *Active Protocols:* These agreements do not keep track of new routes and these agreements help to find routes only when the original location needs to send data packets to the destination. At the time, the need to convey a message to the destination, the flood is used to initiate the route acquisition process. After reaching the destination, the reply message is returned to its original source. These types of protocols are used to deliver low load loading message, although they increase the delay of the route acquisition process. Other active protocols are the AODV (Ad hoc On-demand Distance Vector) route [14] and the AODV + PG route.

a) *AODV:* AOD route protocol was greatly improved by MANET (mobile ad networks). As an active protocol, these rules establish the way in which a node wishes to transfer a package. Uses old route routes, entry points for each destination, and tracking numbers for updated route information. AODV maintains routes (destination) while the source requires the transmission of information posted between nodes is active [15]. input node for other nodes in search destination. Packages of RREPs (Route Response) are sent to the RREQ source for unicast transmission. The complete route is created to store information in the middle of the route between the route in the route of the route table. It also uses error messages (RERR) to report after a failure to communicate. At this point, a new route acquisition cycle should begin. “Hello” messages are often used to find and monitor links to nearby nodes.

b) *AODV + PG:* AODV + PGB to reduce communication using Preferred Group Broadcast (PGB). It provides an endless route than AODV. Since these rules of law are the key to cutting off the high level of communication caused by the AODV route acquisition cycle, PGB receivers find that they belong to the anideal group and determine which node on the set wants to communicate. For node detection, RS (Received Signal) connection is used.

3) *Hybrid Routing:* As its name implies, a hybrid route is a combination of efficient and effective tracking systems. The protocol at this stage aims to reduce the time required to find the route between source and location. Two common examples of protocols in this category are Zone Routing Protocol (ZRP) and Zone-Based Heirarchical Link State (ZHLS).

a) *ZRP:* When communication between nearby nodes is required, ZRP uses an active node locale and an active node. If there is a need to establish local connections, IARP (Intra-zone routing protocol) is used. In another case [16], IERP is used when it is necessary to establish inter-site communication. Therefore, a functional route is used to provide routes locally or locally and the active route aims to find routes according to each need where it is necessary to obtain connectivity in other areas.

b) *ZHLS:* Another route protocol for this protocol class is ZHLS. To divide a network into unrelated regions, ZHLS uses node location information. In this protocol, each node is aware of its approximate location and its local network connections. Node information is transmitted within a location and information about local connections is distributed throughout the network. Ideally, a route can be created on the basis of location ID and location ID.

C. Position Based Routing Protocols

Agreements of this type use the location or location of vehicles from a variety of sources, eg, maps, the Global Positioning System (GPS). Therefore, the source and destination are based on regional information for the nodes by sending and receiving messages. This category of protocols does not require information to be kept about topology, route preservation, and acquisition. Therefore, the main domains of the transferred packets are location and package transfer. Two typical examples of this class of agreements are the Greedy Perimeter Stateless Routing (GPSR) and the Reliability Improve Position-based Routing (RIPR) [17].

1) *GPSR:* GPSR is an active route protocol for wireless and mobile networks. This protocol uses local route considerations. GPSR uses two data transfer techniques: greedy forwarding and cycle transfer.

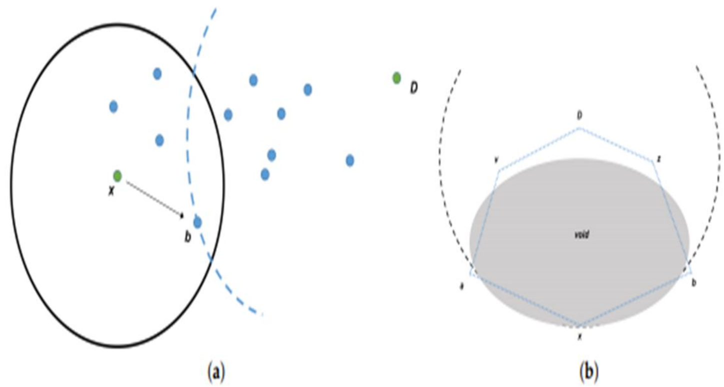

Figure 4. Stable greedy cycle (GPSR) operation. (a) an example of selfishness. b is the nearest neighbor of x in D. (b) In perimeter mode, node x is negative with respect to point D.

The first algorithm transfers the package to a nearby neighbor node, and this is applied automatically (see Figure 4a); The following method is preferred in cases where it is not possible to use greedy transfers (no node is closer than current; see Figure 4b). The perimeter mode allows GPSR to use the right legal concept to deliver pockets to pits where there is no neighbor nearby. This protocol makes a decision on the basis of the hop-by-hop principal, and does not require the establishment of a route from the full point.

2) *RIPR:* RIPR is designed to provide a solution for multiple link failure. This protocol determines the speed and direction of vehicle movement. After that, a route table is maintained for each node that contains information about the location and speed of the neighbor. As a result, the nearest neighbor prefers the location of the source until the destination is located, according to information stored in its table [18]. Therefore, the method used to select the following hop node helps in the better selection of other intermediate nodes required for most hop as a location. This protocol also determines the speed of movement.

D. Cluster Based Routing Protocols

These agreements aim to split nodes in a network into groups called clusters. Therefore, neighboring nodes form a cluster where the vehicle is selected as the cluster head. The size of the collection changes based on the measurements taken to create the collection. If set differently, other parameters such as vehicle number, vehicle location or direction and movement speed can be used to split the network into clusters. Next, the nodes within the group select the CH (head of the group) responsible for managing the group to detect the interactions between the groups. Therefore, in intercluster communication, the best neighbor group is selected to transmit data [19].

1) *Local-Based Navigation Algorithm with ClusterBased Flooding (LORA-CBF):* This legal process divides nodes from a network into clusters. Then, each collection will have a collection head responsible for connecting with other collections and collection heads. Additionally, collection heads occasionally send beacon messages to update their parameters. Additionally, collection titles send location request packages to collect location information in other collections. Saying this route protocol is functional and designed to facilitate V2V communication.

E. Broadcast Routing Protocols

Broadcasting systems are flood-prone and are called classical technologies used to spread information across VANETs. These agreements are used to share information with vehicles outside the source code range while providing information on road and emergency situations. In each case, packets are delivered and transmitted to all network nodes.

1) *BROADCOMM:* This legal process divides space into cells. Then, all members of the cell select the cell display. As a result, the cell display collects messages from nearby nodes. Simply put, the cell display will serve as the base channel for all other nodes in the cell. Therefore, the cell display will transmit messages to other car nodes in the cell [20].

F. GeoCast Routing Protocols

Route agreements in this class depend on the transmission or transfer of information in the right place or associated with the information to be transmitted. Here, local-based broadcasts are used to transfer packets to the Zone of Relevance (ZOR) containing vehicles receiving a geocast message. Alternatively, the Geocast Routing Protocol transmits data packets from one source location to all nodes. located in the region of importance. The network fragmentation that affects the proper delivery of messages is a major flaw in these principles.

1) *RObustVEhicular Routing (ROVER) Protocol:* This protocol uses floods to distribute control packets. In contrast, unicast is used to transmit data messages. This protocol separates the network into critical areas. After that, the car will only receive a message if it is found when the car is in the area.

II. LITERATURE REVIEW

A. Bio-Inspired Routing Protocol on VANET

A. Gopalakrishnan, et. The gate selection focuses on promoting only the permitted source to establish a connection to the sink. An active route is provided between network nodes. SDN (software-defined networking) is used in VANET (car ad network) sources to stabilize network topologies. PASRP (spider track protocol in the parking lot) was proposed by Hao Liu, et.al (2020) with emergency data on the urban VANET [22]. The location information system and digital map were used to configure the spider-web transfer system on the basis of parking. After that, a jealous multi-mode algorithm was used to transfer emergency data to the selected route. A flexible priority planning system was prioritized for prioritizing data. Finally, simulation results showed that the proposed protocol was more effective compared to traditional algorithms. The URAS-inspired nature (unicast route protocol based on attractive selections) was predicted by Daxin Tian, et.al (2018) of VANET (automotive advertising network) in which the mobile attraction selection method was used to select the following hops [23]. This algorithm focuses on self-transformation in a way that conforms to complex and flexible environments. In addition, the number of unemployed students has been reduced to selecting the next hop using a multi-faceted decision-making approach. The simulation results revealed that the proposed method was robust and effective with respect to PDR (packet delivery rate), E2E delays (end-to-end) and congestion compared to the existing method. The PSOR route algorithm was developed by Bhushan Yelure, et.al (2020) on the basis of VANET's (PS swarm optimization) partition (ad ad hoc network) using QoS (Service Quality) obtained [24]. The speed and location of the particles were used to ensure the highest resolution in the world on the basis of value. The next vehicle found near the Dv was determined using this algorithm. Carrying and forwarding method was used to convey the message. Test results confirmed that the improved algorithm provided higher pack size and lower output and latency, higher compared to others in simulation.2.1 Comparison Table

Author	Year	Technique used	Dataset	Results
A. Gopalakrishnan, et al.	2020	Bioinspired Routing Protocol	NS2	The SDN was utilized in the VANET sources for stabilizing the networking topologies.
Hao Liu, et al.	2020	Parking-area-assisted spider-web routing protocol (PASRP)	NS2	The suggested protocol performed more effectively as compared to traditional algorithms.
Daxin Tian, et al.	2018	Unicast routing protocol based on attractor selecting (URAS)	MATLAB	The projected approach was robust and efficient with regard to PDR, E2E delay and congestion.
Bhushan Yelure, et al.	2020	PSOR routing protocol	Network simulator	The developed algorithm provided superior packet size and throughput and lower delay, overhead.

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B. Clustering basedRouting Protocol on VANET

Wenxiao Dong, et.al (2017) recommended CRB (repeated group-based broadcasts) to address issues related to time delay and delivery rate [25]. Only selected vehicles had the opportunity to re-broadcast an emergency event found among vehicles within the transmission range. Additionally, based on the traffic light problem, the recommended algorithm was used to improve message transmission efficiency and to provide targeted streaming. Test results obtained from NS2 showed the height of the recommended algorithm over existing floods related to delay time and delivery rate. RPKHM (route protocol using K-Harmonic Means) was developed by Khalid Kandali, et.al (2020) with the aim of improving the duration of interconnection between vehicles and increasing the stability of the automotive network [26]. Initially, the mathematical model, in which the total number of motors and network topology was considered, was used to determine the number and positions of the first centroids. On the other hand, the analogy value was used on the basis of the Euclidean distance to make a collection. Finally, collections are stored and CH (novel heads) are selected on the basis of cost function based on the total size of the free bar and ETX (expected transfer number). The simulation results showed that the protocol presented was effective with respect to PDR (Packet Delivery Ratio), E2E (End-to-End) delay rate and output. A reliable two-layer algorithm based on the collection was developed by Parisa SarajHamedani, et.al (2018) on VANETs (automotive advertising network) to alleviate link failure problems [27]. The first level selects a solid link and the second level enables the deployment of a greedy algorithm for selecting the most efficient route. NS-2.35 was used to update the target algorithm on the basis of network metrics including E2E and PDR delays unlike conventional algorithms. This algorithm has led to increased PDR and reduced E2E delays. The AAGVs (Autonomous Aerial and Ground Vehicles) route algorithm was developed by Waqar Farooq, et.al (2017) which used aerial vehicles to address AGV communication barriers so that MDMs (Mining Discovery Messages) could be distributed [28]. In addition, the system-based system is designed for real-time algorithm adjustment without affecting its performance. In this case, stable IVC (Inter-Vehicular Communication) links were maintained. Network Algorithm was used to update the default algorithm. The results revealed that the algorithm was developed to help reduce delays and overhead as well as increase PDR and output with the help of multi-channel communication.

C. Comparison Table

Author	Year	Technique used	Dataset	Results
Wenxiao Dong, et al.	2017	Cluster-based recursive broadcast (CRB)	Network simulator 2	This algorithm performed well concerning delay time and delivery ratio.
Khalid Kandali, et al.	2020	Routing protocol using an adaptive K-Harmonic Means (RPKHM)	NS2	The presented protocol was effective with regard to PDR, average E2E delay and throughput.
Parisa SarajHamedani, et al.	2018	Two-layer cluster-based routing algorithm	NS-2.35	This algorithm led to maximize the PDR and lessen the E2E delay.
Waqar Farooq, et al.	2017	Autonomous Aerial and Ground Vehicles (AAGVs) routing protocol	Network Simulator	The established algorithm assisted in diminishing the delay and overhead and enlarging the PDR and throughput.

D. Traffic awareing Routing Protocol in VANET

ForoughGoudarzi, et.al (2018) has designed a site-based algorithm that recognizes VANET traffic (car ad networks) in urban areas [29]. An ant-based algorithm was used to determine the route that contained the network connection. The complete route is found between the source and location by confirming the route on the road map using the total weight of the entire route with the help of the source vehicle. The simulation space was considered to make the computer a precise operation of the designed protocol. Imitation results have shown that the algorithm is designed to improve PDR (packet delivery rate) by 10% more with speeds of up to 70 km / h and to reduce overhead and E2E delays (end to end) unlike other algorithm. . A new RTU-based QTAR (Q-learning-based Traffic-Aware Routing) algorithm was investigated by Jinqiao Wu, et.al (2020) in urban VANETs [30]. Reliable connected road sections have been selected for effective packet transfer.

The package was delivered on the side of the road using V2V Q-learning distributed integrated with QGGF (Q-greedy geographical forwarding) with the aim of minimizing delays and the impact of rapid traffic on the sensitive road. In addition, distributed R2R Q-learning was introduced to distribute the package at each central location. Test results have shown that the investigated algorithm performs better compared to existing agreements regarding moderate to minimal E2E delays (end-to-end). GeoTAR which was a map-based algorithm that detects route traffic was developed by Rui Wu, et.al (2019) in which a digital map and Geohash code system was introduced to collect traffic information for route decision making [31]. In addition, the IFRF algorithm (intersection-first restricted forward) was used to transfer packets where structures were considered radio barriers. The cable station located at RSU (Road Side Units) is considered to be a line rail measurement. The simulation results showed that the proposed algorithm was effective in improving VANET performance in terms of PDR (packet delivery rate) and E2E delays (end-to-end) compared to other systems. The BTA-GRP (Beaconless Traffic-Aware Geographical Routing Protocol) was developed by Sadia Din, et.al (2020) in which traffic congestion, distance and direction were considered in the next transfer and route route [32]. The new route algorithm was designed to address various issues such as disconnected from urban areas as topology evolved. This algorithm worked to reduce delays and improve output. Imitation results have ensured that the built-in protocol has worked successfully on VANETs.

E. Comparison Table

Author	Year	Technique used	Dataset	Results
ForoughGoudarzi, et al.	2018	Traffic-aware position-based routing protocol	VACO. OMNeT++ and SUMO	The designed algorithm was capable of enhancing the PDR by 10% above for speeds up to 70 km/h and decreasing the overhead and E2E delay.
Jinqiao Wu, et al.	2020	RSU-assisted Q-learning-based Traffic-Aware Routing (QTAR)	QualNet	The investigated algorithm performed better with regard to average and least average E2E delay.
Rui Wu, et al.	2019	GeoTAR	NS3	The suggested algorithm was efficient for enhancing the performance of VANET concerning PDR and E2E delay.
Sadia Din, et al.	2020	Beaconless Traffic-Aware Geographical Routing Protocol (BTA-GRP)	NS2.34 simulator	This algorithm was applicable for lessening the delay and enhancing the throughput.

III. CONCLUSION

In this paper, it is concluded that the vehicular ad hoc network is a self-organizing network. Due to such a volatile nature of network design it is a major challenge for the temporary traffic network. Many protocols have been proposed to establish a route from the source to the destination. Various assumptions have been drawn from a survey of route books on VANET. Existing VANET route systems need to be updated to exchange real-time information.

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