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REVIEW ON CLUSTERING AND LOAD-BALANCING APPROACHES IN VEHICULAR ADHOC NETWORKS

[1]R.Sunitha, [2]Dr.B.Sumathi

[1]Ph.D Scholar and Assistant Professor, [2]Associate Professor

[1]Department of Computer Science, CMS College of Science and Commerce, Coimbatore, India

Abstract: Vehicular Adhoc Networks (VANETs) have been attracted a lot of research in recent years. In VANET, vehicles are dynamic nodes which communicating with each other by wireless technology in their own transmission range. Although VANETs are deployed in reality offering several services, the current architecture has been facing many difficulties in deployment and management because of poor connectivity, less scalability, less flexibility and less intelligence. To improve network scalability and connection reliability, a vehicle clustering algorithm, which organizes vehicles in groups, is introduced in VANET. Recently, there are various clustering and load balancing methods such as cluster-enabled capacity-based load-balancing , hybrid Ant Colony Optimization and Artificial Bee Colony (ACO-ABC) optimization, energy-aware predictive clustering approach, Vehicular Genetic Bee Clustering (VGBC), proactive load balancing mechanism, Cluster–on–Demand VANET Clustering algorithm (CDVC) along with load balancing, Link Reliability-based Clustering Algorithm (LRCA), hybrid backbone based clustering algorithm, Load Balanced Routing strategy (LBR) are analyzed and its merits and demerits are evaluated.

Index Terms: Vehicular Adhoc Networks (VANETs), clustering, load balancing and Road Side Units (RSUs).

I.INTRODUCTION

Nowadays, due to adverse development within the transportation field, the recent research in Vehicular Ad hoc NETwork (VANET) has been increasing. The Vehicular Ad hoc NETwork (VANET) is a wireless network which is used to provide communication between vehicles [1]. In VANET, vehicles may act as intelligent machines having components such as sensors, actuators, and GPS which are deployed on the on-board units. There are two types of communications in VANETs, Vehicle-to-Vehicle (V2V) and Vehicle- to-Infrastructure (V2I) [2]. In V2V communication, vehicles communicate with one another such that these are in the transmitting range of one another. In V2I communication, vehicles communicate with access points deployed near the road. These access points are called as Road Side Units (RSUs). RSUs are geographically fixed units used to provide uninterrupted services to the moving vehicles.

From the past few decades, there has been growing interest of the research community in developing efficient and convenient driving conditions for passengers in VANETs [5, 6]. VANETs play an important role in wireless communication among vehicles, which emphasizes driver's safety on the road. Because of vehicles' high mobility, VANETs have high topological changes, which results in network disconnection in some part. So, to keep the connectivity at high rate among the vehicles, these are grouped together based upon some predefined criteria, which is called as clustering.

Clustering in VANETs is importance for addressing the scalability problems also. Clustering is a technique in which vehicles are grouped together and one of these vehicles is elected as the Cluster Head (CH), which takes decisions on behalf of all the other nodes to reduce the communication overhead [3-4]. But, selection of CHs among the nodes in VANETs is one of the most difficult tasks to be achieved because of the high velocity of the vehicles. Many researchers have proposed clustering technique for VANET topology management. Clustering technique making the network more robust and scalable. This similarity is defined in terms of closest distance, farthest distance rules, etc. Clustering analysis has taken several categories like hierarchical clustering, partition-based clustering, density-based clustering, and artificial intelligence based clustering. Clustering algorithms for VANET are used in communication networks to organize nodes into groups to obtain establish a hierarchical clustering structure within the network.

Intelligent information sharing between vehicles is possible using this VANET. There are different types of applications available for vehicular networks such as safety, comfort, entertainment applications. In the field of vehicular networks various types of issues are concerned such as collision, security, congestion, link failures, etc. Balancing of the load between all the vehicles is one of the problems in VANET. The main aim of load balancing is to distribute resources for increasing the performance and to minimize the delay. A Lot of improvements needed for resource sharing by proper load balancing. The resources such as video, audio should be delivered to vehicles without any delay and loss by achieving the proper load distribution. In [5] presented an approach which increases the number of RSU called as Cooperative Load Balancing. In [6] adaptive load balancing schema for efficient data dissemination in vehicular adhoc network. This approach provides a co-operative scheme of data dissemination under different scenarios. However, does not provide satisfactory results in terms of packet delivery ratio and end to end delay.

The rest of this paper is organized as follows. Section II presents the previous VANET clustering and load balancing algorithms. Section III presents comparative analysis of previous clustering and load balancing methods. Inferences of the previous works are discussed in section IV. The study can be concluded in Section V.

II.LITERATURE REVIEW

Wang et al. (2008) presented a new clustering technique for large multihop vehicular ad hoc networks. The cluster structure is determined by the geographic position of nodes and the priorities associated with the vehicle traffic information. Each cluster elects one node as its cluster head. The cluster size is controlled by a predefined maximum distance between a cluster head and its members. Clusters are independently controlled and dynamically reconfigured as nodes move. This work presents the stability of the designed cluster structure, and communication overhead for maintaining the structure and connectivity in an application context. The simulation is performed with comparative studies using CORSIM and NS-2 simulators [7].

Lo et al (2013) presented a multi-head clustering algorithm in vehicular ad hoc networks. In this work introduced a new clustering algorithm that considers both node position and node mobility in vehicular ad hoc environments. The designed algorithm intends to create stable clusters by reducing reclustering overhead, prolonging cluster lifetime, and shortening the average distance between cluster heads and their cluster members. Most important, this algorithm supports single and multiple cluster heads. Simulation results reveal that the presented algorithm generates stable clusters with long lifetime [8].

Singh and Bali (2015) introduced a hybrid backbone based clustering algorithm for vehicular ad-hoc networks. The designed algorithm uses a backbone known as cluster leadership to decide upon the cluster-head. As observed in simulation results the designed algorithm reduces the overhead of CH election and re-election, leads to fewer status changes by a node within the cluster and shows cluster lifetime comparable to ALM algorithm with slight improvement in low vehicle density scenario. The results show that the presented technique reduces the overall communication cost due to involvement of less number of nodes in the CH election and re-election process and also increases the overall stability of the network [9].

Ye et al (2016) presented a salable fog network to utilize transport buses as fog devices for reducing the overloaded burden of roadside cloudlets. The bus fog servers not only provide fog computing service for the mobile users on bus, but also are motivated to accomplish the computation tasks offloaded by roadside cloudlets. By this way, the computing capability of roadside cloudlets is significantly extended. Here consider an allocation strategy using Genetic Algorithm (GA). With this strategy, the roadside cloudlets spend the least cost to offload their computation tasks. Meanwhile, the user experience of mobile users is maintained. The presented scheme reduces the response time of the network and improves network utilization [10].

Zheng et al (2016) presented a Cluster–on–Demand VANET Clustering algorithm (CDVC) along with load balancing for urban. Urban vehicles are characterized by unpredictable moving direction. These challenges are solved by CDVC, which is composed of three main procedures; that is, initial clustering, cluster merging, and cluster head selection. In initial clustering, vehicles are clustered determines the boundary of each cluster. In cluster merging, Self–Organizing Maps (SOMs) is used for re–clustering by the similarity of nodes, which guarantees the stability of clusters. It leads to achieve load balancing. In cluster head selection, the information of location and mobility are combined to select a more stable cluster head. The performance of CDVC is evaluated and compared with the Lowest ID (LID) and Mobility based on clustering (MOBIC). Finally, the simulation results reveal that CDVC is superior to LID and MOBIC in terms of cluster head duration, clusters number, and load balancing [11].

Agarwal et al (2016) presented a Load Balanced Routing strategy (LBR) to improve the network stability and battery lifetime in individual nodes. Assuming variable energy levels of transmission in each vehicle, the analysis establishes some upper bounds on the separation of two consecutive RSUs for nearly load balanced routing. The problem has been defined for linear network with uniform distribution of vehicles over 1-D road. Simulation studies show that the designed scheme enhances the network performance significantly in terms of energy usage, network load and average packet delay [12].

Bali et al (2017) designed an efficient energy-aware predictive clustering approach for vehicular ad hoc networks. In order to do form the clusters of vehicles in a highly dynamic vehicular network, the prediction strategy is used. In this strategy, the future and present positions of vehicles are considered. They predict the future positions of vehicles for correct cluster formation. Moreover, cluster head is used to manage the resources of a cluster. The CH is selected based on the predictive accuracy and the minimum speed among the neighbouring vehicles. This approach efficiently predicts the position of mobile vehicles and verifies it by averaging the difference between the predicted and actual positions of a vehicle. Due to this predictive scheme, clusters are easily formed and the number of vehicles in clusters is also easy to determine. This scheme achieves balanced energy consumption in the network [13].

Ren et al (2017) designed a new dynamic mobility-based and stability-based clustering scheme for urban city scenario. In this scheme, vehicles are clustered in a single-hop based cluster limited by a predetermined value"Safe Distance Threshold". The Cluster Head (CH) is selected as the vehicle which is at the geographical center of a cluster, and CMs are within Safe Distance Threshold range of the CH, moving in the same direction. A new vehicle state, called temporary cluster head which is designed in order to help cluster formation process. Temporary cluster head vehicle only exists at the beginning of a cluster formation procedure. It changes its state to CH or CM as soon as the CH is selected. Cluster maintenance mechanisms are presented, including cluster merging and leaving a cluster procedure. The simulation results show that the designed clustering scheme provides higher cluster stability even in a high dynamic traffic scenario [14].

Mohaisen et al (2017) proposed a bandwidth estimation strategy based on normalized throughput of a link, taking into account the interference and packet loss ratio in discrete time for every successfully delivered packet for a hybrid network of VANET-WSN. The simulation results show that the strategy is effective, and can accurately estimate the bandwidth of VANET-WSN. A comprehensive performance analysis in representative urban scenarios is performed that takes into account realistic propagation models and real city scenario traffic [15].

David et al (2017) evaluated energy consumption and load balancing among MANET and VANET. With the rapid increase in vehicular traffic in urban areas, optimal use of available resources is necessary to minimize the load and energy consumption. One of the scenarios of MANET is Vehicular adhoc networks. For communication in VANET, the vehicles interacting between themselves as well as along with roadside device stations, efficient routing Protocols are needed [16].

Amudhavel et al (2018) designed a fault tolerant load balancing in vehicular communication using Distributed Spanning Tree (DST). DST is used to distribute the root node vehicle across its group. Here groups are considered as clusters. Each vehicle act as a root vehicle so load is balanced equally among the vehicles. This is the first structure applied in Vehicular Ad-Hoc Network. In DST, the selection of vehicles is done by identifying the root vehicle. The vehicles which come within the range of RSU are selected. Among the group of vehicles, one vehicle act as a root vehicle and this vehicle is linked with other vehicles. Now overload occurs in that vehicle. To overcome this problem DST distributes the root node across the network that is each mobile node act as a root node. Distributed Spanning Tree is similar to broadcast algorithm. In broadcasting algorithm the root vehicle initiates by sending the message to its neighbor vehicle then other vehicle act as a root vehicle and communicate with the nearby vehicles. DST disseminates the communication load and information's between the vehicles. Discovery of services in VANET which ensures good QoS (Quality of Service) is very essential [17].

Ji et al (2018) designed a Link Reliability-based Clustering Algorithm (LRCA) to provide efficient and reliable data transmission in VANETs. Before clustering, a novel Link LifeTime-based (LLT-based) neighbor sampling strategy is put forward to filter out the redundant unstable neighbors. The presented clustering scheme mainly composes of three parts such as cluster head selection, cluster formation, and cluster maintenance. Furthermore, introduced a routing protocol of LRCA to serve the infotainment applications in VANET. To make routing decisions appropriate, nominate special nodes at intersections to evaluate the network condition by assigning weights to the road segments. Routes with the lowest weights are then selected as the optimal data forwarding paths. The extensive simulation results show that the designed approach outperforms in both cluster stability and data transmission [18].

Zhang et al (2018) introduced a new passive multi-hop clustering algorithm (PMC) for vehicular ad hoc networks. The PMC algorithm is based on the idea of a multi-hop clustering algorithm that ensures the coverage and stability of cluster. In the cluster head selection phase, a priority-based neighbor-following strategy is designed to select the optimal neighbor nodes to join the same cluster. This strategy makes the inter-cluster nodes have high reliability and stability. By ensuring the stability of the cluster members and selecting the most stable node as the cluster head in the N-hop range, the stability of the clustering is greatly improved. In the cluster maintenance phase, by introducing the cluster merging mechanism, the reliability and robustness of the cluster are further improved. The presented algorithm can improve the stability and reliability of VANET [19].

Gao et al (2018) proposed a hierarchical geography routing protocol for SDVN. First, the protocol divides a large region into multiple small grids according to the geographical location and finds a series of grids with good connectivity based on real-time grid vehicle density and historical vehicle transfer probability between grids. Second, we construct a path cost function with load balancing and keep two paths with minimal costs from the selected grids. Finally, a series of relay nodes on each selected path are filtered for routing according to node utility [20].

Rui et al (2018) proposed a new traffic congestion detection and quantification method based on vehicle clustering and fuzzy assessment in VANET environment. To enhance real-time performance, this method collects traffic information by vehicle clustering. The average speed, road density, and average stop delay are selected as the characteristic parameters for traffic state identification. We use a comprehensive fuzzy assessment based on the three indicators to determine the road congestion condition. Simulation results show that the proposed method can precisely reflect the road condition and is more accurate and stable compared to existing algorithms [21].

Chang et al (2018) proposed a distributed transmission power adjustment algorithm for communication congestion control and awareness enhancement to address communication congestion problems that can arise in VANETs. The objective of the proposed algorithm is to provide maximum awareness of surrounding vehicles' status while maintaining a communications channel load below the allowed threshold. The proposed algorithm accomplishes this by adjusting the transmission range of each vehicle in the network progressively and gradually, while monitoring the communications channel load of each vehicle [22].

Cherkaoui et al (2019) presented an approach to detect the state of road traffic in urban areas based on the Big Data tools. During a traffic jam, several resources are wasted, such as time, fuel and many other resources. Through the VANET networks, we can circulate useful information on the state of the traffic in order to guarantee fluidity and an easy circulation. The vehicle-to-vehicle (V2V) communication is a way of transmitting this information in a VANET network [23].

Ahmadzadegan et al (2019) implemented and evaluated the impact of traffic congestion caused by the number of cars on the detection of the missing packets. VANETs can create alert systems in a certain distance for awareness of drivers about road and traffic conditions, to help drivers make better decisions and modify their driving habits to reduce these hazards and accidents [24].

Vijayakumar et al (2019) focused on efficient data dissemination on V2I communication model. The proposed model, considers real world time delay without imposing delay tolerance. With this proposal, real time simulation environment has been developed using CSIM19 and the results are tabulated. The performance of proposed model has been compared with a standalone approach and another load balancing approach and it is proved that the proposed Adaptive Load Balancing approach performs better than existing approaches [25].

Huang et al (2020) studied the RSU load-balancing problem and propose two solutions. In the first solution, the whole network is divided into sub-regions based on RSUs' locations. A RSU provides Internet access for vehicles in its sub-region and the boundaries between sub-regions change dynamically to adopt to load migration. In the second solution, vehicles choose their serving RSUs distributed by taking their future trajectories and RSUs' loading information into considerations. From simulation results, the proposed methods can improve packet delivery ratio, packet delay, and load balance among RSUs [26].

Murugan et al (2020) represented the performance of ACO (Ant colony optimization) and PSO (Particle Swarm Optimization) in MANET as well as VANET for efficiently transmit the data in the shortest route to reach the destination and also evaluates energy consumption and load balancing among MANET and VANET. Network lifetime is increased by reducing energy consumption in which it is necessary to balance energy in nodes. By using ACO and PSO is evaluated that selects the most reliable path which helps to reduce the possibility of link breakages, i.e. particular zone area as well as responds better to changes in the network topology [27].

Roh et al (2020) proposed Q-learning based load balancing routing (Q-LBR) through a combination of three key techniques, namely, a low-overhead technique for estimating the network load through the queue status obtained from each ground vehicular node by the URN, a load balancing scheme based on Q-learning and a reward control function for rapid convergence of Q-learning. Through diverse simulations, we demonstrate that Q-LBR improves the packet delivery ratio, network utilization and latency by more than 8, 28 and 30%, respectively, compared to the existing protocol [28].

Ahmad et al (2020) presented an optimized clustering in vehicular ad hoc networks based on honey bee and Genetic Algorithm (GA) for Internet Of Things. Firstly, the clustering problem (CP) in VANET is formulated into a dynamic optimization problem. Secondly, an optimization algorithm named Vehicular Genetic Bee Clustering (VGBC) based on honey bee algorithm and properties of genetic algorithm solves the CP in VANETs is suggested. In VGBC, individuals (bees) represent a realistic clustering structure and its fitness is measured on the basis of load balancing and stability. A technique that merges the properties of genetic algorithm and honey bee algorithm is planned. It helps the population to handle the topology changes and harvest high quality solutions. The simulation results piloted for justification demonstrate that the VGBC form steady and balanced clusters. The VGBC attains better performance in terms of cluster count, cluster duration, re-affiliation rate, computational overhead, load balancing, VANET lifetime and clustering overhead [29].

Peixoto et al (2021) designed a data clustering framework to perform traffic information reduction at the edge of vehicular networks by exploiting fog computing. The presented data clustering framework defines two methods for the reduction of the traffic data stream: (i) Baseline method, which is an ordinary traffic congestion detection approach, and (ii) two adapted clustering methods for a data stream; namely, the Ordering Points to Identify the Clustering Structure (OPTICS) and the Density-Based Spatial Clustering of Applications with Noise (DBSCAN). The results have shown that the designed traffic data framework using clustering methods is accurate even when the vehicular traffic condition is highly congested, potentially reducing the communication costs and bringing significant results for the development of VANETs [30].

Hameed et al (2021) presented a cluster-enabled capacity-based load-balancing approach to perform energy and performance-aware vehicular fog distributed computing for efficiently processing the IoT jobs. It designed a dynamic clustering approach that takes into account the position, speed, and direction of vehicles to form their clusters that act as the pool of computing resources. This work also presents a mechanism for identifying a vehicle‘s departure time from the cluster, which allows predicting the future position of the vehicle within the dynamic network. Furthermore, it provides a capacity-based load-distribution mechanism for performing load-balancing at the intraas well as the inter-cluster level of the vehicular fog network. The simulation results are obtained using the state-of-the-art NS2 network simulation environment. The results show that the presented scheme achieves balanced network energy consumption, reduced network delay, and improved network utilization [31].

Qun and Arefzadeh (2021) presented a new energy-aware method for load balance managing in the fog-based Vehicular Ad Hoc Networks (VANET) using a hybrid Ant Colony Optimization and Artificial Bee Colony (ACO-ABC) optimization algorithm. The effect of increasing the number of nodes on the amount of energy consumed by the fog-based VANET and the residual energy in the battery were investigated. Also, the number of residual nodes was increased by increasing the length of routing periods in the presented method with the ant and ABC optimization algorithm. The simulation results in the Network Simulator 2 (NS2) environment. Also, with the increasing number of tasks, load balancing by the designed method has been improved [32].

Kadhim and Naser (2021) introduced a proactive load balancing mechanism for fog computing supported by parked vehicles in IoV-SDN. This can improve the capabilities of the fog computing layer and help in decreasing the number of migrated tasks to the cloud servers. It increases the ratio of time sensitive tasks that meet the deadline. In addition, a new load balancing strategy is presented. It works proactively to balance the load locally and globally by the local fog managers and SDN controller, respectively. The simulation experiments show that the presented system is more efficient than VANET-Fog-Cloud and IoV-Fog-Cloud frameworks in terms of average response time and percentage of bandwidth consumption, meeting the deadline, and resource utilization [33].

III. COMPARATIVE ANALYSIS OF EXISTING METHODS

Table 1: Comparative analysis of previous clustering and load balancing methods

S.no	Authors name	Methods	Merits	Demerits
1.	Wang et al. (2008)	Position-based clustering technique	Better energy consumption	It has issue with It has issue with cluster overlap.
2.	Lo et al (2013)	Multi-head clustering algorithm	It provides higher stable clusters with long lifetime.	It does not consider energy to improve the performance
3.	Singh and Bali (2015)	Hybrid backbone based clustering algorithm	Better cluster stability in urban scenarios.	It does consider distance, density and geographical location of a vehicle to achieve more stable clusters.
4.	Ye et al (2016)	Genetic Algorithm (GA)	Efficiently utilizes underutilized vehicular resources.	Genetic algorithm is computationally expensive .i.e. time –consuming
5.	Zheng et al (2016)	Cluster–on–Demand VANET Clustering algorithm (CDVC)	Better load balancing	It has issue with computation time
6.	Agarwal et al (2016)	Load Balanced Routing strategy (LBR)	Better energy usage, network load and average packet delay	It does not consider the mobility of nodes with variable velocities to increase the packet delivery ratio.

7.	Bali et al (2017)	Energy-aware predictive clustering approach	High throughput Lower end to end delay High probability of transmissions	Secure clustering is major issues.
8.	Ren et al (2017)	Dynamic mobility-based and stability-based clustering scheme	High clustering efficiency Higher cluster stability	It impact of the number of hops on the cluster performance
9.	Mohaisen & Joiner (2017)	EMHR-energy based with mobility concerns hybrid routing protocol for VANET-WSN	Estimate the bandwidth in more efficient way	Mobility is major issues.
10.	David & Navaneethakrishnan (2017)	Evaluates energy consumption and load balancing among MANET and VANET	Energy consumption and network lifetime	It has issue with computation time
11.	Amudhavel et al (2018)	Distributed Spanning Tree (DST)	Minimum end to end delay	Better mechanisms are required to improve the performance.
12.	Ji et al (2018)	Link Reliability-based Clustering Algorithm (LRCA)	Higher clustering stability	Various methods are required to improve the route strategy to minimize the end-to-end delay.
13.	Zhang et al (2018)	Passive Multi-Hop Clustering algorithm (PMC)	It effectively reduces the inter-cluster interference	It has issue with cluster overlap.
14.	Gao et al (2018)	Hierarchical Routing Scheme	Achieves significant gains in terms of delivery ratio, throughput, average delay, and average hop count	This routing mechanism is only for urban scenes

15.	Rui et al (2018)	Clustering and fuzzy assessment in VANET	Congestion detection	Considers only the road side units
16.	Chang et al (2018)	Distributed transmission power adjustment algorithm	Controls communication congestion, enhances a vehicle's awareness and controls the transmission power	There is no any specific disadvantage.
17.	Cherkaoui et al (2019)	Road traffic congestion detection	Efficient congestion detection	Time complexity
18.	Vijayakumar & Joseph	Adaptive Load Balancing Schema	Higher lifetime	Higher computation time
19.	Huang & Jhang (2020)	RSU load-balancing	Improve packet delivery ratio, packet delay, and load balance among RSUs.	Due to high mobility, it may affect the performance sometimes
20.	Murugan et al (2020)	ACO (Ant colony optimization) and PSO (Particle Swarm Optimization) in MANET as well as VANET	Improvement in energy consumption and load balancing	Convergence problem may occur in optimization approaches
21.	Roh et al (202)	Q-learning based load balancing routing (Q-LBR)	Improves the packet delivery ratio, network utilization and latency	does not consider the traffic characteristics fully
22.	Ahmad et al (2020)	Vehicular Genetic Bee Clustering (VGBC)	Higher VANET lifetime Minimum clustering overhead.	Higher computation time

23.	Peixoto et al (2021)	Ordering Points to Identify the Clustering Structure (OPTICS) and the Density-Based Spatial Clustering of Applications with Noise (DBSCAN)	Minimum communication costs	It has issue with quality of the clusters
24.	Hameed et al (2021)	Cluster-enabled capacity-based load-balancing approach	It achieves balanced network energy consumption, reduced network delay, and improved network utilization	Congestion issues are not focused clearly. In this work road side units are not considered which is more essential for vehicular network with increased mobility.
25.	Qun and Arefzadeh (2021)	Hybrid Ant Colony Optimization and Artificial Bee Colony (ACO-ABC) optimization algorithm	Higher load balancing performance Higher energy consumption	The optimization algorithms are suffered from long search time and tendency to fall into the local optimal problem.
26.	Kadhim, and Naser, (2021).	Proactive load balancing mechanism	Better average response time and percentage of bandwidth consumption	It has issue with energy consumption

IV. INFERENCES FROM RECENT WORKS

Vehicular Adhoc network has gained popular attention in last few years due to the provision of safety and comfort related applications. An efficient load management and clustering approaches in VANET is a challenging task due to the dynamic nature of the VANET. In recent years various approaches such cluster-enabled capacity-based load-balancing , hybrid Ant Colony Optimization and Artificial Bee Colony (ACO-ABC) optimization, energy-aware predictive clustering approach, Vehicular Genetic Bee Clustering (VGBC), proactive load balancing mechanism, Cluster–on–Demand VANET Clustering algorithm (CDVC) along with load balancing, Link Reliability-based Clustering Algorithm (LRCA), hybrid backbone based clustering algorithm, Load Balanced Routing strategy (LBR) are introduced. Several load balancing are available for VANETs but none of them provides better performance for balancing load in the network. And also, these clustering methods have issues with packet delivery ratio, end to end delay and energy consumption.

V.CONCLUSION

Highly dynamic nature of vehicles in vehicular ad-hoc networks causes the rapid change in its network topology. Hence the clustering and load balancing algorithm can be used to stabilize the network topology in vehicular ad-hoc-networks. Many clustering and load balancing methods have been applied to improve the energy consumption and packet delivery ratio of VANET. In this paper, various clustering and load balancing algorithms such as cluster-enabled capacity-based load-balancing , hybrid Ant Colony Optimization and Artificial Bee Colony (ACO-ABC) optimization, energy-aware predictive clustering approach, Vehicular

Genetic Bee Clustering (VGBC), proactive load balancing mechanism, Cluster–on–Demand VANET Clustering algorithm (CDVC) along with load balancing, Link Reliability-based Clustering Algorithm (LRCA), hybrid backbone based clustering algorithm, Load Balanced Routing strategy (LBR) are evaluated. According to this survey hybrid ACO-ABC optimization, VGBC and Cluster-enabled capacity-based load-balancing approach were found to give better performance. Here, conclude that clustering in VANET is an open research issue since an efficient and stable clustering algorithm is still under research.

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