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EFFICIENT ROUTING IN VANET NETWORKS USING CLUSTERING AND SEGMENTATION ALGORITHM

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Master's Thesis

Supervisor

Prof. Dr. Osman Nuri UCAN

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The thesis titled Efficient Routing in Vanet Networks Using Clustering and Segmentation Algorithm prepared by MUSTAFA SAHER MOHAMMED ALHELLI submitted on 8/12/2022 ALHELLI and has been **accepted unanimously** for the degree of Master of Science in Information Technology.

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I hereby declare that this thesis meets all format and submission requirements of a Master's thesis.

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Signature

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To Prof. Dr. Osman UCAN, The professor I followed and encouraged me to complete my research and teach me how to draw my first letter, compose my first full phrase, and apply the first of many rules. To my colleagues, on whose unflinching assistance I can always rely and who have given me all the resources I need to finish my thesis without hesitation.

ABSTRACT

EFFICIENT ROUTING IN VANET NETWORKS USING CLUSTERING AND SEGMENTATION ALGORITHM

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VANET is a type of network (MANET) that connects vehicles instead of cars. The VANET has wireless transmitters that can connect with other cars, infrastructure, and outside world as part of an intelligent transport systems (ITS) (V2X). DSRC and WAVE (wireless accessibility in vehicular contexts) protocols are utilized. VANETs are able to move nodes more quickly than MANETs. In VANETs, node movement is unpredictable and rapid, resulting in network availability, scalability, & structural instability. It decreases the network's Quality of Service (QoS), resulting in more communication errors We must show that bio-inspired routing algorithms outperform conventional routing algorithms due to the lack of research on bio-inspired routing algorithms for fixed-wing unmanned aerial vehicle networks. The absence of a three-dimensional environment, a suitable mobility model, and acceptable node speed ranges are all obstacles that must be addressed to solve the routing issue in VANET networks. This study's goal is to fill information gaps. With VANET mobility models, this research compares AdHoc, a bio-inspired routing algorithm, against AODV and OLSR, two common routing algorithms

Keywords: Vanet, Manet, ADHOC, AODV, OLSR.

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ABBREVIATIONS

VANET	:	Vehicular Ad Hoc Network
QOS	:	Quality Of Service
MANET	:	Mobile Ad Hoc Network
RIP	:	Router Information Protocol
WMN	:	Wireless Mesh Networks
CBR	:	Cluster-Based Routing

1. INTRODACTION

1.1 BACKGROUND

VANET is a type of network (MANET) that connects vehicles instead of cars. The VANET has wireless transmitters that can connect with other cars, infrastructure, and outside world as part of an intelligent transport systems (ITS) (V2X). DSRC and WAVE (wireless accessibility in vehicular contexts) protocols are utilized. VANETs are able to move nodes more quickly than MANETs. In VANETs, node movement is unpredictable and rapid, resulting in network availability, scalability, & structural instability. It decreases the network's Quality of Service (QoS), resulting in more communication errors. These challenges have led to the development of technologies such as intelligent clustering algorithms. It divides a network into logical units called "clusters," which are further subdivided. The distance between nodes and the communication connection capacity are two metrics that may be utilized to enhance overall network performance. Smaller groups are simpler to manage. Algorithms based on clustering are utilized widely. Also, the criteria for creating clusters vary with clustering algorithms. These requirements may change depending on the product's functionality and intended application. However, cluster network vehicles enable nodes to function as either members or leaders depending on their configuration (CHs). A communication hub (CH) allows information to travel between and among individual nodes in VANETs. As a result, CHs are selected for their enhanced capabilities to maximize network performance. Choosing the CH ensures secure connection at all times. A single CH may control both cellular and satellite backbone networks, making selecting the best CH for VANETs problematic. According to this classification, VANET optimal clustering is a Non-Polynomial-Hard problem. Due to the difficulty of finding ideal answers, near-optimal solutions are acceptable here. Many traditional methods have been created in a similar field, but none have been able to solve the problem satisfactorily.

MOBIC is a well-known and commonly used method for selecting CH in MANETs. Contrast this with MANETs' lack of node mobility. As a consequence, VANETs will not be able to profit from a similar method soon. Many conventional VANET approaches, such as message transmission in agent-based vehicle networks, are currently being researched (NCABAT). This method finds three nodes: context, optimization, and cluster head. NCABAT is presently tested on a grid of 60 nodes with a fixed transmission range of 160 meters. The grid is 1300 x 700 meters and has 60 nodes.

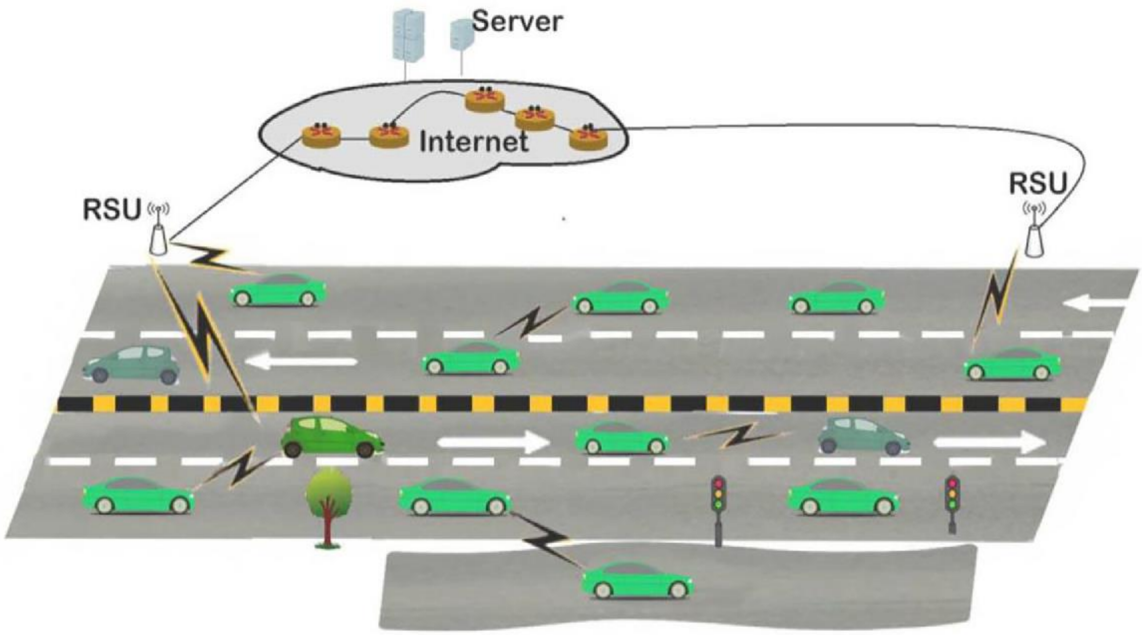

Figure 1.1: Grey VANET Clustering [3]

A network that connects automobiles is referred to as a MANET, while a network that connects vehicles is referred to as a type of MANET. The Intelligent Transportation Systems (ITS) incorporate wireless transmitters into the VANET so that it may communicate with other cars, infrastructure, and the outside world. These wireless transmitters allow the VANET to function as an ITS component (V2X). Protocols referred to as DSRC and WAVE, both of which stand for wireless accessibility in automobile contexts, are utilized here. It is feasible for VANETs to reposition their nodes at a more rapid pace compared to MANETs. In VANETs, the availability of the network, as well as its scalability and structural integrity, are all jeopardized by the unpredictability and speed with which nodes move throughout the network. It brings about a decrease in the Quality of Service (QoS) of the network, which in turn causes an increase in the frequency of communication errors. As a response to these problems, innovative solutions such as algorithmic approaches to intelligent clustering have been created. After a network has been segmented into its component logical units, which are referred to as "clusters," the clusters themselves can be further subdivided. The physical distance that exists between nodes and the capacity of the communication links that exist between them are two measures that might potentially be used to improve the performance of the network as a whole. Smaller groups are much simpler to monitor and direct than larger ones. In recent years, there has been an explosion in the use of algorithms that are based on clustering. In addition, the prerequisites for the development of clusters can vary greatly depending on the method of clustering that is used. Both the product's functionality and the environment in which it will be utilized have the ability to have an impact on the manner in which these criteria are put into practice. On the other hand, cluster network vehicles give nodes the ability to take on the role of either a member of the cluster or a leader of the cluster, depending on the configuration of the cluster (CHs). The utilization of a communication hub, also known as a CH and abbreviated as CH in VANETs, makes it possible for information to travel between and among the various nodes. As a direct result of this, CHs are selected on the basis of their increased capabilities with the intention of achieving the highest possible level of performance from the network. If you decide to utilize the CH, you will consistently have a connection that is safe to use. It is challenging to select the best CH for VANETs due to the fact that a single CH can manage both cellular and satellite backbone networks. According to this classification, the issue of optimally clustering VANET nodes is regarded as a challenge of non-polynomial degree of difficulty. Because it is impossible to get the ideal answers, we will have to settle for finding solutions that are almost as good as the perfect answers. There are many conventional ways that have been established in this field; however, none of them have been successful in resolving the issue to anyone's satisfaction.

In MANETs, the MOBIC method is a well-known strategy that is widely used for the purpose of selecting CH. When compared to the stationary nature of MANET nodes, this is a striking contrast. As a direct result of this, it is highly unlikely that VANETs will be able to employ a method that offers equivalent benefits any time in the near future. Study is currently being carried out on a wide variety of conventional VANET methodologies, such as the transmission of messages in agent-based vehicle networks. This research is being carried out at the moment (NCABAT). This method identifies three nodes, which are called, in succession, the context node, the optimization node, and the cluster head node. At the moment, NCABAT is being tested on a grid that is made up of sixty nodes and has a transmission range that has already been established at one hundred sixty meters. The grid has a total of 60 nodes and has dimensions of 1300 meters on one side and 700 meters on the other.

Distance vector routing (DVR) protocols that allow multicast are known as "ad hoc on-demand DVR" (MAODV). NCABAT performs better than MAODV in the simulated network. Chatterjee devised the "efficient clustering approach" for MANETs, which was later refined by Daeinabi for VANETs (VWCA). Network variables like transmission range & node ID are weighted by WCA and all nodes must use CH. Static weights are also used by VWCA for various network topologies, result in a unified approach. There are similarities between this and Wang's PassCAR routing method for automobile networks. Passive clustering is used in PassCAR, which does not need any control channel input. Clustering and categorization of data are made possible by using data packets. For PassCAR to function properly, a from on of 350 nodes is required. The original passively clustering strategy is superior than PassCAR in many situations. Similar optimization issues are faced by traditional methods of communication. As a result, evolutionary algorithms are now more suited than other approaches to NP-hard/non-convex issues. Bird & insect behavior, as well as the importance of DNA in the production of living beings, are examples. Because of this, they may be used to a broader range of optimization problems. The NFL theorem encourages the use of a wide range of optimization strategies to a wide range of problems. To the NFL, there is no one optimization solution that can solve all optimization difficulties at once An considerable amount of research has been done on the topic of using drones to assist VANET. Clustering of cargo nodes was introduced in this study. Clustering was enhanced by tweaking a few parameters (nodes direction, network area, communication link capacity, node density, and transmission, range, etc.). The grasshopper optimization technique was used to build this piece of software (GOA). Until now, no one has attempted to use this strategy in a VANET. Grasshopper swarming behaviour is statistically replicated to compute the overall clusters in each scenario. The social attraction & repulsion between persons must be taken into account.

1.2 PROBLEM STATEMENT

Vanet networks (VANETs) have emerged as an important research engine for governments, vehicle manufacturers, and academic institutions due to their wide variety of uses and high effectiveness. Many things must be addressed while installing VANETs. Urban environments need the development of flexible and efficient routes between sources and destinations. The advantages of VANETs are severely limited until this routing challenge is overcome. When it came to city-based VANET routing, the following factors should be taken into account: For precise and timely QoS routing, use one. Choosing a routing choice based on latency, packet delivery ratio, and connection probability is critical since they provide an accurate and speedy evaluation of routing performance. Stable and durable routing channels with high packet delivery ratios are required to make VoIP & e-payment services readily accessible to customers. VANET traffic may include a broad range of vehicle numbers, locations, and times. At any one time, the spatial and temporal densities of vehicles in a given location may range from relatively sparse to very crowded. Consequently, it is challenging to predict the real-time and precise QoS routing in VANET urban scenarios. Second, we must solve network congestion. Car-assisted networking (VANET) may rapidly put a strain on the wireless channel in urban areas with high vehicle density, particularly during quiet hours. The traffic loads used to transmit a node's position to its neighbors include data packets and Hello packets. DSRC (Dedicated Short-Range Communications) provides 75 MHz of bandwidth divided across seven channels, the most restricted of which is designated for the 10 MHz-capable channels. Increased traffic and limited bandwidth may cause network congestion and poor routing performance. Thus, the goal of this thesis is to solve the confounding issue of network congestion and overhead reduction in virtual private networks.

Third, the service's overall quality of service (QoS) is poor. Maintaining the highest possible QoS for packet forwarding in urban contexts is vital, but difficult. Several explanations are given here. Large-scale networks are compelled to rely on uncertain locally gathered data because to the difficulty of defining global quality of service (QoS) of various routing paths from a source vehicle. Finally, while designing a system, consider scalability and stability. Establishing a reliable and scalable routing system over VANETs is a vital step in developing effective vehicular communication systems, say the authors. It is difficult to ensure long-term sustainability and consistency when routing patterns are often disrupted. Using source-driven routing to connect nodes or junctions in large metropolitan areas is difficult owing to scalability. Finally, data packets were transmitted through heterogeneity. Virtual private networks (VANs) may be used for security, entertainment, and more. Driving safety applications need low transmission latency and high dependability, whereas infotainment apps often measure resource utilization, packet loss, and fairness. Dense cars, for example, improve connection but increase packet loss ratio owing to channel congestion and interference, among other things. A broad variety of traffic data is needed to choose the appropriate Routing protocol solution for just a range of applications. To get around these problems, several VANET routing methods have been proposed in the literature. Large-scale VANETs benefit from topology-based routing algorithms, which are regarded to be more reliable and appropriate. By simply forwarding the packets to the next closest GPSR node, the scalability problem may be solved. They're designed to find the shortest route to a certain location. Due to their disdain for traffic conditions, they may be vulnerable to access control or congestion. A-STAR examines data on bus use to design routes based on anchors that are well-connected. This data may be out-of-date or insufficient to explain the overall routing performance of a system or network. In both CAR and ACAR, real-time routing information is used to pick the optimum quality of service route. Because this data is not updated in real time, it is not an accurate representation of the signal's quality of transmission. Many routing tactics are slowed down or halted entirely due to the time and effort required to conduct blind routing research. TADS prioritizes the quality of a local connection above the quality of a global route when determining the next suitable junction, putting packets at risk of poor forwarding. Routing has been studied extensively, but many questions remain. For example, how can major metropolitan areas with lots of traffic benefit from real-time traffic information but instead of historical/instantaneous traffic information.

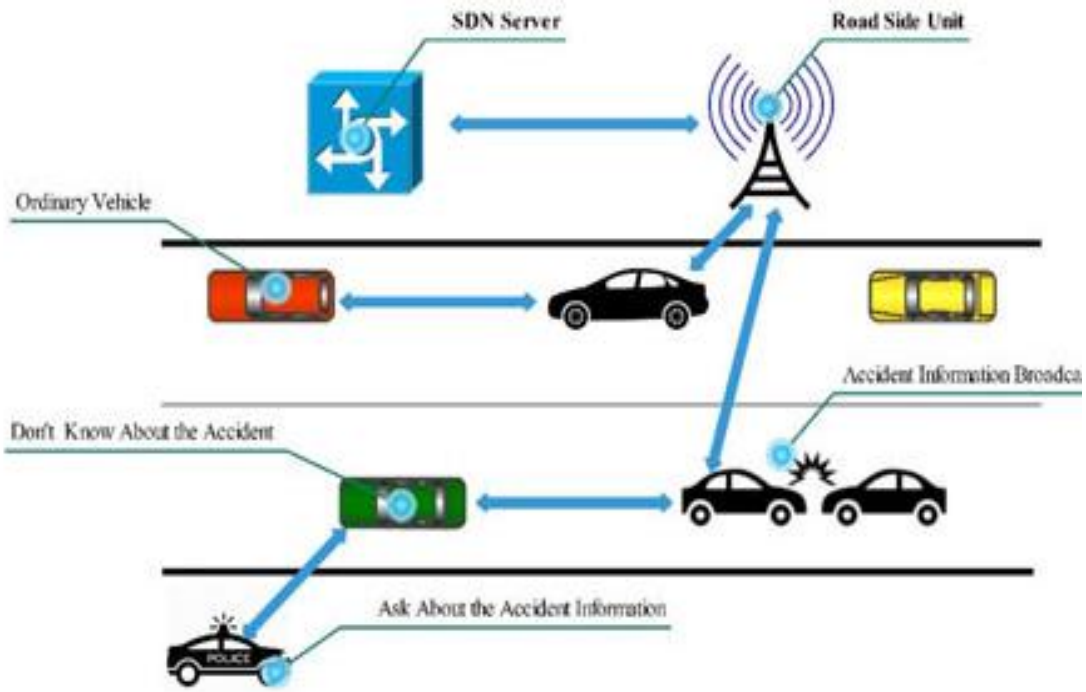

Figure 1.2: SDN-Based VANETS, Security Attacks [5]

Vanet networks, which are often referred to as VANETs, have evolved into an essential research engine for governmental organizations, automobile manufacturers, and academic institutions. This is as a result of the high level of efficacy that they provide in addition to the extensive range of applications that can be created using them. When it comes to the implementation of VANETs, there are a significant number of minute details that need to be attended to. In urban areas, it is an important necessity to design and build transportation corridors that are both adaptable and efficient, with the goal of connecting points of origin and points of destination. In the absence of a solution to this routing issue, the potential benefits of VANETs will be severely diminished. When it came to the process of routing city-based VANETs, the following factors should have been prioritized as much as possible: Utilizing one will be of great assistance to you in accomplishing your objective of having an accurate and current QoS routing system. It is essential to base your routing decision on latency, packet delivery ratio, and connection probability since these metrics enable an accurate and speedy evaluation of the performance of the routing. This is because latency is a measurement of how much time elapses between when a packet is sent and when it is received. Customers need to have access to routing channels that are not only stable and will survive for a long time, but also have high packet delivery ratios in order for VoIP and electronic payment services to be conveniently available. There is a wide variety of possibilities that could be incorporated in VANET traffic, particularly with regard to the kinds of automobiles, the locations, and the hours. It is possible for the spatial and temporal densities of cars in a particular region to range anywhere from quite sparse to very busy at any given time, depending on the particular location and the time of day. This is a phenomenon that is capable of taking place in both space and time. As a direct result of this, it can be challenging to produce an accurate forecast of the real-time and correct QoS routing in VANET urban situations. Second, we have to devise a strategy to reduce the congestion that already exists in the network in order to make it more usable. Car-assisted networking, also known as VANET, has the potential to swiftly produce a stress on the wireless channel in urban areas with a high car density, especially during the quieter hours of the day. This stress could be caused by VANET, which is also known as car-assisted networking. This is especially the case in the wee hours of the morning and the wee hours of the evening. Using a variety of traffic loads, the position of a node can be conveyed to the nodes that are in close proximity to it. These loads include things like data packets and "Hello" packets, as few examples. The bandwidth that is made available by Dedicated Short-Range Communications (DSRC) is 75 MHz, and it is split between seven different channels. The channels that are able to support 10 MHz have the most stringent limitations on what kinds of transmissions can take place over them. Congestion on a network may be the result of a combination of a rise in the amount of traffic and a reduction in the available bandwidth. This combination may also result in subpar performance of the routing protocols that are utilized by the network. As a direct result of this, the purpose of this thesis is to develop a workable solution to the difficult problem of reducing the amount of overhead that is associated with virtual private networks (VPNs) (VPNs).

Third, the quality of service (QoS) that is provided by the service is, on average, lower than what is considered to be average. It is essential, but difficult, to keep the quality of service for packet forwarding at the highest feasible level that is practically possible in urban contexts. This is a challenge that must be met. This article presents a variety of unique perspectives, each of which sheds light on what took place. Large-scale networks are forced to rely on locally obtained data that may or may not be accurate because it is impossible to define the global quality of service

(QoS) of the numerous routing channels that originate from a source vehicle. Large-scale networks are forced to rely on locally obtained data because it is impossible to define the global quality of service (QoS). The reason for this is that large-scale networks are compelled to rely on data that is collected locally. In conclusion, when developing a system, it is imperative to keep in mind the significance of scalability in addition to the relevance of stability. The authors are of the opinion that one of the most important aspects of the process of designing reliable and extensible vehicular ad hoc networks for electronic communications (VANETs), which is the process by which efficient vehicular communication networks are developed, is the establishment of a trustworthy and scalable routing system. This stage is widely regarded as being among the most important steps in the process as a whole. When there are frequent disruptions to the established routing patterns, it is difficult to provide assurance that a routing pattern will be sustainable over the long run and will maintain its consistency. In large metropolitan areas, utilizing source-driven routing to connect nodes or junctions is a task that is fraught with difficulty. This is because of the challenges that are related with scalability. When it seemed like it would never happen, heterogeneity was finally implemented into the process of data packet transmission. Virtual private networks, which are more generally referred to as VANs because of the acronym for their name, have a great deal more applications than simply providing protection and amusement. Driving safety apps are required to have a high level of dependability and a small amount of transmission delay, in contrast to the resource utilization, packet loss, and fairness that are continually checked by infotainment applications. For instance, research has shown that having a greater number of people in a vehicle can lead to faster connection rates. However, this comes at the expense of a bigger packet loss ratio, which can be ascribed to a number of factors including increased channel congestion and interference. This comes at the expense of a greater packet loss ratio comes at the expense of an increased channel congestion. Access to a broad variety of different types of traffic data is required in order to choose the routing protocol solution that is best suited for a number of different applications. This access is necessary in order to select the optimal solution. In the published works of the scientific community, a variety of VANET routing algorithms from a variety of different vendors have been proposed as possible answers to the difficulties that have been found. Topology-based routing strategies, which are generally considered to be more appropriate and trustworthy, can be implemented in large-scale VANETs. These strategies can be used. Large-scale VANETs, as a consequence, stand to gain from the implementation of the aforementioned strategies. It is quite possible that the scalability issue can be resolved by only transmitting the packets to the subsequent GPSR node that is positioned in the region that is the closest to the source of the issue. They are created with the purpose of calculating the quickest path to reach to a particular destination; as a result, the goal behind their creation is the same as the goal behind their construction of the other. They pay zero attention to the flow of traffic around them, which makes them susceptible to access constraints and makes it more likely that there will be congestion. The data on bus use are analyzed by A-STAR, and the routes that are generated as a result are based on anchors that have a high degree of connectedness with one another. It is possible that these statistics are not up to date, or that they do not provide enough information to adequately explain the overall performance of the routing capabilities of a system or network. Both of these scenarios are possible. Real-time routing information is utilized by both CAR and ACAR in order to assess which route provides the highest possible level of service quality and then select that route as the optimal option. Because these statistics are not updated in real time, it is impossible to adequately illustrate the quality of the signal's transmission using them because they do not give an accurate depiction of the quality of the signal. Because of the amount of time and effort that is required to conduct blind routing research, numerous various routing strategies are either significantly slowed down or completely halted. This is due to the fact that blind routing research is necessary. TADS places a greater emphasis, while looking for the next suitable junction, on the quality of a local connection as opposed to the quality of a global route. This is because local connections tend to be more reliable than worldwide ones. As a consequence of this, there is a risk that the packets will be forwarded in an unsatisfactory manner. In spite of the substantial amount of research that has been put into routing, there are still a great many questions that have not been answered. Real-time traffic information, as opposed to immediate or historical traffic statistics, is one example of how major metropolitan areas that experience a lot of traffic can benefit from having access to real-time traffic information. Real-time traffic information is one example of how major metropolitan areas that experience a lot of traffic can benefit from having access to real-time traffic information.

1.3 OBJECTIVES

To enable VANET success, routing protocols must be able to successfully transport packets while supporting a broad collection of applications. This thesis proposes intersection-based QoS routing algorithms for large-scale urban settings. These routing methods use real-time quality of service (QoS) measures for road segments, such as connection probability, latency, and packet delivery ratio, to identify the ideal QoS routing path. These routing protocols are useful for coping with network congestion and capacity limits in VANETs because they are adaptable and scalable. The following are key scientific contributions made to achieve our aims. (1) Develop system models proportionate to service level (QoS). Our routing algorithms try to find the ideal route that maximizes QoS while also conforming to a number of QoS parameters. Developing efficient system models that optimize varied routing barriers may help us achieve this aim. (2) Develop an PSO-based exploration approach for the routing protocol. Its scalability, flexibility, fault tolerance, and other PSO-specific properties were suggested as a solution to comparable routing challenges. As many potential routing paths as feasible are discovered using a range of network investigation methods and communication pairings. These approaches and communication pair’s work together to update routing information along found routes. Adaptive routing is possible when a network has certain features. The author examines the network opportunistically to find the best routing patterns, including both local and global quality of service criteria (QoS). We leverage local road segment quality of service (QoS) to identify new routing paths, optimize the usage of real-time routing information, and improve our routing protocols' exploration unpredictability. Our routing system is protected from making poor selections on future road sections thanks to this study. The most effective path to network discovery is always taken. We can clearly see that our approach enables us to strike a balance between route study and actual usage of the routes. Our method reduces network overhead and routing discovery time compared to blind flooding. Analyze quality of service on first- and second highways using real-time analytical methodologies. A road segment's level of service is taken into account by our routing algorithms (QoS). Road segment quality on service (QoS) models are used to determine the frequency and latency of connections. The channel transmission and the channel length are important factors to consider. models surpass other, slower ways like transmitting periodic packets to gather real-time route discovery (SADV), collecting data in real time (CAR), or using historical route data (HRD) in terms of performance (VADD). Introduction to Terminal Intersections (TI) is provided in this section (5). Both the direction of travel of the source and destination vehicles and the distance between every TI are taken into consideration while creating the TI. Instead than relying on standard backbone intersection-based routing search methods, this new approach is being tested instead. The TI concept builds communication connections with same TID (Terminal Interaction of the Destinations vehicle) and QoS criteria in order to speed up data packet transmission. It is more reliable & scalable to use intersection-based routing approaches in large metropolitan regions. Improved techniques for data packet transmission. Using RTS/CTS with such a receiver-side relay elections mechanism minimizes the quantity of Hello packets delivered between nearby nodes, which reduces network congestion.

It is necessary for routing protocols to be able to successfully transport packets while also providing support for a diverse range of applications in order for VANET to be successful. In this thesis, intersection-based Quality of Service (QoS) routing algorithms for large-scale metropolitan contexts are proposed. These routing approaches locate the best quality of service (QoS) routing path by employing real-time quality of service (QoS) measurements for road segments. Some examples of these measures are connection probability, latency, and packet delivery ratio. Because of their flexibility and scalability, these routing protocols are helpful for overcoming the limitations of capacity and network congestion that are inherent to VANETs. The following is a list of important scientific contributions that were made to accomplish our objectives. (1) Construct models of the system that are proportional to the service level (QoS). Our routing algorithms work to identify the path that would provide the highest possible Quality of Service (QoS) while also meeting the requirements of a variety of QoS metrics. It's possible that developing effective system models that optimize different types of routing barriers may help us accomplish this goal. (2) Conceive of a PSO-based exploration strategy for the routing protocol and work on its implementation. Its scalability, flexibility, fault tolerance, and other PSO-specific qualities were recommended as a solution to comparable routing difficulties. [Citation needed] [Citation needed] A variety of network investigation techniques and communication pairs are utilized in order to uncover the maximum number of potentially usable routing paths that are technically possible.

The routing information along found routes is kept up to date thanks to the collaborative efforts of the aforementioned approaches and communication pairs. When a network possesses a given set of characteristics, adaptive routing becomes a viable option. The author performs a random scan of the network in order to identify the optimal routing patterns, which take into account both regional and international quality of service standards (QoS). We make use of local road segment quality of service (QoS) to find new routing paths, optimize the use of real-time routing information, and improve the exploration unpredictability of our routing protocols. The results of this study will prevent our routing system from making incorrect judgments regarding the location of future road sections. The method of discovering networks that is proven to be the most productive is always used. It is abundantly evident to us that the strategy that we took gives us the ability to achieve a healthy equilibrium between the study of the routes and the actual use of the routes. In comparison to blind flooding, our solution minimizes the amount of time needed for the discovery of network routing. Utilizing real-time analytical methods, conduct an investigation of the quality of service provided on first and second-tier roadways. Our routing algorithms take into account the quality of service provided by each individual route section (QoS). Models of the quality of service (QoS) for individual road segments are utilized in order to ascertain the frequency and latency of connections. There are a number of key considerations to make, including the channel transmission and the channel length. In terms of performance, models are superior to alternative, slower methods such as broadcasting periodic packets to obtain real-time route discovery (SADV), collecting data in real time (CAR), or using historical route data (HRD) (VADD). This section contains an introduction to Terminal Intersections (TI), which you may read here (5). When calculating the TI, it is important to take into account not only the distance between each TI but also the direction that the source and destination vehicles will be traveling when they reach their respective TIs. This innovative strategy is being investigated as an alternative to the more conventional routing search methods, which are intersection-based and focus on backbone nodes. In order to hasten the process of data packet transfer, the TI idea establishes communication links that meet the same TID (Terminal Interaction of the Destinations vehicle) and QoS standards. In big metropolitan areas, it is recommended to adopt intersection-based routing algorithms since they are more reliable and scalable. transmission methods for data packets that are significantly improved. When a receiver-side relay elections mechanism is used in conjunction with RTS/CTS, the amount of Hello packets that are delivered between neighboring nodes is reduced, which in turn results in less network congestion.

1.4 CONTRIBUTION

We must show that bio-inspired routing algorithms outperform conventional routing algorithms due to the lack of research on bio-inspired routing algorithms for fixed-wing unmanned aerial vehicle networks. The absence of a three-dimensional environment, a suitable mobility model, and acceptable node speed ranges are all obstacles that must be addressed to solve the routing issue in VANET networks. This study's goal is to fill information gaps. With VANET mobility models, this research compares AdHoc, a bio-inspired routing algorithm, against AODV and OLSR, two common routing algorithms.

1.5 THESIS STRUCTURE

The thesis is structured as follows: Section 2 is where we review some of the previous work and implementation on smart grids. Section 3 is where we give a background about all the components. Section 4 is where we explain our model in details and implementation of that model in details, Section 5 is where we simulate our model and record the results obtained. Section 6 is where we conclude our work and put a future scope into perspective.

2. LITERATURE REVIEW

The term "cluster" refers to a grouping of cars that share certain characteristics. It might be dispersed or concentrated in a single area. In the first mode, the cluster does not have a controlling node. The nodes in a network are responsible for both management and communication. Second, a vehicle designated as a CH is in charge of centralizing communication and network management, hence improving resiliency in the system.... There are a variety of ways to deal with VANET issues via clustering. In many cases, they depend on techniques which has only been tried in MANETs. In spite of their differences, both approaches are unable to completely work in a VANET context. Specifically, for MANETs, VWCA is a method. WCA is a more advanced version of more traditional methods like the VWCA. Entropy and mistrust scores are also included in the VWCA's weighted cluster matrix. As previously said, VWCA has consistently excelled the competition when it comes to various scenarios. The weights within this mechanism are defined by same solutions as the preceding mechanism. Not suited for VANET use cases. It was motivated by the HyBR idea that led to the development of a routing protocol with VANET security applications. A bee swarm is used to demonstrate a bio-inspired method for unicast routing on VANETs. Improved safety applications may be achieved by combining a bio-inspired algorithms with traditional geographic routing techniques. It has been shown that every one of these protocols are preferable in certain situations, but HyBee replace them. It only examined grids of 1000m by 1000m. Insufficient clustering patterns were created. It is used to improve the binary communication between artificial bee colonies (BABCs). To avoid communication re-routing, a spanned tree is used. At the same time, a single hit predictions parameter may simulate as many as 16 nodes at once. The dynamic and evolutionary nature of the Kruskal algorithm enabled BABC to outperform the competition. Vehicle-to-roadside (V2R) testing is the only way to measure performance. Another swarm-based approach to finding the most effective VANET pathways is put forward by the authors. Multi-objective particle swarm optimization, or MPSO, is used in conjunction with the ant colony optimization (PSO) (MOPSO). It outperformed two other approaches in terms of providing the fewest possible CHs across a variety of network topologies. Nevertheless, newer protocols, including and, make use of SI methods, as do the dragonflies and grey wolf optimisation algorithms found in newer procedures like and. It was shown that these methods outperformed CLPSO, MOPSO, & PSO when compared to other strategies. The dragonfly optimizer recommends GWOCNET & CAVDO for clustering highway vehicle nodes (CAVDO). Internet of Vehicles (IoV) matching game is used to practice evaluating IoVs' unique clustering method Using this method, the cluster head and the rest of the nodes could be able to maintain match. Only vehicle-to-vehicle communication would be subject to the coalitional game theory. Additionally, automobiles employ ad hoc networking to keep themselves updated on their surroundings. Next-generation wireless networks must take into account the importance of clustering. To improve VANET quality of service, the PSO approach employs clustering-based reducing latency routing algorithms (QoS). AODV consumes more energy and is less reliable, but this protocol is faster and more reliable in terms of latency and the number of delivered bePSOns. An algorithm influenced by human genetics is used to increase the efficiency of VANET clustering with in GA-PSO VANET clustering protocol. PSO uses the GA results to determine which features to deploy. On 4000 × 4000 m & 1000 x 1000 m grids, it surpassed PSO, CLPSO, and MOPSO. There isn't any consideration made in the simulation, however, for areas of network coverage that fall somewhere in between. Static control weights are also used in this manner, as they have been in previous systems. There are a wide variety of communication contexts where dynamic control weights might be useful. VANET clustering may be improved by using an effective naive Bayesian inference estimate technique for traffic flow (ANTSC). Artificial intelligence (AI) is used in this procedure. TFB & VANET clusters are much less stable than ANTSC across a wide range of network situations. When it comes to delivering effective clustering solution in communication contexts, the ANTSC technique fails. Stability is improved by using a 5G-VANET in conjunction with the infrastructure-based method. In order to improve network performance, this technique picks dual CHs. Even though it outperforms no clustering with centralized clustering solutions, it is not presently the most practicable technique for 5G-enabled networks. For grasshoppers at different life stages, researchers say GOA is one of the most sophisticated swarm-based algorithms known. In the larval stage of grasshopper growth, large-scale and quick motions are critical for food hunting and social interaction. A VANET cluster protocol uses this mechanism for the first time. "GOA" is a method for maximizing the clusters produced by VANET swarming. FANET and 5G possibilities were examined in the second case study, which used a larger Unmanned Air Vehicle-based flying backbone environment.

The term "cluster" refers to a collection of automobiles that have specific qualities in common with one another. It is possible for it to be widely spread or highly concentrated in a single location. The first mode of operation for the cluster involves there being no controlling node. In a network, the nodes are the entities that are in charge of both management and communication. Second, a vehicle that has been designated as a CH is tasked with the responsibility of centralizing communication and network administration, which ultimately results in an improvement in the system's resilience.... When it comes to clustering, there are many different approaches that may be taken to address problems with VANET. They rely on methodologies that have only been tested in MANETs in many different instances. Both strategies, despite their distinct features, are incapable of functioning normally inside the confines of a VANET. In particular with regard to MANETs, VWCA is an approach. The WCA is an improved and more modern variant of older and more conventional approaches such as the VWCA. The weighted cluster matrix that is used by the VWCA additionally takes into account scores for entropy and mistrust. As was mentioned before, VWCA has regularly outperformed the competitors in a wide variety of settings. The previous mechanism's solutions are used to define the weights used in this mechanism as well. Not suitable for use in VANET scenarios. The HyBR notion served as the impetus for this, which ultimately resulted in the development of a routing protocol that included VANET security applications. For the purpose of demonstrating a bio-inspired technique for unicast routing over VANETs, a bee swarm is utilized. When bio-inspired algorithms are used with more conventional geographical routing methods, the potential for improved safety applications is increased. It has been demonstrated that every single one of these protocols is superior under particular circumstances; however, HyBee has replaced them all. It only looked at grids that were 1000 meters by 1000 meters. The number of clustering patterns that were produced was insufficient. The binary communication between artificial bee colonies can be improved with its use (BABCs). A spanning tree is utilized so that there is no need to reroute communication. At the same time, a single hit predictions parameter has the potential to simulate up to sixteen nodes all at once. The Kruskal algorithm is dynamic and evolutionary, which is what allowed BABC to outperform the other companies in the competition. The only accurate method of measuring performance is called vehicle-to-roadside testing (V2R). The authors propose yet another method that is based on swarms in order to locate the most efficient VANET paths. In conjunction with the ant colony optimization (PSO), the multi-objective particle swarm optimization, also known as MPSO, is utilized (MOPSO). It outperformed two other ways in terms of giving the fewest feasible CHs across a variety of network topologies and performed better than both of those other approaches. Despite this, more recent protocols, such as and, use SI methods. The optimisation algorithms, such as dragonflies and grey wolves, that may be found in more recent procedures, such as and, also use SI methods. When compared to other strategies, it was demonstrated that these methods had a better performance than CLPSO, MOPSO, and PSO. When it comes to grouping together highway vehicle nodes, the dragonfly optimizer suggests using GWOCNET and CAVDO (CAVDO). The Internet of Vehicles (IoV) matching game serves as a tool for analyzing the Internet of Vehicles' one-of-a-kind clustering algorithm. It is possible that the cluster head and the remaining nodes will be able to keep their match by utilizing this strategy. Only communication between individual vehicles would fall under the purview of the coalitional game theory. In addition, ad hoc networking is utilized by vehicles so that they can keep themselves apprised of their surroundings at all times. The relevance of clustering is something that wireless networks of the next generation need to take into consideration. Clustering-based lowering latency routing algorithms are utilized by the PSO technique in order to enhance the quality of service provided by VANET (QoS). This protocol is quicker and more trustworthy in terms of latency and the amount of bePSOns that are delivered, whereas AODV consumes more energy and has a lower degree of dependability. Within the GA-PSO VANET clustering protocol, an algorithm inspired by human genetics is employed to boost the efficiency of VANET clustering. This helps ensure that the protocol is as effective as possible. The findings of the GA are used by PSO to decide which features should be deployed. It outperformed PSO, CLPSO, and MOPSO on grids measuring 4000 by 4000 meters and 1000 by 1000 meters. The simulation, on the other hand, does not take into account any regions of network coverage that lie anywhere in the middle. In this fashion, static control weights are also utilized, just as they were in the systems that came before this one. The application of dynamic control weights could be beneficial in a wide range of different communication scenarios. The clustering of VANETs could be made better by employing an efficient naive Bayesian inference estimation method for the flow of traffic (ANTSC). In order to complete this process, artificial intelligence (AI) is utilized. TFB and VANET clusters are significantly less stable than ANTSC clusters in a considerably wider variety of network circumstances. The ANTSC technique is not successful when it comes to giving an efficient clustering solution in communication-related scenarios. The infrastructure-based strategy, when used in conjunction with a 5G-VANET, results in an improvement in the network's stability. This approach chooses dual CHs so that the performance of the network can be improved. Even if it has better performance than not clustering at all with centralized clustering solutions, it is not the most practical method for 5G-enabled networks at the present time. Researchers believe that GOA is one of the most advanced swarm-based algorithms that are currently known to exist for grasshoppers at various phases of their lives. During the larval stage of grasshopper development, it is essential for the grasshopper to make large-scale and rapid movements in order to successfully forage for food and interact socially. This method is being used for the very first time in a VANET cluster protocol. The acronym "GOA" refers to a strategy for increasing the number of clusters created via VANET swarming. In the second case study, which used a more expansive flying backbone environment based on unmanned aerial vehicles (UAVs), FANET and 5G were also investigated as possible solutions.

3. MATERIALS AND METHODS

3.1 WIRELESS COMMUNICATIONS

Among today's most hotly debated IT concerns are mobile, wireless, and ubiquitous technology. With the growth of mobile telephony, broadband and wireless networks, mobility and computing across multiple platforms and devices become increasingly feasible. The IT industry has carried out intense dissemination of these technologies, arguing that they enable the so-called "Mobile Business" (m-business). Despite certain restrictions regarding cost, availability, universal standards and security, Mobile and Wireless Information Technologies are propagated worldwide and, in the same way, , the number of cell phones (57 million) has already surpassed the number of landlines. Several companies are already installing Internet access services via wireless link in different environments, such as airports, cafes, hotels, especially in the country's capitals. In addition, laptops and PDAs (Personal Digital Assistants), recently produced, are already suitable for using wireless networks. Smart phones (cellular phones and PDAs with Internet access in a single device) begin to be sold in the country. Cell phones are becoming more sophisticated, moving to 2.5 and 3rd generation calls. There has been an increase in the usage of RFID (Radio Frequency Identification), particularly in retail environments. A growing number of businesses are turning to WLAN (Wireless Local Area Network) networks and mobile data connectivity to assist their commercial activity and customer service out in the field. In light of the increasing usage of these technologies, many issues about their conception, selection, adaptation, and repercussions of use have come to light. When it comes to the phrases "mobile," "wireless," "ubiquitous," and "mobile commerce," there is a lot of uncertainty since these concepts are so new (m-business). These phrases are employed in abundance, both in the market and in academic research, frequently without a clear description of their meaning, as will be shown below. Most experts agree that one of the best ways to learn more about this subject is to look for more exact definitions of common terminology. Additionally, it's critical that we track what kinds of study are being conducted in this area, and the future research that still remain, given these technologies' potential. An important aspect of a mobile, wireless, and ubiquitous information technology study is mapping the current state of the art and defining the major ideas associated with these technologies, as well as identifying research possibilities on this topic. To achieve this objective, a survey was carried out on the existing literature on these technologies. Thus, in the next section, the research method is presented; then, the analysis of the data, trying to reach the definitions of the terms cited in the literature and the identification of the main themes approached, as well as the research methods used. In the following section, production on the subject of study is made. Based on these analyses, the conclusions of the study and indication of opportunities for future research are presented. The sixth section lists all the articles researched via the Survey and the final section indicates the production analyzed and other bibliographic references used.

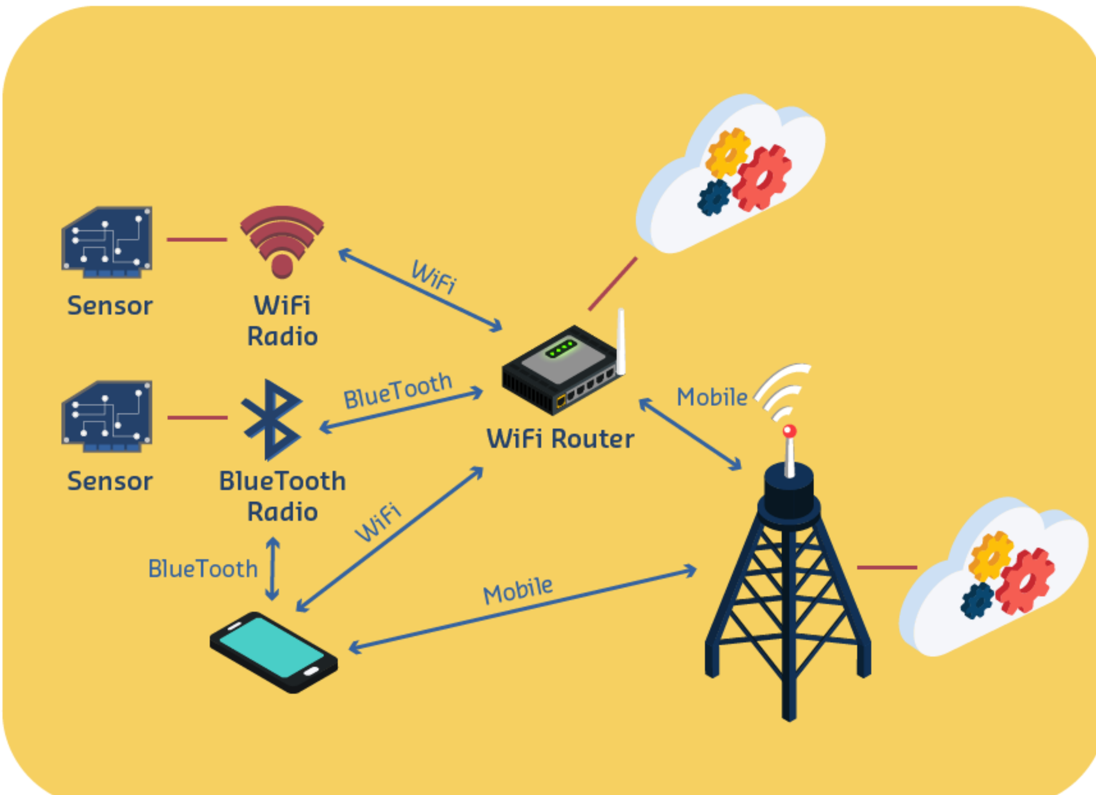

Figure 3.1: Mobile Wireless and Ubiquitous Information Technologies [21]

3.1.1 Manet

Wireless mobile networks, known as Mobile Ad-hoc Networking (MANET), are the subject of RFC2501, which focuses on the performance assessment of communication protocols used in these networks. Evolving from Mobile Packet Radio and Mobile Mesh Networking, according the author, Nodes in this network are tied to a single location, allowing them to connect and disconnect in whatever manner they see fit. All of the network's nodes share in the burden of managing and organizing it. As for the second, it is described as "a self-contained system of mobile devices (also functioning as routers) linked by wireless connections, the union of which constitutes a communication network modelled in the form of arbitrary graphs." Nodes, the shorthand for these mobile devices, may be found on everything from aircraft and ships to trucks and vehicles, or even on individuals and extremely tiny electronics. For example, a battalion of tanks on a battlefield may need quick communication in a dangerous and loud environment, without no time and money to build a wired infrastructure. This form of network is most often used in the military. Other conceivable uses include disaster relief, commercial and educational applications, and sensor networks. One or so more pairs of nodes may be unable to connect directly since they are outside of the network in a mobile ad - hoc network, usually known as just a peer-to-peer network. Each other's compass range In spite of this, it is possible for these two nodes to communicate, but only with the aid of intermediate nodes that are ready to pass along the information. It's common for these networks to include routers that identify & maintain routes to these other nodes. The number of hops required to allow communication between two specified nodes in such a mobile ad - hoc network relies just on number of intermediary nodes employed to do this. This sort of network necessitates the use of intermediary nodes to store and route data packets from their point of origin to any destination. It is essential that all other nodes in the network be informed of any changes in network topology that occur when a node relocates. Because all of the nodes in the network are capable of routing & retransmitting packets, these network are fault robust and can survive the loss of stations (nodes). Adding more nodes to these networks is also a cinch. Cellular networks, on the other hand, employ a single-hop network paradigm, in which the base station serves as just a fixed entry point between both the sender and receiver devices. The cable backbone & fixed base stations are the only means of communication between two nodes in these networks. On the other hand, in a wireless ad - hoc mobile network, there really is no infrastructure as well as the network topology may vary constantly, unpredictably, since nodes can freely relocate.

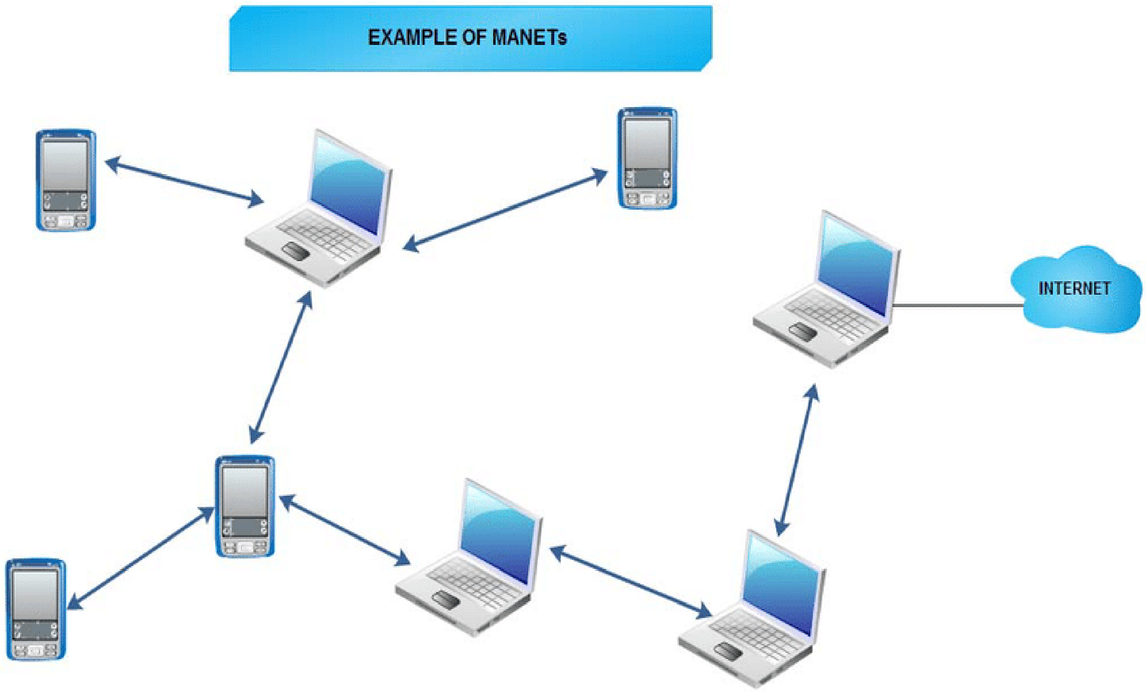

Figure 3.2: Mobile Ad Hoc Networking Example [22]

RFC2501 addresses the problem of Mobile Ad-hoc Networking (MANET), which is sometimes referred to as wireless mobile networks. The purpose of this document is to evaluate the performance of the communication protocols that are used in wireless mobile networks. This network is said to have originated from Mobile Packet Radio and Mobile Mesh Networking, as stated by the author. The nodes that make up this network are each connected to a specific location; however, this does not restrict them in any way in terms of their ability to associate or disassociate themselves from other nodes in the network as they see fit. Every node in the network is partially responsible for the management and organization of the network as a whole. When it comes to the second, it is referred to as "a self-contained system of mobile devices (also working as routers) linked by wireless connections, the union of which forms a communication network modelled in the form of arbitrary graphs." Nodes is a shorthand term for these mobile devices, which can be positioned anywhere from airplanes and ships to trucks and automobiles, or even on humans and extremely small gadgets. The word "node" is used interchangeably with "nodes." On each of these items, there are nodes waiting to be discovered. For instance, a battalion of tanks on a battlefield may require rapid communication in an environment that is both dangerous and noisy, but they may not have the time or money to construct a cable infrastructure. In this case, wireless communication may be the best option. The military is the industry that has the most need for this kind of network and uses it the most frequently. There is a good chance that this technology might also be used for a variety of other purposes, including disaster relief, corporate applications, educational applications, and sensor networks. It is possible that one or more pairs of nodes within a mobile ad hoc network, which is more commonly known as simply a peer-to-peer network, will be unable to connect directly to one another due to the fact that they are located outside of the network. This scenario can also occur within a peer-to-peer network. within each other's respective compass ranges each and every time In spite of this, it is still possible for these two nodes to communicate with one another; but, in order to do so, it is necessary to utilize intermediate nodes that are willing to forward the information along. It is not unusual for these kinds of networks to incorporate routers, which are devices that discover and keep track of routes to other nodes inside the network. The number of hops that are required to permit communication between two specific nodes in a mobile ad hoc network is only defined by the number of intermediary nodes that are utilized to achieve this task. This is the only factor that governs the number of hops that are required. Because of the characteristics of this kind of network, it is essential to make use of intermediate nodes in order to store and transmit data packets between the point of origin and any destination. These packets can be sent to any location. It is essential that all of the other nodes in a network be informed of any changes that may occur to the topology of the network whenever one of the nodes in the network moves to a new location. This is because the topology of the network may be altered as a result of the relocation. Because every node in the network has the capability to route and retransmit packets, these networks are fault-tolerant and able to continue functioning even after the loss of stations. This is made possible by the fact that every node in the network has the ability to reroute packets (nodes). Adding new nodes to these networks is a piece of cake as well, and there's no reason not to. On the other hand, cellular networks make use of a network model that is known as a single-hop network. In this model, the base station just serves as a fixed entry point between the many devices that are used to send and receive information. The cable backbone and the fixed base stations are the only means by which two nodes in one of these networks can communicate with one another; any other means, such as wireless, are ineffective. On the other hand, in a wireless ad hoc mobile network, there is almost no infrastructure, and the topology of the network may change frequently and in an unpredictable manner due to the fact that nodes are free to go wherever they like. This is because there is no central location for the nodes to connect to.

3.1.2 Vanet

While some authors indicate that 2G/2.5G/3G/4G cellular networks are standard for VANET networks, at the present time there is no technical evidence of its application as long as it is using 5G technology. -defined networking (SDN) is only designed to support VANET networks. Therefore, in this article we only give an account of the standards that effectively work for the vehicular networks. An allocation of 5,850-5,925 GHz spectrum has been made by the Federal Communications Commissioned by the United States (FCC) principally for vehicle communications. Similar groups exist in both Europe and Japan. Vehicle communication is de facto in an emergent stage, as shown by the Communications Dedicate's (DSRC). IEEE 802.11p is the name given to DSRC, which is based by IEEE 802.11 technology. DSRC's function is to assist communications systems in handling large amounts of data transmission. Toll costs, security messages between cars and the like are only a few examples of the types of information that may be sent between vehicles through these interactions. The DSRC standard's broad bandwidth and ability to use several channels make it appealing. In accordance with IEEE standards, several channels at 10 MHz, each capable of conveying 27 Mbps of data, are proposed for automotive communications. It is expected that one of the seven 5.9 GHz channels is reserved for security purposes.

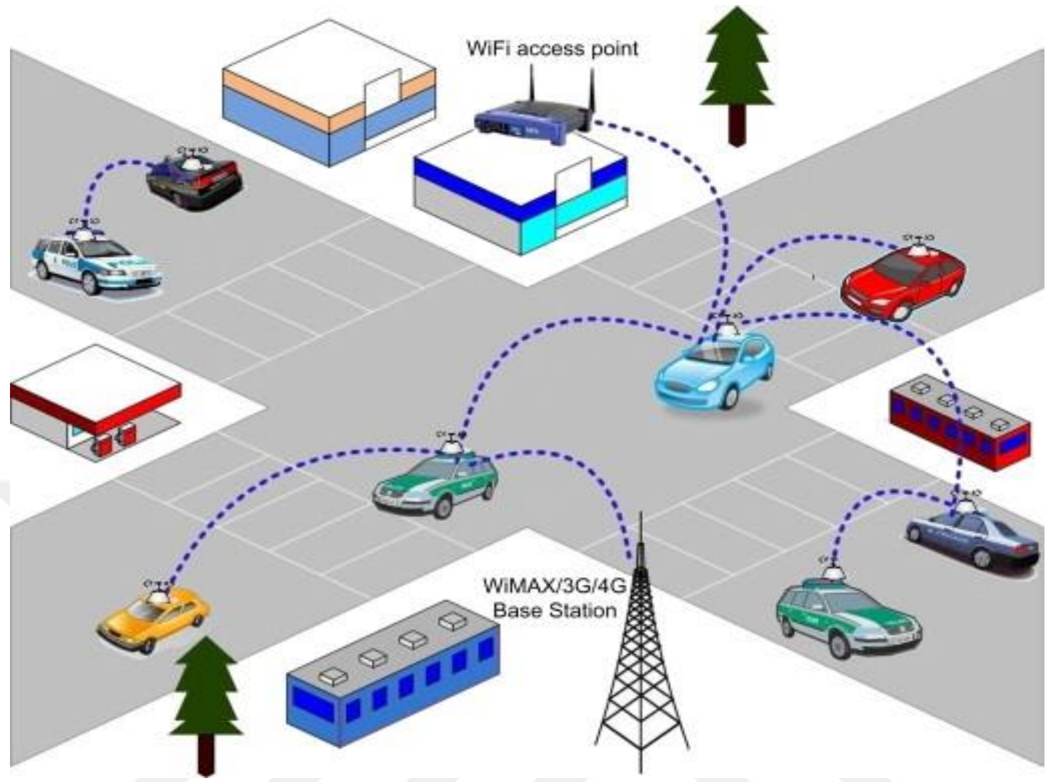

Figure 3.3: Vehicular Ad-Hoc Network Example [34]

Although some authors claim that 2G/2.5G/3G/4G cellular networks are the norm for VANET networks, there is currently no technical evidence to support this assertion as long as the technology in question is 5G. This is the case even though some authors make the claim. The software-defined networking (SDN) protocol can only be used to support VANET networks due to its design. Because of this, the only standards for vehicular networks that will be discussed in this article are those that have been proven to be successful in practice. The Federal Communications Commission has assigned spectrum with frequencies ranging from 5,850 to 5,925 GHz. Commissioned by the Federal Communications Commission of the United States primarily for use in car communications. There are groups that are analogous to this one in both Europe and Japan. The Communications Dedicate's data demonstrates that the communication between vehicles is currently at an emerging stage (DSRC). The technology known as DSRC is referred to as IEEE 802.11p, and it is based on IEEE 802.11 technology. The purpose of the DSRC is to provide assistance to communications networks so that they can manage the transmission of massive amounts of data. These interactions can allow for the transmission of a wide variety of information between vehicles, some examples of which include toll costs, security messages between cars, and other similar forms of information. Attractive features of the DSRC standard include its expansive bandwidth and its adaptability to multiple channel configurations. For vehicle communications, it has been proposed to use a number of channels operating at 10 MHz, each of which is able to transmit data at a rate of 27 Mbps. These channels would comply with IEEE standards. It is to be anticipated that one of the seven channels at 5.9 GHz will be set aside exclusively for use in security-related communications.

Users will get content and services through the existing distribution channels. DSRC in Europe and Asia is not limited to IEEE 802.11p, but there are a number of various levels in terms on type of communication, radio frequency band utilized, the number of channel and thus separation, data transfer speed, coverage, and just modulation. A 5 GHz brief communication access (MAC) and physical cover parameters of ASTM E2213-03, the specifications for telecommunications and information exchange between roadway and vehicle systems, are yet another standard (PHY). As well as forming a globally acknowledged floor known as the IEEE 1609.x (WAVE). Using the IEEE 1609 standard, wireless communication systems may have their communication models, security mechanisms, management structures, physical access, and overall architecture defined (RSU, OBU). The 5G architecture must also incorporate microcells, microcells, etc. since it is heterogeneous. A wireless 5G cellular network's small cell idea includes aspects of both basic mobile phones and small cells. 5G if you are planning to meet users with high mobility, who are inside high-speed cars or trains. The small cells in the mobiles are placed inside the cars or trains and the movement to communicate with the users inside the vehicle, while a massive MIMO unit, which consists of sets of antennas, is placed outside to communicate with the base station. In view of this characteristic of 5G, investigations have been carried out in a recent way to integrate VANET networks with the 5G architecture.

3.2 ROUTING PROTOCOLS

The network layer's primary duty is to transport packets from their source to their destination. Before packets reach their final destination, the majority of networks route them via a huge number of routers. To ensure that packets reach their final destination, the algorithms make advantage of the pathways provided by neighboring routers. The routing algorithm, which is included in the network layer software, determines which output channel should be used to convey the input packet while it is being sent. There are several autonomous systems available on the Internet (SAs). Each SA is administered by a distinct organization, which utilizes its own internal routing algorithm to carry out its obligations. For example, Asses inside a single AS utilize the internal gateway protocol, but Asses outside a single AS use the outer gateway protocol. Internal router protocols, sometimes referred to as intra-AS routing protocols, are a subset of routing protocols (IGPS). To satisfy the company's objectives, each existing routing protocol as well as the provider's network assets have to be analyzed and compared separately in order to choose the best alternative to deploy. When an IP datagram is received on the same network or subnet as the source, an IP network's routing algorithm tries to route it straight to the source IP address, effectively resolving the source IP address to the destination IP address. If the destination IP address is not found in the routing table for the same subnet as the source IP address, a message is returned, and the IP datagram is forwarded to the intended destination as a consequence of the message. This site is currently unavailable. Route tables are maintained using the routing protocols that are utilized inside an AS. The Router Information Protocol (RIP), Open Shortest Path First (OSPF), and EIGRP are three of the most extensively used routing protocols for autonomous systems (ASs) today (enhanced inner gateway routing protocol). When the University of California (Berkeley) developed RIP (Routing Information System) in 1982, it was the first widely available intra-AS routing protocol. Today, RIP is still in use. IP addresses are used to communicate consistently across several devices about the availability of your local networks. There are just a few minor alterations to the original Xerox Network Systems (XNS) design, from which both the name and predecessors derive. The Bellman-Ford algorithm, which was inherited from the ARPANET network, formed the basis of the Internet protocol's initial iteration. The acronym RIP stands for distance vector protocol (DVP). It functioned effectively on local networks, but as the Internet increased in size and complexity, this protocol developed issues. In the RFC 1058 version of RIP, the hop count is utilized as a cost measure, and each hop is given a cost of one. The acronym RIP stands for distance vector protocol. Because the maximum cost of a route is limited to 15 hops, it is inapplicable not networks with more than 15 hops. Every 30 seconds, routers in close proximity send routing information as part of the Cisco-developed distance vector protocol (DVP). Due to the network's scale, RIP had difficulty counting to infinity, resulting in unpredictable unstable slow convergences.

The biggest advantage of the RIP protocol is the simplicity of implementation, but on the other hand, it has a wide range of issues, including:

a. The maximum number of fifteen hops, therefore, it is not indicated for complex distributed networks.
b. The hop count metric is not always really the best way to go between links.
c. Bandwidth consumption occurred by broadcast, occurred every thirty seconds to exchange information for each router.
d. Does not provide a view of the entire network topology.
e. Slow convergence time, generating inconsistency in the routers' routing table.
f. Routing choices are based only on the number of hops in the network.

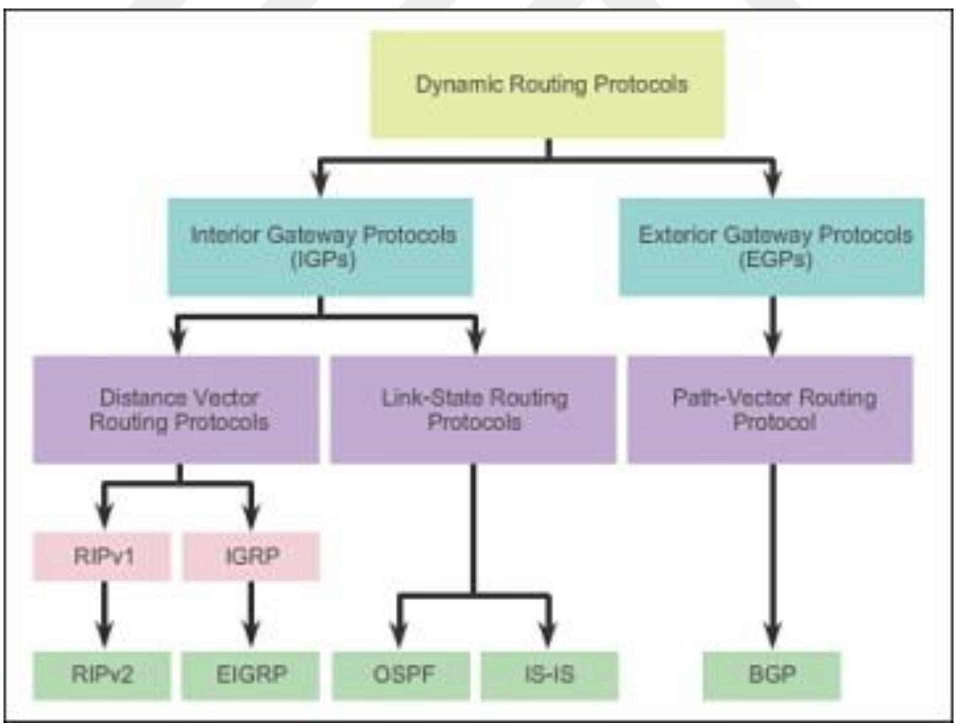

Figure 3.4: Routing Protocols in Vector Routing Protocol [34]

The transmission of data packets from their point of origin to their ultimate destination is the most significant duty that is delegated to the network layer. The vast majority of networks route data packets to their final destination by passing them via an exceptionally high number of routers along the way. The algorithms make use of the pathways provided by neighboring routers in order to guarantee that data packets arrive safely at their intended location after making their way across the network. The routing algorithm, which is part of the software that makes up the network layer, is in charge of determining which of the network's output channels should be used to carry the input packet while it is being transmitted. This decision is made while the packet is being sent over the network. The Internet enables users to access a diverse range of independent systems in their preferred format (SAs). The management of each SA is handled by a different organization, and in order to carry out the tasks that have been delegated to it, each organization makes use of the one-of-a-kind internal routing algorithm that it has devised. For instance, autonomous systems (ASes) that are included within a single AS utilize the internal gateway protocol, whereas autonomous systems (ASes) that are not included within a single AS utilize the outer gateway protocol. Internal router protocols are a subclass of routing protocols that can be found in computer networks. The term "intra-AS routing protocols" may also be used to refer to these protocols (IGPS). Before a choice can be made regarding which alternative is the superior one to put into operation in order to satisfy the objectives of the company, each existing routing protocol and the provider's network assets need to be analyzed and compared on their own. When an IP datagram is received on the same network or subnet as the source, the routing algorithm of an IP network will attempt to route it directly to the source IP address in order to resolve the source IP address to the destination IP address. This occurs when an IP datagram is received on the same network as the source. When an IP datagram is received on the same network or subnet as its source, this condition is triggered. If the destination IP address cannot be discovered in the routing table for the same subnet as the source IP address, a message is sent back to the sender of the IP datagram. This message is sent back to the sender of the IP datagram. Following the delivery of the message, the IP datagram will be transmitted to the location that was originally planned for it. Due to unforeseen technical difficulties, access to this website is presently unavailable. The route tables in an AS are kept up to date through the utilization of the various routing protocols that are present within the AS. Today, the three routing protocols that see the most widespread use in autonomous systems (ASs) are the Router Information Protocol (RIP), Open Shortest Path First (OSPF), and Enhanced Interior Gateway Routing Protocol (EIGRP). RIP stands for Router Information Protocol; OSPF stands for Open Shortest Path First; and EIGRP stands for Enhanced Interior Gateway Routing Protocol (enhanced inner gateway routing protocol). It was the first intra-AS routing protocol that was publicly available when RIP (Routing Information System) was established at the University of California, Berkeley, in 1982. People continue to use RIP even in this present day and age. IP addresses are the means through which devices that are connected to the same local network can communicate with one another in a standardized manner about the availability of the network. This communication can take place between any two devices that are connected to the network. The original blueprint for the Xerox Network Systems (XNS), from which both the name and the blueprints that came before it are derived, has undergone just a few minor modifications over the course of its existence. The Bellman-Ford algorithm, which was originally developed for use on the ARPANET network and later included into the Internet as part of its legacy, served as the basis for the first iteration of the Internet protocol. When reduced to its abbreviated form, "distance vector protocol" is what "RIP" refers to (DVP). This protocol performed admirably on local networks; however, as the scale and scope of the Internet continued to expand, issues with its operation on the global network began to emerge. The RFC 1058 implementation of RIP employs the hop count as a cost measurement, and each hop is given a cost of one. This makes the total cost of the network equal to the hop count. Because of this, the total cost of using RIP is the same as the hop count. The abbreviation "RIP" refers to the distance vector protocol, which is what it stands for. It is inapplicable to networks with more than 15 hops since the maximum cost of a route is capped at that number. This causes it to be inapplicable to networks with more than 15 hops. Routers that are physically close to one another and are connected by Cisco's distance vector protocol exchange routing data with one another once every 30 seconds (DVP). RIP had difficulty counting to infinity due to the magnitude of the network, which resulted in unpredictable unstable sluggish convergences.

3.2.1 Aodv

When it comes to mobile networks, AODV is one of the protocols that may be used. The AODV protocol, one of several wireless ad hoc routing methods now being developed by networking specialists, is one such example. These protocols need the development of tools that can mimic them. In an effort to replicate a scalable mobile ad hoc networks network, I developed the AODV protocol I've optimized the code to scalability by using a unique Java modeling method. To reduce the number of REQ packets delivered, my approach (expanding ring search) was developed. I also tried to reduce RAM use by decreasing event count, buffer size, and removing expired data from the database. Not to mention using high-performance data structures like hash tables. The code seems correct. Simulators were used throughout the development process to ensure code was tested and hardened. These sections describe the protocol's architecture, performance metrics, and code overview for future developers.

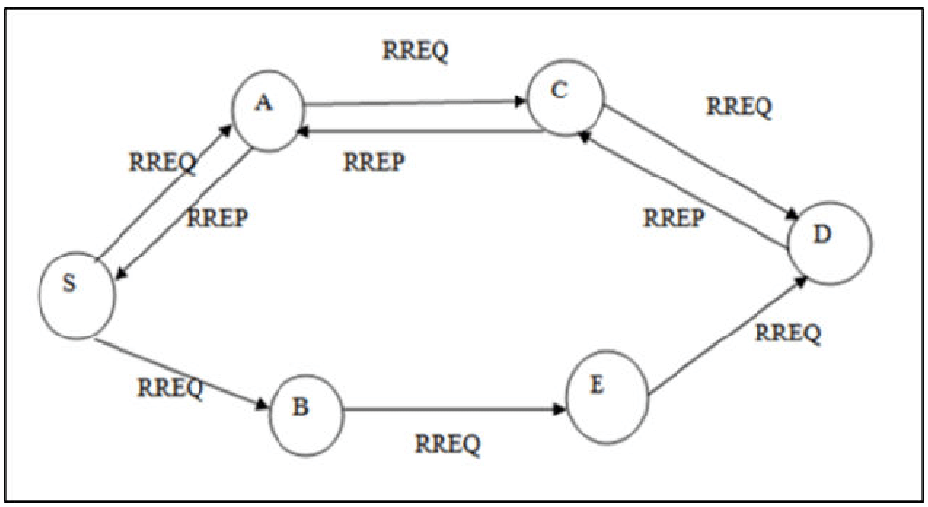

Figure 3.5: Ad Hoc on Demand Vector of Distance [36]

a. According to the Request, the Route requests are stored in a buffer.

Almost invariably, once a node sends or receives a route request from its neighbors, it receives a comparable message. Routing requests are stored in the buffer of each node. This buffer retains previously broadcast route requests, reducing duplication (leading to endless cycles). A node regularly checks its buffer for RREQ messages. Nodes that transmit RREP messages will also receive RREQ messages. If this is done, a node cannot broadcast multiple RREPs in response to identical RREQs received on different channels. If a node receives an RREQ from the network with a better route, it will resend it to the network (i.e., fewer hops). The route request buffer contains an identification for the route request and the node that submitted it (RREQ id). The RREQ identifier distinguishes requisitions from a single node. As a result, each network node may uniquely identify a request using its IDs. To keep route request buffers small, entries are automatically removed after a specified period. Also, each node's buffer has a set amount of available space. Older nodes are removed to make place for newer ones.

b. Extending the Ring-Searching Operation

Because a route request might effect any node in the network, the previous flooding strategy is not scalable. This is not a serious concern if the network is tiny. This approach may be wasteful if the destination node is near to the RREQ originator, which is particularly true in large networks. You may guarantee that RREQ messages reach their intended recipients on time by setting the TTL value to a low enough number. Even if a node has a complete network connection, computing the appropriate TTL is difficult. To address this issue, an expanding ring search was created. The RREQ message is sent by the node that originally began the TTL request (say, 1). If an RREP message is not received within an acceptable amount of time, an RREQ message is issued with a longer TTL delay to assure receipt (and also a new RREQ identifier to distinguish the new request from the old ones). The only way to resolve this is to continue sending messages with increasing TTL and RREQ ID values until one is received. If the route request TTL exceeds the threshold and the location does not get any RREP signals, it is considered unreachable. The system deletes any and all communications that have been queued for this address.

c. A series of numbers

Each destination's logical time is preserved by the use of a monotonically growing sequence number (node). Additionally, a destination sequence number may be obtained for each route record by noting when the route began and when it arrived at the destination node. Due to the protocols use of sequence numbers, nodes may only update routes with "newer" versions. In this approach, there are no loops in the routes leading to a destination. Each RREQ broadcast includes the source and destination sequence numbers. When a new record is produced with a greater number than the previous one, the node to the new record modifies the route to the source. If a node gets a duplicate RREQ message from another source, it will take the shortest route to the destination. The receiving node may use the sequence number of the route to assess if it is "fresh enough" to respond to an RREQ message and so should be utilized. To send RREQ messages, the maximum destination sequence number must be greater than the total number of nodes traversed so far. Due to the unusual nature of this route, we send an RREP to the originator as a precautionary measure. The RREQ and RREP messages include the destination sequence numbers. To update a routing table item, it is possible to get the most current destination sequence number for each node.

3.2.2 Maodv

Wireless Mesh Networks (WMNs) are a new technology with a diverse range of potential applications, and academics and business leaders are increasingly focused on them. Nodes in WMNs have the potential to self-organize and self-con in order to autonomously create an ad-hoc network and keep it connected to the mesh in real time. Mesh clients and mesh routers, both of which have limited mobility, form the backbone of wireless mesh networks (WMNs). The mesh network's routers enable devices in both mesh and non-mesh networks to connect to the network concurrently, which benefits both. Additionally, a client mesh network may be constructed using mesh clients, both fixed and mobile. Due to its broadcast capabilities, WMNs are an excellent choice for interacting with a large group of people in a concentrated area. If nodes employ multicast routing protocols, they may be able to identify one another's routes more quickly. Multicasting considerably reduces the overhead associated with a single-cast routing scheme. Multicasting allows several users to receive the same broadcast simultaneously, hence increasing network capacity and overall performance. It is becoming more customary to deploy many broadcasts at the same time. Distance Vector Multicast Routing Protocol (DVMRP) is the first protocol in the TCP/IP stack to support multicasting. The MOSPF, CBT, and protocol-independent multicast routing for sparse multicast networks are only a few of the several multicast protocols that have been created for dense and sparse multicast networks, respectively. Routing in ad-hoc networks is more difficult than routing in traditional wired networks due to the frequent topological changes that occur in these networks. Routers must be designed with a variety of factors in mind, including energy consumption and bandwidth limits. Numerous approaches have been offered in this context to enable multicasting: MAODV and the Ad hoc Multicast Routing Protocol (AMRP) are two such protocols (AMRoute). Both the On-Demand Multicast Routing Protocol (ODMRP) and the Core-Assisted Mesh Protocol (CAMP) have been offered as potential alternatives to today's network design (CAMP). Multicast routing protocols are classified into two types: proactive and reactive multicast routing systems. According to their setup, active protocols lead all nodes in a dispersed network to their final destinations, even nodes outside the network. The phrase "table-driven methods" refers to proactive measures in general. DVMRP, MOSPF, and PIM are all proactive multicast routing technologies. On the other hand, reactive strategies are more concerned with the conveyance of information. When data packets are required to be transmitted between locations, routes are supplied; however, when they are not, no routes are provided. In certain domains, on-demand methods are also referred to as reactive tactics. ODMRP, MAODV, and other types of reactive therapy are examples of these kind of treatments. In contrast to earlier techniques, hybrid tactics mix proactive and reactive measures.

Wireless Mesh Networks, or WMNs for short, are a relatively new technology that has the potential to be utilized in a broad range of contexts thanks to its adaptable nature. As a direct consequence of this, researchers and influential businesspeople are devoting an increasing amount of attention to them. The nodes that make up WMNs have the ability to self-organize and self-configure, which enables them to construct an ad-hoc network on their own and ensure that it remains linked to the mesh in real time. The ability to "self-organize" is another name for this skill. Mesh clients and mesh routers, both of which have limited mobility, make up the core of wireless mesh networks. Mesh clients and mesh routers form the backbone of wireless mesh networks (WMNs). The capability of mesh network routers to simultaneously connect devices coming from non-mesh and mesh networks to the mesh network enables users of both types of networks to take use of the benefits offered by the latter. In addition, it is feasible to construct a client mesh network by making use of mesh clients, which may be mobile or fixed depending on the circumstances. Because of its broadcasting capabilities, WMNs are an excellent option for starting a conversation among a large number of people who are constrained to a small area. This is because WMNs make it possible to start such a conversation. It is feasible that the nodes will be able to more rapidly identify one another's routes if they are utilizing multicast routing protocols. This would make it possible for them to communicate with one another. When multicasting is utilized instead of a single-cast routing approach, the overhead that is normally associated with that method is greatly reduced.

The capability of several users to simultaneously receive the same broadcast is made possible by multicasting. This leads to an improvement in both the capacity of the network as well as its overall performance. The method of transmitting numerous transmissions at the same time is gradually developing into a standard business practice. The Distance Vector Multicast Routing Protocol, or DVMRP for short, is the first protocol in the TCP/IP stack to handle multicasting. Its full name is the Distance Vector Multicasting Protocol. Both dense and sparse multicast networks have required the development of a number of multicast protocols, such as MOSPF, CBT, and protocol-independent multicast routing for sparse multicast networks. These two varieties of multicast networks support a greater number of users in comparison to dense multicast networks. It is more difficult to route data via these sorts of networks than it is to route data through regular wired networks. This is because topological shifts occur more frequently in ad-hoc networks, making it more difficult for data to be routed through these kinds of networks. When constructing routers, there are a number of factors that need to be taken into account. Two of these factors are the amount of energy the router uses and the maximum amount of bandwidth that it can support. In this regard, a variety of tactics have been proposed in order to facilitate multicasting. MAODV and the Ad hoc Multicast Routing Protocol (AMRP) are two protocols that fall into this category and are examples of such strategies (AMRoute). The On-Demand Multicast Routing Protocol, which is also known as ODMRP, and the Core-Assisted Mesh Protocol, which is also known as CAMP, are both instances of possible replacements to the current design of networks. Both of these protocols are known as ODMRP and CAMP, respectively (CAMP). The various kinds of multicast routing protocols can be divided into two categories: proactive and reactive multicast routing systems. These are the categories that are used to classify the various multicast routing protocols. Active protocols in a distributed network direct all nodes in the network, including nodes that are not part of the network, to their respective final destinations, as their setup specifies. This includes nodes that are not part of the network. According to the explanation provided by the phrase, table-driven operations are a subset of proactive measures in general. DVMRP, MOSPF, and PIM are all types of technologies that are considered to be examples of proactive multicast routing. On the other hand, reactive strategies put less emphasis on the development of plans and more of a priority on the communication of information. If it is essential for data packets to be transferred from one location to another, then routes will be supplied; on the other hand, if the transfer of data packets is not essential, then there will be no routes provided. The terms "reactive tactics" and "on-demand techniques" can be used interchangeably in some situations; however, this depends on the nature of the situation. Treatments such as ODMRP and MAODV are two examples of medications that are included in this category. This category also includes other types of reactive therapies. [Citation needed] On the other hand, in contrast to the previous tactics, hybrid methods combine both proactive and reactive actions into a single strategy.

3.2.3 Clustering Based Routing

The Intelligent Transportation System (ITS), which covers all forms of vehicle communication, is a critical component of next-generation transportation. Along with safety applications, driving assistance features, and emergency alerts, passengers may access a range of ITS services. Vehicular Ad Hoc Network (VANET) has been created as a consequence of the MANET and is simply a self-organizing mobile ad hoc network (MANET). The VANET system is made up of Onboard Devices (OBUs) that are capable of communicating with one another (V2V communications) as well as with stationary road-side units (V2Is) strategically positioned along roads. While VANETs use less energy than MANETs, they are distinguished by their high mobility, predictable and constrained mobility patterns, quick network topology change, and frequent battery charging. VANET It was developed as a revolutionary technology with the objectives of working effectively inside continuously changing networks, promoting quick connection setup, and minimizing communication delay. DSRC is a novel technology in its infancy. To assure the dependability of safety applications, the DSRC was built with the time restrictions associated with this kind of application in mind. In the United States, DSRC technology will be enabled in V2V and V2I applications due to the Federal Communications Commission's (FCC) allocation of 5.9GHz for DSRC purposes. The frequency separates the 5.850-5.925 GHz band into seven distinct 10 MHz channels that do not overlap. The DSRC must be used to facilitate data transfer over VANETs, where responsiveness and high transmission rates are critical. The IEEE 802.11p and IEEE 1609 wireless access protocols are used to connect VANETs to the Internet. According to IEEE 802.11p regulations, automobiles are permitted to broadcast GPS-based location information, as well as velocity and acceleration. VANET communicates with its users using a variety of routing protocols, including proactive and geographic-based routing protocols. Prior to initiating data transmission, Topology-based routing systems, such as proactive and reactive, aim to discover the shortest route between two points on a network. As a result of the proactive routing protocol's increased control messages and end-to-end latency, each node on the network is obliged to undertake route discovery. When reactive routing is employed, a source node initiates the discovery process, which is subsequently used to reach the destination. While route discovery is still necessary for each new node, this strategy reduces the control overhead messages.

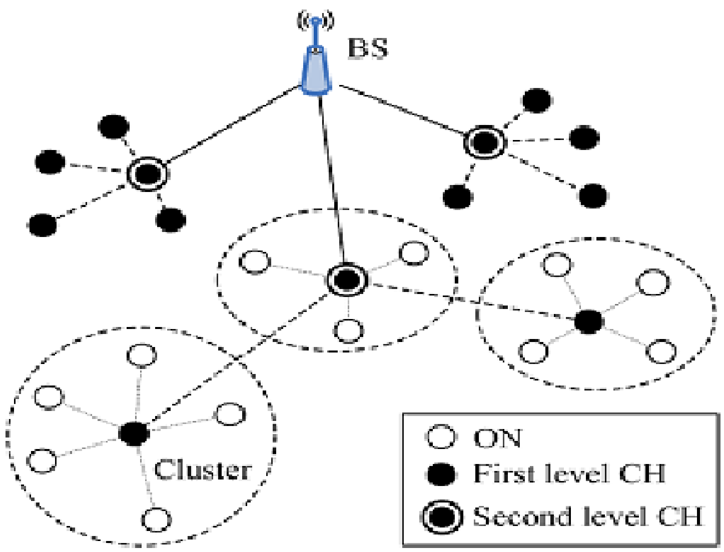

Figure 3.6: Clustering Technique in Wireless Network ***[42]***

The Intelligent Transportation System, sometimes known as ITS for its acronym in full, is an important part of the transportation system that will be used in the next generation. This system incorporates all different ways in which vehicles can communicate with one another. Passengers have access to a wide range of ITS services, some of which include access to safety applications, driving assistance features, and emergency notification systems. The Mobile Ad Hoc Network (MANET) was the impetus for the development of the Vehicular Ad Hoc Network (VANET), which is a type of mobile ad hoc networking that operates on its own without the need for centralized administration (MANET). The VANET system is composed of Onboard Devices, sometimes referred to as OBUs. These devices are the fundamental components. These OBUs are able to communicate with one another using a method known as vehicle-to-vehicle (V2V) communications, as well as with stationary road-side devices that are known as V2Is, which are strategically positioned along roads. VANETs are differentiated from MANETs not only by their lower energy consumption, but also by their greater mobility, mobility patterns that are both predictable and limited, rapid network topology change, and frequent battery recharge. Additionally, VANETs are characterized by their frequent battery recharge. VANET It was conceived as a ground-breaking technological innovation with the objectives of functioning effectively within dynamic network environments, fostering brisk connection establishment, and reducing the amount of time wasted in communication. These objectives were established with the expectation that they will bring about a paradigm shift in the sector. The DSRC is a completely novel technology that is just now entering its formative years. The DSRC was built with the time restrictions that are normally associated with applications of this sort in mind in order to ensure the dependability of safety applications. These time limits were taken into consideration during the construction of the DSRC. The United States will be able to make use of DSRC technology in vehicle-to-vehicle and vehicle-to-infrastructure contexts after the Federal Communications Commission (FCC) allocated 5.9GHz for use in DSRC applications. Because of the frequency, the spectrum from 5.850-5.925 GHz is separated into seven distinct channels, each of which is 10 MHz in size. This prevents any channels from overlapping with one another. When it comes to the transfer of data across VANETs, where both responsiveness and quick transmission rates are of the utmost significance, the DSRC is an unavoidable necessity. Utilizing wireless access protocols such as IEEE 802.11p and IEEE 1609 is necessary in order to connect VANETs to the Internet. According to the requirements of the IEEE 802.11p standard, it is permitted for autos to broadcast GPS-based position information in addition to information regarding their speed and acceleration. This provision is included in the language that describes the protocol. The users of VANET are able to communicate with one another thanks to the utilization of a variety of distinct routing protocols, including proactive and geographic-based routing protocols, amongst others. Topology-based routing systems, such as proactive and reactive, make an effort to discover the shortest path that connects two sites on a network before commencing to send data. This is done in an effort to maximize efficiency. They want to determine the quickest way to get there. Because the proactive routing protocol results in a higher number of control messages being sent and an increase in the end-to-end latency, it is necessary for every node on the network to participate in the process of route discovery. When reactive routing is used, the discovery process to get to the destination is started by a source node, and it is this process that is ultimately employed to get there. This means that when reactive routing is used, a source node is responsible for initiating the discovery process. Despite the fact that route discovery must still be performed for each new node, this method reduces the amount of control overhead messages that must be sent.

The hybrid routing system encapsulates the proactive and reactive components of traditional routing. Clusters are the nodes in a hybrid network that are clustered together. Hybrid routing methods, sometimes referred to as Cluster-Based Routing (CBR) protocols, allow cluster nodes to communicate with one another using a proactive routing protocol that utilizes a pre-selected set of Cluster Heads. This improves network scalability by allowing cluster nodes to communicate with one another using a proactive routing protocol that utilizes a pre-selected set of Cluster Heads. However, while communicating across clusters, the reactive routing protocol is used. The development of Geographic- or Location-based routing protocols is enabled by the combination of location data with topological information about the real road map and its surroundings. Geographic-based routing protocols send data instantly from the source to the destination, without the need for route discovery. As a consequence, each forwarding node makes the following assumptions: its present position (as determined by GPS), its neighbors' locations (as determined by the frequent exchange of Hello messages), and the location of the intended destination.

3.3 METAHEURISTIC ALGORITHMS

EAs, created throughout the years, comprise a family on optimization technique inspired by biological fact of evolution. They take their cues from Darwin's theory of evolution by natural selection, which states that only those who have inherited traits well-suited to their environment will be able to reproduce. There have been numerous attempts to model evolution since the introduction of calculators. As a result, a number of options have emerged:

i. Modeling genetic evolution, genetic algorithms were first developed to tackle discrete variable optimization issues.
ii. Individuals (or chromatids) are represented as computer programs using a tree structure in genetic programming based on genetic algorithms.

iii. Programming techniques based on evolutionary algorithms, which were originally developed to learn from deterministic finite automata. Selection and mutations are used in succession to modify the phenotype (specifically, the behaviour of finite automata).
iv. When it comes to solving issues with continuous variables, evolution techniques were originally meant to be used. Rather than focusing on "the evolution of evolution," they simulate the strategic factors that govern variation in evolution.
v. Continuous variables were initially the target of differential evolution, which was originally developed to handle issues with discrete variables. Its strategy would be to use the calculated distinctions between the other randomly selected students to bias a mutation operator applied to an individual. The algorithm's common pattern is what evolutionary techniques depend on. Individuals that are prone to evolution might be a solution to the dilemma. All of these people create a population. Generations are how this population grows and changes through time. The populace of the following generation is formed by a series of operations conducted to people throughout each generation. Each operator generates new persons, called children, by using one or even more individuals, referred to as "parents". A subset of the population is replaced at the conclusion of each generation by a group of children who were born during that generation.

The three primary operators of an evolutionary algorithm are:

a. A selection operator that encourages the spread of the best methods throughout the population while preserving a certain degree of genetic variation.
b. During the formation of a kid, a crossover operator is used. Its goal is to make offspring by exchanging DNA from various parents. An example of a basic crossover, for binary-coded persons.
c. Randomly pulling a component from of the parent individual & replacing this with a random value constitutes a mutation operator. It is feasible to preserve a certain level of variety in the population because of the random character's role in the production of the offspring. An example of a mutation, for a binary representation of a person. Many dynamic optimization algorithms are based on the principles of EAs. Indeed, the algorithms of this class can be

adapted to changing environments, because they are inspired by the theory of the evolution of species.

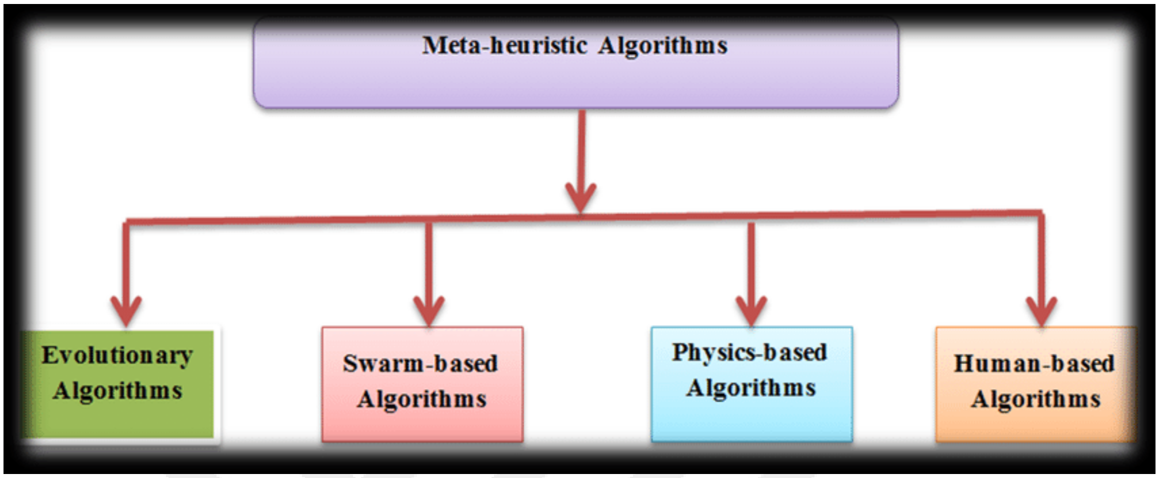

Figure 3.7: Clustering Meta Heuristic Algorithms [47]

EAs with several populations can in particular obtain good results for multimodal dynamic optimization problems. Indeed, interesting results have been obtained by the self-organizing scouts algorithm proposed in. This algorithm uses a population. Mother to explore the search space, while daughter populations follow local optima as the objective function changes. In, a differential evolution (DE) algorithm using multiple populations is presented. This algorithm is based on techniques aimed at maintaining good diversity between individuals and between populations. A variant based on the evolution of several populations is presented in. The strategy used by this algorithm is as follows: each individual ages over generations, and old stagnant individuals are reset. If a stagnant individual is the best of its population, then that population is reset. Moreover, if two populations overlap, then the "worst" of them (by comparing the best individual of one population with that of the other) is reset. Moreover, the best individuals are archived during the execution of the algorithm, and the resulting archive is used when resetting individuals. Present an evolutionary programming algorithm, which adapts to changes in the objective function, by generating diversity after a change, maintaining good diversity throughout execution, and saving individuals in two archives (l one representing short-term memory, and the other, long-term memory).

3.3.1 Goa Clustering

In order to create a small number of lattices from a vast number of text documents, the clustering of the text is taken into consideration. Text documents are pre-processed utilizing a benchmark pre-processing step prior to the use of clustering methods in order to improve their performance. To reduce computation time and improve defensive text grouping effort, preprocessing text selects the most thought-provoking bits in order to save computation time and increase defensive text grouping effort. As a result of using the recommended approach, a unique collection of information-oriented text characteristics with a limited number of spaces has been discovered. Its primary advantage over other well-known meta-heuristic algorithms is that it does not need any specific input parameters in order to function properly. Furthermore, it is straightforward and does not need a significant amount of processing. In addition to its readability and simplicity, this programming language paradigm has a number of advantages. GOA users will have little trouble avoiding local optima while dealing with complex, high-dimensional, and multi-modal problems. A deterministic random-like method identified in a dynamic, non-linear system [28] has no period, non-convergence, or limit. It is possible to consider both chaos and simple deterministic dynamical systems as causes of unpredictability in mathematical systems. The random error of the recommended strategy is reduced by running the program multiple times. A dominance hierarchy, which has been constructed using statistical methods, is at the center of the GWO algorithm. The ideal method is located high up on the intellectual food chain. It is considered to be the second and third most likely solutions respectively. The remaining prospects () are supposed to be on the lookout for wolves, among other things. As a result, when |A| is less than 1, the wolf is obliged to kill the prey in order to move on to |A| higher than 1, at which point the wolf searches for more advantageous prey. If you're on the lookout for gray wolves, you'll need to search in one of three locations. When it comes to exploitation or exploration, the vector values A and C are important considerations. We may use a random value for the letter A to differentiate between the wolf and the prey in order to make this distinction. C Within the range [0, 2], vector random values play an important role in preventing local optimum stagnation by preventing local optimum stagnation from occurring. When it comes to gray wolves, raising the random weight of the ability makes the space between the battlements and the wolf more difficult to navigate. Prey's impact is best shown by a C value more than 1, but a C value less than 1 de-emphasizes the influence of prey on the predator.

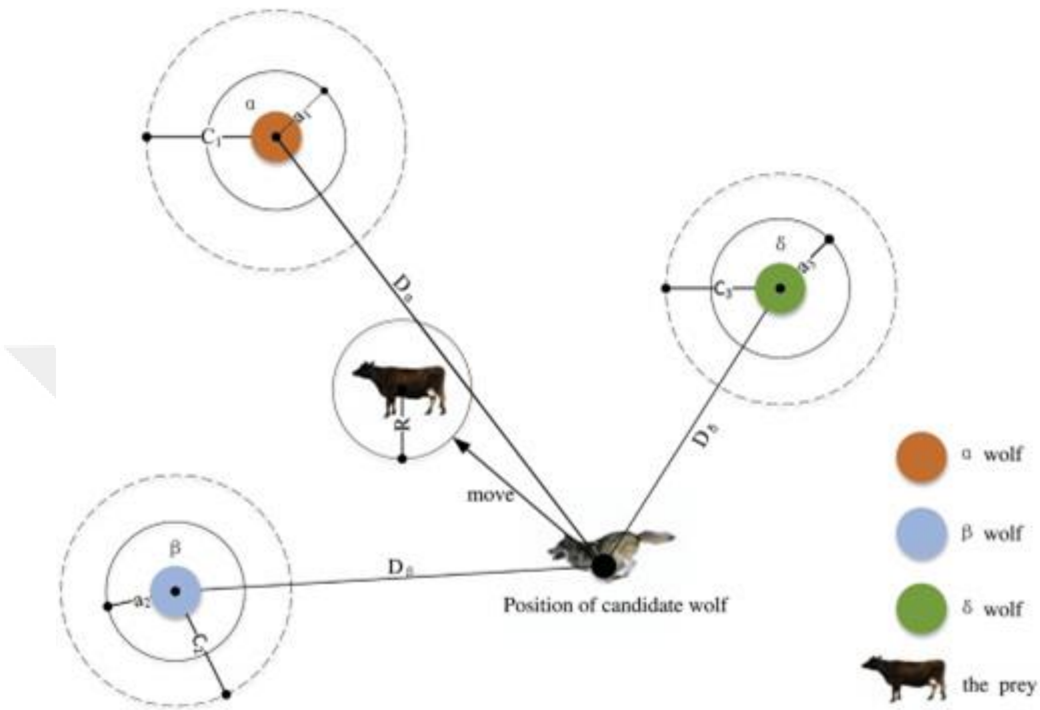

Figure 3.8: Gray Wolf Optimization Hierarchy [49]

In order to construct a small number of lattices from a big number of text documents, the clustering of the text is one of the factors that is taken into consideration. This is achieved by dividing the total amount of text documents into a greater number of more manageable groupings. The text documents are first put through a benchmark pre-processing step before the clustering algorithms are applied to them in order to improve the performance of the clustering methods. This is done in order to improve the efficiency of the procedures used for clustering the data. In order to reduce the amount of time spent computing and to maximize the amount of effort put into defensive text categorization, it is best practice to select the most thought-provoking sections of a text before preprocessing it. This helps to limit the amount of time spent computing and improves the way defensive text is grouped. The strategy that was recommended resulted in the uncovering of a one-of-a-kind compilation of information-focused text characteristics that had a limited number of spaces. When compared to other well-known meta-heuristic algorithms, the primary advantage that it possesses is that it does not call for any particular input parameters in order for it to function successfully. This is the fundamental benefit that it possesses. In addition to this, it is simple to comprehend and does not require a significant amount of time for processing. This paradigm for a programming language has a number of advantages, not the least of which is an exceptionally high level of readability and straightforwardness. Users of GOA won't have any trouble avoiding local optima even when working with complicated, high-dimensional, and multi-modal problems. A deterministic random-like method [28] does not have a period, non-convergence, or limit, which are characteristics of a dynamic non-linear system. [Citation needed] It is possible to incorporate chaos in addition to straightforward deterministic dynamical systems as potential contributors to the unpredictability that can be noticed in mathematical systems. This would be a good thing to do because it would make the systems more interesting. Running the program multiple times has the effect of reducing the number of errors that are produced as a result of random factors in the procedure that is being proposed. The GWO algorithm may be broken down into its component parts, the most fundamental of which is a dominance hierarchy that has been constructed by making use of various statistical methods. The strategy that achieves the best results is located fairly high up on the methodological equivalent of a food chain. These two solutions are evaluated as the second and third most likely possibilities, respectively, among the available options. The candidates who are still in the running have been given specific instructions, one of which is to keep an eye out for any wolves that might be in the neighborhood. When this occurs, and the value of |A| is less than 1, the wolf is forced to kill the prey in order to advance to a value of |A| that is more than 1, at which time the wolf searches for prey that provides a bigger advantage to itself. If you are seeking for gray wolves, you will need to search in one of these three regions. You won't find them anywhere else. When selecting whether to participate in exploitation or exploration, the vector values A and C are critical considerations to give attention to as potential options. In order to differentiate between the hunter and the hunted, we might use a random value for the letter A as a means of doing so. This would serve to denote who was the predator and who was the prey. C Within the range [0, 2], vector random values play a crucial role in preventing local optimum stagnation by preventing local optimum stagnation from occurring. This is accomplished by preventing local optimum stagnation from occurring. This is accomplished by removing any potential for a local optimal state to become stagnant. When dealing with gray wolves, raising the random weight of the ability makes it more challenging to traverse the space that between the battlements and the wolf. A C number that is more than 1 is the most effective way to highlight the impact that the prey has on the predator, whereas a C value that is less than 1 has a tendency to minimize the impact that the prey has on the predator.

The A and C vectors have been the major focus of attention during the whole process. Almost every metric emphasizes the importance of exploration and exploitation. When the final benchmark is achieved, the GWO algorithm is placed on hold, and the best location for the alpha wolf is calculated by using a mathematical formula. Gray wolves are able to form a circle around their prey because of their ability to track their victim's movements. Most of the time, the wolf is in charge of the bulk of the hunting activities. And wolves are always on the lookout for any gray wolves that they may come upon. To keep the wolves in the best possible posture, the wolves must continually adjust their positions. Eq. (1) provides a statistical expression for it (1).

$$\begin{aligned} &D_\alpha = |C_1 \cdot X_\alpha - X|, D_\beta = \left|C_2 \cdot X_\beta - X\right|, D_\delta = |C_3 \cdot X_\delta - X| \\ &X_1 = X_\alpha - A_1 \cdot D_\alpha, X_2 = X_\beta - A_2 \cdot D_\beta, X_3 = X_\delta - A_2 \cdot D_\delta \end{aligned} \tag{3.1}$$

3.3.2 Pso Clustering

PSO was modeled after the old school. For example, the PSO makes use of an iterative method. The PSO algorithm generates random solutions at first, and then, in each iteration of the algorithm, Particles constantly adjust their positions to take advantage of the local & global optimums. As a consequence, we've come up with the most appropriate solution. Ideally located particles may be found in two sorts of locations: one for each individual particle and another for the whole swarm. Random numbers that satisfy the conditions of 1 rand () 2 rand () 1 () 2; and positive constants known as acceleration coefficients that govern. The particle's travel speed is 1 c 2 c, and the weight used to govern the impact of the particle's historical position is. Particles are encoded as wavefunctions in wavefunction coding (W5.2). Because there are nodes in the network, it is necessary to use a particle composed entirely of numbers. In this document, create a route from one node to another by connecting them together. One particle carries a () integer that indicates the ID of the node that came before it in the chain of previous hops. If the number is 0, the node does not appear on the route. Node is considered to be a node if and only if the I ith I it integer matches the node's identification number. There are six integers in every particle since there are six nodes in the network. This is due to the fact that there are two routes to S D 1 and 2 from here 2:

$$\begin{aligned} V_{ld} &= WV_{ld} + c_1 \text{ rand }_1() \ (P_{ld} - X_{ld}) \\ &\quad + c_2 rand_2() \left(P_{gd} - X_{ld}\right) \\ X_{ld} &= X_{ld} + V_{ld} \end{aligned} \tag{3.2}$$

Particle Speed is the rate at which particles move across space. Route optimization is based on particle velocity, which may be represented as V, where V denotes the particle's journey direction. The new node's identification number is represented by the value 0 or a V N ith ID for each of these elements. Do-nothing actions are represented by the number zero, and IDs are used to identify previous hop nodes that have been replaced by new ones. In this game, particle iteration is the only way to progress. The typical iteration equations have been adjusted to account for the fact that the concept of a particle in VANETs differs from the usual definition and that a particle's location does not change continuously as it does in other networks, as shown in the preceding section. The technique for establishing the Relay Node's placement at the Network's Boundary is lengthy. Their proximity to the cluster head may be defined as nodes that are greater than or equal to one hop distant. You may make a maximum of k H k op jumps. For a node to be considered a border node with its neighbors, it must be smaller than or equal to the distance between the clusters of all of its neighbors. The nodes k H k op k and node 8 in Cluster 1 are the cluster's initial two nodes, and they are the cluster's initial two nodes. The cluster's center node is physically isolated from the other nodes. The hop count indicates that there are 5 8 hops between the node and a CH1 2 3 H B operation, indicating that it is a CH1 2 3 H B border node. A similar pattern exists for nodes 1, 2, and 3, which are all bounded by the boundary nodes HBRB, B1R, and B1R1B2 as well as the boundary nodes Hop op, Hop op, and Max hop B1RB1RB2. A boundary relay node is one that receives multiple ELECTED messages from identical cluster heads. This is because messages are sent in hops rather than as a single packet, and nodes such as CH2 2 CH21 13RB4RB1 may get the message from a source other than the originator (for example, along routes and CH2 2 CH21 13RB4 CH1 CH1 RB2). Due to the fact that the distances between the nodes in cluster 2 exceed one hop, the node CH2 B1 B1 will be able to receive only ELECTED messages from those nodes and will be unable to relay ELECTED RB1 RB2 messages from those nodes. While they are not now border relays in cluster 1, it is possible that they may become such in the future. In a similar vein, nodes and may operate as border relay nodes B1, B3, and B4 in cluster 2. (B1, B3, and B4, respectively). Clusters 1 and 2 are deemed neighbor clusters if each boundary relay candidate node in cluster 1 is relatively close to a neighboring boundary relay candidate node in cluster 2. Route boundary relays are the most viable candidates for boundary relays on routes with a significant number of information producers, such as those connecting clusters 1 and 2. It is possible for two clusters in F Clusters 1 and 2 to be relatively close to one another. If information is to be transferred across clusters 1 and 2, the two clusters must have two border relay nodes. The optimal candidate for relaying information could be a CH1 or an RB1, and thus it is necessary to compute all possible routes between nodes and the RB2 CH1 f CH1 RB1RB2 in order to determine which of the nodes along the route with the greatest maximum the optimal candidate for relaying information is. If this is the case, node f CH1 in Cluster 1 will serve as the boundary relay node, and node f CH1 in Cluster 2 will serve as the boundary relay node as well. It selects the second boundary relay node in Cluster 2 as the source for data transmission to RB1. Cluster 2 is served by two border relay nodes. The relays in cluster 2 (assume) calculate the maximum value for all routes from their neighboring boundary relay RB1f RB1 candidates and choose the node that is closest to the maximum value for that route as the cluster 2 border f relay. This is done to ensure that data is available to the rest of the network.

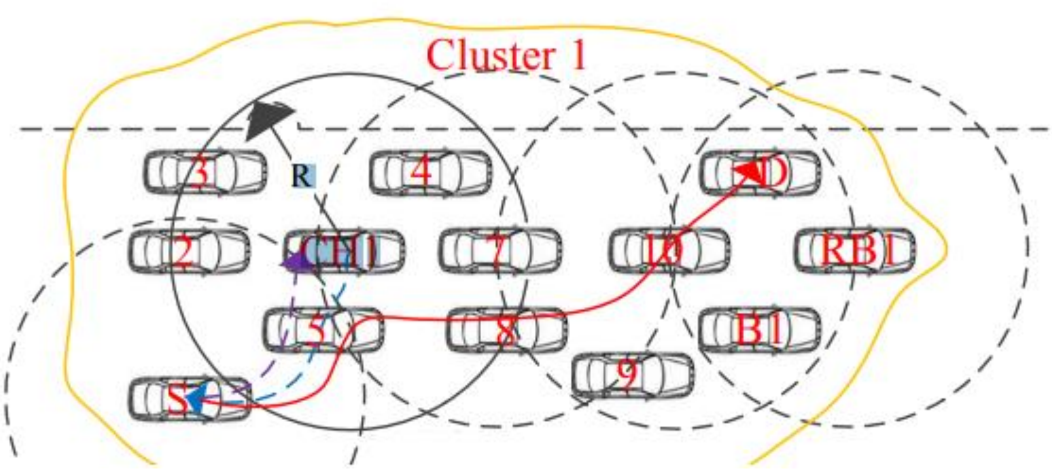

Figure 3.9: Clustering of VANET Elements Using PSO [52]

The term "particle speed" refers to the velocity at which individual particles move across space. The velocity of the particles, which is represented by the letter V and stands for the direction in which the particles are traveling, is the primary factor that decides which pathways are the most efficient. The representation for the identification number of the new node will be either the value 0 or a V N ith ID, depending on which of these components is being considered. While the value zero is used to denote ineffective activities, IDs are used to identify past hop nodes that have been upgraded to newer versions. The number zero stands for actions that involve doing nothing at all. You have to go through this process of iterating over the particles many times in order to make progress in the game. As was shown in the prior part of this chapter, the standard iteration equations have been altered to take into account the fact that the concept of a particle in VANETs differs from the typical definition and that the location of a particle does not change continuously as it does in other networks. This was done in order to take into account the fact that the typical definition of a particle does not apply in VANETs. This was done in order to take into consideration the fact that the conventional notion of a particle does not apply to the idea of a particle that exists within VANETs. The process of figuring out where the Relay Node ought to be situated at the Network's Boundary is one that requires a lot of time and effort. If a node's distance from the cluster head is higher than or equal to one hop, then that node can be considered to be in close proximity to the cluster head. At any particular point in time, you are only permitted a maximum of k H k op leaps. If a node is to be considered a border node with its neighbors, it must be smaller than or equal to the distance between the clusters of all of its neighbors. Otherwise, the node will not be considered a border node. In such case, we won't count it as a border node because it doesn't meet the criteria. They are regarded to be the original two nodes of Cluster 1, along with the node 8, which is also considered to be one of the initial two nodes of Cluster 1. The node that is in charge of acting as the cluster's hub is located in a different part of the world than the other nodes. The hop count indicates that there are a total of 5 8 hops between the node in question and a CH1 2 3 H B operation. This would indicate that the node in question is a border node between CH1 2 3 H and B. There is a pattern that is somewhat analogous to this one that can be observed in the nodes 1, 2, and 3, all of which are bounded by the boundary nodes HBRB, B1R, and B1R1B2, in addition to the boundary nodes Hop op, Hop op, and Max hop B1RB1RB2. If a node is in a position to receive several ELECTED messages from cluster heads that are identical, then that node is recognized as being a border relay node. This is because messages are not sent in a single packet but rather in a series of hops, and nodes such as CH2 2 CH21 13RB4RB1 may get the message from a source that is different from the one who initially sent it. This is because messages are not sent in a single packet but rather in a series of hops (for example, along routes and CH2 2 CH21 13RB4 CH1 CH1 RB2). Because the distances between the nodes in cluster 2 are greater than one hop, the node CH2 B1 B1 will only be able to receive ELECTED messages from those nodes, and it will not be able to relay ELECTED RB1 RB2 messages from those nodes. This is because the node CH2 B1 B1 will only be able to receive ELECTED messages from those nodes that are farther away than one hop. This is due to the fact that the distances between the nodes that make up cluster 2 are greater than the distance covered by a single hop. In spite of the fact that they do not currently operate as border relays for cluster 1, it is not inconceivable that they may start doing so in the relatively near future. In a manner that is somewhat comparable to this, the nodes and have the ability to function as border relay nodes B1, B3, and B4 in cluster 2. (specifically in locations B1, B3, and B4, respectively) If each surrounding boundary relay candidate node in cluster 2 is substantially close in proximity to a boundary relay candidate node in cluster 1, then that cluster 1 will be regarded as a neighbor cluster by all of the boundary relay candidate nodes in cluster 1. On routes that have a high number of information producers, such as those that connect clusters 1 and 2, route boundary relays are the most plausible options for boundary relays. Other examples of routes that have this type of high information producer density include those that connect clusters 3 and 4. It is not completely out of the question for two clusters to be found in very close proximity to one another in either F Cluster 1 or F Cluster 2. In order for information to flow freely between clusters 1 and 2, it is necessary for each cluster to have a border relay node. Clusters 1 and 2 must both have two border relay nodes. It is important to compute all of the possible routes between the nodes and the RB2 CH1 f CH1 RB1RB2 in order to identify which of the nodes along the route has the highest maximum and so should be considered the best option for relaying information. Because the best option for information relaying might be a CH1 or an RB1, it is important to compute all of the many possible routes that might be taken between nodes in the network. In the event that this proves to be the case, the node f CH1 in Cluster 1 will function as the boundary relay node, and the node f CH1 in Cluster 2 will perform the same function in the event that this occurs. It comes to the conclusion that the second boundary relay node in Cluster 2 is the most suitable option to perform the function of serving as the source for data transfer to RB1. The relays in cluster 2 (assume) calculate the maximum value for all routes from their neighboring boundary relay RB1f RB1 candidates, and then choose the node that is closest to the maximum value for that route as the cluster 2 border f relay. This is done so that the cluster 2 border f relay can have the best chance of achieving the maximum value. Choosing the node that will act as the border relay for cluster 2 is the first step in achieving this goal. This is done to ensure that the data will be available to the rest of the network at all times.

3.3.3 Pso Clustering

It is TACA's primary contribution, according to the model created using assumptions, to use trust-based CH selection in conjunction with the robust PSO strategy. Prior techniques had issues, and our trust computation-based strategy for finding a secure and optimal CH provides a solution to those concerns. For the purpose of avoiding data loss and network instability, it is essential that the CH be selected from among the most reliable vehicles available. In order to compute the trust score, we used both direct (packet forwarding ratio) and indirect trust (mobility, degree of connection, and vehicle congestion) factors. To identify the best, most stable, and most dependable CH, we employed the PSO algorithm with a modified fitness function, which we developed ourselves. To determine the fitness of each PSO algorithm ant, direct and indirect trust parameters were employed to compute their values. As a result of current research on the PSO's benefits across a broad variety of routing and clustering challenges in varied networks, we use it to choose the optimal CH with the least amount of computational effort feasible. Specifically, according to the challenge specification in 2 (1), the PSO's task is to replicate ant behavior in regard to their ability to find the best available vehicle to transport them from their anthill to a food source (reliable and stable CH selection). Due to the fact that the pheromone communicates the route, the PSO process is iterative, with subsequent ants utilizing the pheromone to choose the most suitable CH (2)). After considering every possible scenario, the ant's final decision becomes crystal apparent. This has resulted in the following PSO methods for choosing the best CH being established. Develop various CH solutions that are acceptable, starting with the initialization of the number of ants in each cluster as well as other parameters pertaining to iteration and the temporary optimum solution for each cluster. Updates should be performed on an existing solution to the CH selection problem, in which case the fitness of each ant should be calculated until the convergence conditions are met. Inspect the routing table to ensure that the pheromone value linked with each ant is still up to date. Assuming that the convergence conditions have been fulfilled, return the best CH choice. An illustration of the suggested TACA protocol PSO-based CH selection technique is provided by the flowchart and pseudo code of algorithm 1. At the time of creation of a cluster, PSO sets up parameters for each vehicle in the cluster, such as the number of iterations and the ant count for each iteration. It was decided to dispatch an ant army of k in order to discover a solution to a particular issue. At each iteration, each ant an I I k develops its own solution to the problem based on the rules that have been established. When selecting a reliable CH from among the numerous available options, TACA employs a trust-based fitness technique to ensure that the clustering solution for VANET is stable and reliable. When PSO is a component of each Ite, it completes the three processes required to choose an environmentally friendly and reliable CH for each cluster, including (1) finding the solution, (2) depositing the CH, and (3) depleting the CH. Over the course of this phase of VANET, periodic network information is acquired and delivered to match destinations in a multi-hop fashion on a regular basis, as described above. In order to reduce data loss or congestion, we used a modified Shortest Road Tree (SPT) approach, where the number of short hops to the destination is taken into consideration. The updated SPT selects the forwarder or relay node depending on the current fitness score of the node in question. After much deliberation, it has been determined that the node with the greatest fitness rating would be in charge of data relating to the ultimate destination. The route with the fewest hops is picked to commence data transmission once all possible routes have been identified and compared. Traditionally, communication between CH and RSU has been thought of as two distinct processes: (1) communication from CH to RSU through other intermediate CH nodes, and (2) communication from the CH nodes of the CMs to their own CH node. VANET reliability and data security are assured by the selection of relays depending on the trust factor of the relay.

4. DESIGNED CLUSTERING APPROACH

Based on the following, the clustering model depends on techniques that are explained in detail.

4.1 ALGORITHM DESIGNED FOR CLUSTER FORMATION

The fundamental purpose of the VANET is to offer a secure and efficient method of communication for its users. In order to organize and optimize communication in the VANET, clustering is a fundamental component of its design. Following the construction of a cluster, the initial stage is to identify the target node, predict the node's position and the fastest path, and send information in a secure manner. During the cluster construction step, nodes may be assigned to one of three types. These are: In a VANET, non-member nodes (NM) are nodes that are not connected to the cluster as a whole. The Cluster Head is in charge of all of the members of the cluster (CH). Maintain a separate database for each individual member of the cluster.

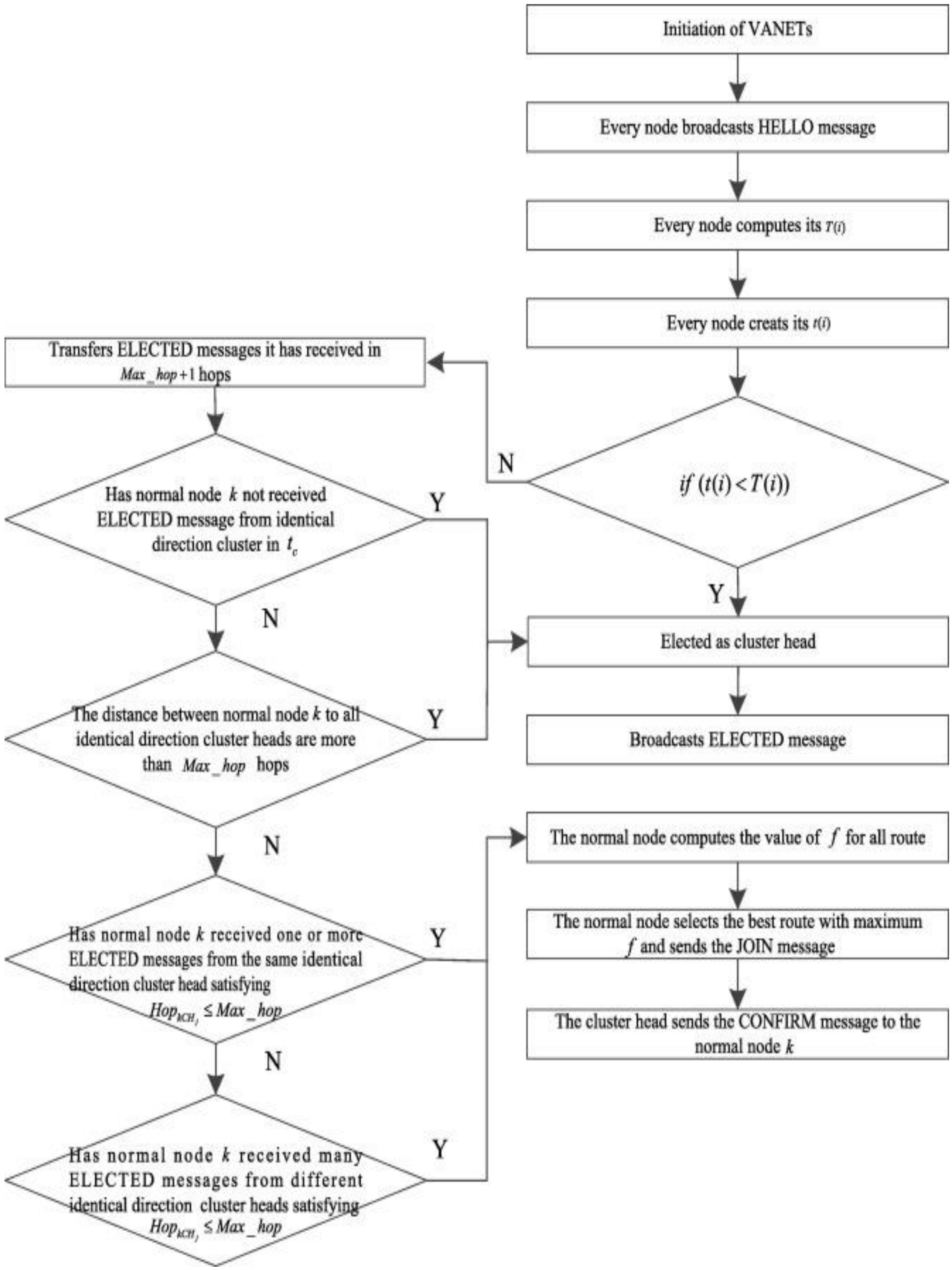

Figure 4.1: Proposed system diagram

A single CH can be found in the whole group. The following diagram illustrates the process of picking a cluster. The algorithms 1 and 2 presented below were designed to optimize data traffic in VANET networks based on the Ant Colony Optimization theory. In algorithm 1, PSO is used to search for a destination route in an IoV environment. The strategy of using artificial ants is applied for the selection of the best route, based on the AntHocNet theory. probability Pnd described in the equation 1 to choose the next jump. For this implementation, B = 1 is assumed. The parameter Ti , is the pheromone table. However, if you don't know a route there was, an initial broadcasting is started, where each vehicle receives a replica of the F to d (x) of the initial tracking F to d . The work of each F to d (x) is to find a route to d. When a route is found, the tables of entrustment and the table of pheromone Ti are updated. In algorithm 2, I use PSO to update the existing routes in order to maintain the load balance. The purpose of these is to maintain the correct paths that lead to a destination d. Using hello messages the nodes know the status of their direct and the pheromone information via their tables. The nodes can detect failures in the link when the hello messages fall. If a link fails, and the node knows other possible routes to destinations, the shipping tables are updated, and notification messages are sent to neighboring nodes. However, if this link was the only route that the node was known to have the destination, or if this route was one of the most requested, an attempt will be made to look for another alternative route using algorithm 1. This is a strategy used in AntHocNet, with the restriction that a route will be repaired, only when the destination has knowledge that it fails.

Algorithm 1. Searching a route algorithm

```
s is the source node, d is the destination node and c is the current node
if s known d
    Choose the route using (1)
    Increase pheromone using (7)
    Update T_i.
else
    if NextHop = s.
        Calculate \phi using (7)
        Update T_i.
    else
        Calculate V using (3).
        for (each neighbor of s create a replica F_d^a(x) of F_d^a.)
            send F_d^a(x) to neighbors
            for (each path to d)
                calculate \phi using (7)
                Update T_i.
                Update routing table.
            end for
        end for
    end if
end if
```

a. Gateway Node (GW): As a forwarding node, CH or another gateway, or even the nearest junction, receives packets and transfers them to the next node in the chain.... A cluster may include a large number of GWs. The cluster head has an important role to play in the process of selecting a new gateway. Members of the cluster who are linked to another cluster's CH or GW node via a CH or GW node will get a request from the CH or GW node.

b. Cluster maintenance (enter/exit from cluster): Vanet cars are constantly entering and exiting clusters because to the network's high level of dynamic nature. Here is a breakdown of the circumstances that cause the maintenance process to be initiated:

c. Joining a cluster: Periodically perform the selection process for all members of cluster including CH & GW and cluster’s new member node.

while new node() is being joined (true) Using a periodic calculation, determine the relative importance of CH and GW, as well as the other members of the cluster The number of members in the cluster has been reduced based on their relative importance.

i. The most important member of the cluster.
ii. Control of the Cluster has been assumed.

When a member of a cluster leaves the cluster radius, he or she is said to have lost contact with the cluster's leadership. This has resulted in the cluster head removing this vehicle from the list of available cluster members. When the weight of a cluster member is less than the weight of the current cluster head, the current cluster head resigns from the position of cluster head, and the current highest weight node is proclaimed as the new cluster head, with the data from the previous CH being copied to the new cluster head. Our current approach is for CH to surrender leadership of the cluster to another node if its weight is less than the weights held by any of the other nodes in the cluster.

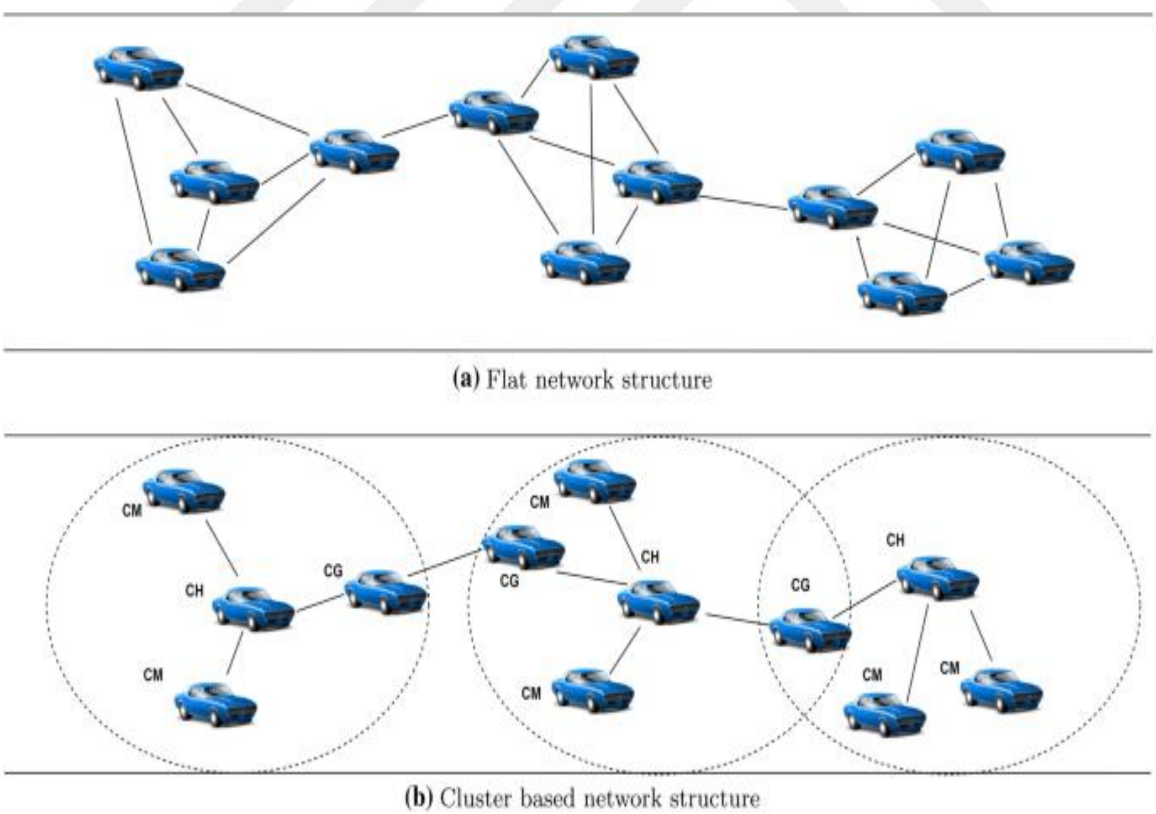

Figure 4.2: Platooning function in the proposed system

5. SIMULATION AND RESULT ANALYSIS

5.1 JUSTIFICATION OF NEEDS OF AODV

As in VANET, nodes (vehicles) have high mobility and moves with high speed. Proactive based routing is not suitable for it. Proactive based routing protocols may fail in VANET due to consumption of more bandwidth and large table information. AODV is a reactive routing protocol, which operates on hop-by-hop pattern. The Ad hoc On-Demand Distance Vector (AODV) [4] algorithm enables dynamic, self-starting, multihop routing between participating mobile nodes wishing to establish and maintain an ad hoc network. AODV allows mobile nodes to obtain routes quickly for new destinations, and does not require nodes to maintain routes to destinations that are not in active communication. After implementation of above clustering algorithm called Advance AODV Protocol (AAP) simulate through NS2 simulator using following input:

Table 5.1: Input data

Parameters	Simulation value
Simulator	NS-2.34
Simulation Time	300 second
Antenna Model	Omni directional antenna
Radio Propagation Model	Two Ray Ground
Transmission Range	250 m
MAC Type	IEEE 802.11
Interface Queue Type	Priority Queue (50 Packets)
Routing Protocols	Clustering
Simulation Area	1000 m X 1000 m
No. of vehicles	20

5.2 ANALYSIS AND PERFORMANCE COMPARISON

The Advanced AODV Protocol has produced some interesting findings (AAP):

5.2.1 Examinations Using Standard AODV / AAP-Enhanced Version

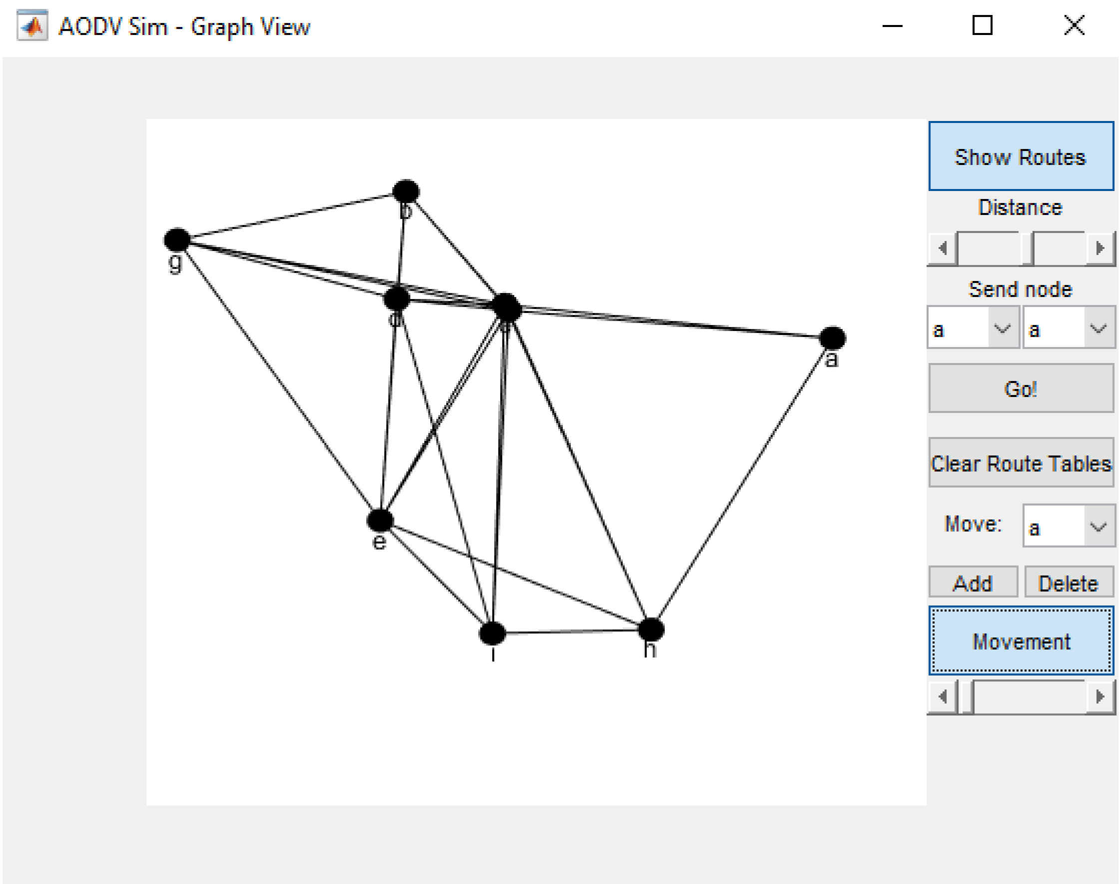

Figure 5.1: simulation of the proposed AODV protocol

Table 5.2: Analysis of the data Comparing the AAP with the AODV

PARTICULAR	AODV	`AAP	
SENT PACKET	9564		9564
RECVD PACKET	9124		9357
ROUTINGPKTS	2109	1324	
PDF	95.4	97.84	
NRL	0.23	0.14	
NO. of dropped Data	440	207	
ACTUAL Performance	20797	20245	
Efficiency	96.40%	98.24%	

Table 5.3 illustrates the results obtained via the implementation of the protocol outperform those obtained by AODV. This routing protocol outperforms the AODV VANET routing protocol by 1.84 percent when compared to its predecessor. In the event of a packet being dropped, the outcome will determine whether or not data is delivered or received. It is possible to lose communication and have packets lost in a number of conditions when communication is experiencing problems.

Table 5.3: that packets of both protocols are being dropped is shown to be true

	AODV			AAP
Drop from ARP	30	0.14%	22	0.11%
Drop from IFQ	37	0.17%	26	0.13%
Drop from CBK	63	0.29%	30	0.15%
Drop from TOT	0	0.00%	0	0.00%
Drop from NRT	199	0.92%	73	0.35%
Drop from END	7	0.03%	4	0.02%
Drop from DUP	0	0.00%	0	0.00%

There is no doubt that the AODV packet dropping rate is 3.60 percent higher than the AAP packet dropping rate of 1.6 percent

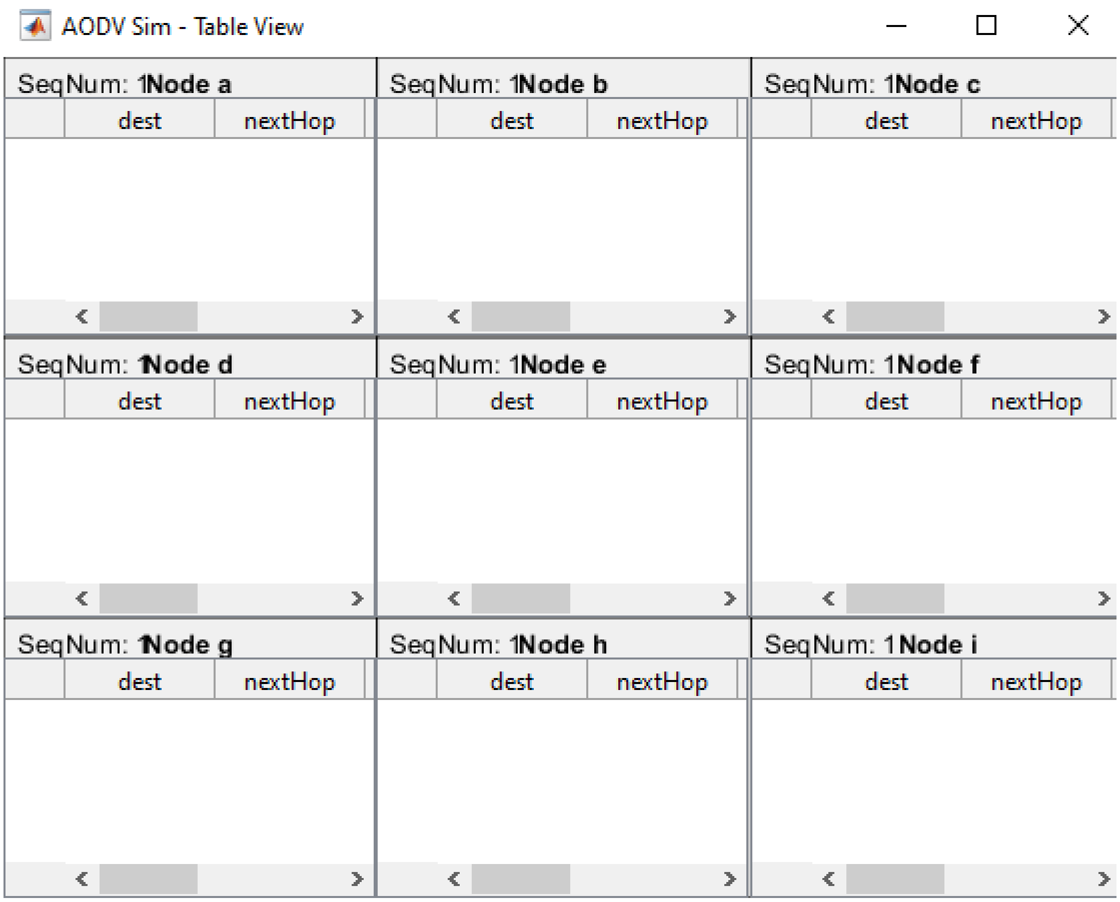

Figure 5.2: Multihop tracking in the AODV metaheuristic system

6. CONCLUSION

Maintaining proper connectivity and network management in IoT devices is difficult because cars move at high speeds on roads. The findings of this study call for a systematic approach to adjusting routing protocol and clustering settings. We also evaluated the Internet of Things and its communication architecture. More study is being done to identify how PSO may be applied in various contexts and to enhance solutions in general. Two unique clustering techniques should be used to categorize IoV networks. In the first case, an Ant Colony Optimizer is used, whereas in the second, a Heuristic Multi-Objective Clustering Algorithm. We developed an intelligent search method for the search space and a new mechanism for balancing PSO convergence speed and time at this stage. To keep the IoV network connected, an algorithm based on traffic density is used. This method is compared to PSO and AODV. Positive indicators include packet delivery, latency, cluster size, total throughput, and packet loss. We achieved our study's aims via the use of unique methodologies, including avoiding local optimum issues and network dispersion concerns. Additionally, our algorithm displays superior performance in terms of establishing fast and consistent V2I connections that are qualitative, as well as guaranteeing that each automobile receives trustworthy information transmission. To allow sustainable traffic in IoV highway settings for smart cities, the creation of an efficient and trustworthy information transmission protocol was required. Our unique approach may be capable of addressing a broad range and large-scale (congested traffic) optimization challenge that has bedeviled the industry for years. Our suggested protocol expertise may boost services given by Internet of Things networks in the highway environment. To do this, we want to use Open Street Map-based traffic simulations to assess the performance in real-world conditions. Numerous more PSO components may be updated in the future to enhance IoV routing. Apart from that, our approach may be employed in urban settings. Additionally, the topic of IoV hand-off may be addressed in conjunction with the technique presented here.

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